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A  
DICTIONARY  
OF  
CHEMICAL SOLUBILITIES  
INORGANIC

FIRST EDITION

BY

ARTHUR MESSINGER COMEY, PH D

SECOND EDITION

ENLARGED AND REVISED

BY

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## PREFACE TO FIRST EDITION

FOR many years a need has been felt by chemists for a book which shall collect into convenient form for ready reference the various data concerning the solubility of chemical substances that have been published from time to time in chemical periodicals and elsewhere

The first mention that can be found of such a plan was made in 1731, when Peter Shaw delivered Chemical Lectures in London, as may be seen from the following —

EXTRACTS from PETER SHAW's Chemical Lectures, publickly read at London in 1731 and 1732 London Second Edition, London 1755 8vo

Page 97 Experiment I — That Water as a Menstruum dissolves more of one body and less of another

[He shows that two ounces of water dissolve two ounces of Epsom salt, five drachms of common salt, and eight grains of cream of tartar Only in the latter case much remained undissolved until boiled ]

"It might be proper for the further Improvement of Chemistry and Natural Philosophy to form a Table of the Time and Quantity wherein all the known Salts are dissolvable in Water Such a Table regularly formed might ease the Trouble of refining Salts, by shewing at once without future Trial or Loss of Time how much Water each Salt required to dissolve it for Clarification, Filtration, or Crystallization It would likewise supply us with a ready and commodious Way of separating any Mixture of Salts, by shewing which would first shoot out of the Mixture upon Crystallization The same Table might also direct us to a ready and commodious Method of separating two Salts without waiting for Crystallization "

It was many years, however, before the scheme suggested by Peter Shaw was put into execution Professor F H Storer published the first work that undertook to carry out the idea in its entirety, in 1864, in a book, which he entitled "First Outlines of a Dictionary of Solubilities of Chemical Substances," and which contained a compilation of nearly all the data on the subject published before 1860 It was at once recognized as a most valuable contribution to chemical literature, but for many years it has been difficult to obtain this work, as the limited edition which was published was soon wholly exhausted Since then nothing has appeared on the subject except the brief tabulations found in various reference books, and no attempt has been made to cover the whole subject

It is needless to state that the growth of chemical science since the publication of Professor Storer's book has been so enormous that that work has lost, at least to a great extent, the practical value it possessed thirty years ago This growth has been indeed so great, and the data which have accumulated since 1860 so far surpass the earlier in volume, that a simple revision of Professor Storer's book was impracticable, and it therefore seemed best to start afresh

With the facilities offered by the various scientific libraries at Harvard University, the Massachusetts Institute of Technology, and other libraries in Boston, it has been possible to collect nearly all the data relating to the subject. For the work before 1860 Professor Storer's work has been found invaluable.

The method pursued has been to form a preliminary list of compounds with more or less data by consulting the two most complete works on inorganic chemistry—Gmelin-Kraut's "*Handbuch der anorganischen Chemie*" and Graham-Otto-Michaelis's "*Lehrbuch*." These statements have been verified and elaborated by consulting the original memoirs in all the periodicals devoted to chemical literature which were obtainable. The "*Jahresbericht der Chemie*" also has been used extensively in tracing references, but the original memoirs have always been consulted and references given to them when possible.

It has been found impracticable to draw any distinction as to reliability between the various data given by different observers. It was manifestly impossible to attempt to verify experimentally the statements of those who have carried on the researches, for the most assiduous labor of many could only cover a small portion of the attested facts. Therefore, even when two statements are directly contradictory, both have been given with the authority for each. The only exception to this has been made when more recent discoveries have shown beyond any reasonable doubt the falsity of previous work. In this way some of the older manifestly inaccurate work has been omitted. In a majority of cases the more recent work may be considered to be the more accurate, but this is not the invariable rule. A Synchronistic Table of the more common periodicals is given in the Appendix, whereby it is easy to determine the date of the publication of a research to which reference is made.

It may be objected by the practical chemist that most of the work previous to 1850 might well have been omitted, but a great deal of this work possesses at least a historical value, and often furnishes facts which have not since been verified. Much of the earlier work, when obviously of less importance, has been printed in smaller type.

The aim has been to include in this volume all analyzed inorganic substances, that is, all substances which do not contain carbon, but exception has been made in the case of  $\text{CO}_2$ ,  $\text{CO}$ ,  $\text{CS}_2$ , the carbonates, cyanides, ferro-cyanides, etc., which are here included.

The work has been brought up to March, 1894, when this volume went to press, and the results of researches published since that time are not included in the present edition.

It is hoped that this book will fill to some extent the want that has been felt by chemists for a compilation of this nature. While it has been attempted to make the book as free from errors as possible, nevertheless it is naturally impossible to avoid many mistakes, and the compiler will be very grateful to those who may call his attention to any errors or omissions.

A M C

## PREFACE TO SECOND EDITION

DURING the twenty-five years which have elapsed since the publication of the first edition of this dictionary, a very large amount of work has been published in chemical periodicals, containing data concerning the solubility of inorganic chemical compounds. As it was impossible for the compiler of the first edition to devote the time necessary for the collecting of the published data, it was necessary to employ assistance, and Dr Dorothy A Hahn, Professor of Chemistry, Mt Holyoke College, was engaged for this work. Dr Hahn has collected the larger part of the material in this book, which work in spite of its arduous and tedious nature, she has performed in a most painstaking manner.

The compilation and arrangement of the data collected by Dr Hahn, which devolved upon the original author, took much time. This, together with difficulties in printing, caused by the general conditions after the war, has delayed the publication until the present year, although the work was begun in 1916, and it has only been brought up to January 1st of that year.

Since the publication of the first edition of this work, Dr Atherton Seidell has brought out two editions of his book, entitled "Solubilities of Inorganic and Organic Substances," which covers quite a different field, as he considers only quantitative data and those only for the commoner substances. Dr Seidell has followed the plan in most cases where there are several available solubility determinations of a substance, of selecting and averaging the more reliable results, and embodying them in tables. Although this undoubtedly facilitates ready reference, it has seemed better to adhere to the original plan of the first edition, and to publish all the data in the form of the original authorities with references and dates, so that the user may be at liberty to use his own judgment in selection. Some few of the tables arranged by Dr Seidell, however, have seemed to possess decided advantages over any other published data and they have been incorporated in the present volume. It is desired also to acknowledge indebtedness to Dr Seidell's work for certain other tables where the original sources were not available to the present compilers.

The same plan and arrangement used in the first edition has been followed with certain elaboration, however, of the arrangement of data on the solubility of two or more salts in a solvent, which is explained in the Explanatory Preface.

Data published since the first edition on the cobalt and chromium ammonia compounds and those of the platinum group have been omitted, as it seemed that solubility data on those compounds possessed very little general interest.

As stated in the preface of the first edition, while every possible attempt has been made to avoid errors, it is manifestly impossible to avoid many mistakes in a work of this nature, and the compiler will be glad to have his attention called to any errors or omissions.

WILMINGTON, Del , Jan , 1921

A M C



## EXPLANATORY PREFACE

In order to reduce this volume to a convenient size the subject-matter has been abbreviated and condensed as far as seemed compatible with clearness, but it has been the aim not to use any abbreviations which are not at once intelligible without consulting the explanatory table. The more common chemical formulæ have been universally used, thereby saving a large amount of space without detracting from ready intelligibility to chemists.

The solubility of the substance in water is first given, the data being arranged chronologically in the longer articles. Then follow the specific gravities of the aqueous solutions, and also any data obtainable regarding their boiling-points, other physical data concerning solutions are not included. Following this is the solubility of the substance in other solvents—first the inorganic acids, then alkali and salt solutions, and finally organic substances.

Owing to the great increase of data, published during the last twenty years, on the simultaneous solubility of two or more salts in a given solvent, it has been found necessary to plan some arrangement, whereby such data can easily be found, and the plan adopted is as follows. The data for the solubility of two salts in a solvent is placed under the salt which comes first according to the alphabetical arrangement in this dictionary, and the order of the data on various salts under the same heading follows the alphabetical order of the salts considered. Thus the data on the solubility of  $\text{NH}_4\text{Cl} + \text{BaCl}_2$ ,  $\text{NH}_4\text{Cl} + \text{CuCl}_2$ , and  $\text{NH}_4\text{Cl} + \text{PbCl}_2$ , and  $\text{NH}_4\text{Cl} + (\text{NH}_4)_2\text{SO}_4$  are placed under Ammonium Chloride and arranged in the given order. Certain exceptions have been made to this rule, where the data directly concerns the solubility of a salt in a solution of another salt, in which case, it is placed under the former. Numerous cross references, however, are given, which it is hoped will avoid confusion.

In many cases no definite distinction can be drawn between the phenomena of solution and decomposition. At present the theory of solution is in a confused state, and until what really takes place when a substance dissolves is thoroughly understood no distinct line can be drawn. The whole subject is unsettled at the present time, for while many chemists believe in the so-called "dissociation" theory, yet the "hydrate" theory is not without its supporters. It is not my intention to discuss the theoretical side of the question, which has been so well treated in many recent works. It is, however, obvious that the phenomena are essentially different, when, for example, sodium carbonate is dissolved in water, in which case the original salt is deposited on evaporation, and when iron is dissolved in sulphuric acid, and the solution deposits a sulphate of iron. Yet it is still the custom to speak of iron as soluble in sulphuric acid, although it would be much more accurate to say that the sulphuric acid was decomposed by the iron. It has thus been found impracticable to draw a sharp line between solu-

tion and decomposition, and the term "soluble" has in general been used where a solution of some sort is formed by the action of the solvent

The matter of alphabetical arrangement of chemical compounds, in the present somewhat confused state of chemical nomenclature, has been a difficult question to decide. The plan followed has been practically that of the standard Dictionaries of Chemistry, whereby the compounds of metals with one of the non-metallic elements have been classified under the metals, while the salts of the other acids (the oxygen acids so called and some few others) have been arranged alphabetically under the acids. Thus barium chloride is found under barium, while barium chlorate is found under chloric acid. No exception has been made in the case of the rare metals, as is usually the custom in Dictionaries of Chemistry. Double salts are to be found under the word which comes first alphabetically, thus, "common alum," potassium aluminum sulphate, is found under aluminum sulphate as aluminum potassium sulphate (under sulphuric acid), but ammonia chrome alum is found under ammonium sulphate as ammonium chromium sulphate. In the same way the double sulphate and chromate of potassium is found under potassium chromate (chromic acid), and not under potassium sulphate (sulphuric acid). The double chloride of ammonium and magnesium is found under ammonium chloride (ammonium), while the double chloride of potassium and magnesium is found under magnesium chloride (magnesium). An exception is made, however, in the case of double compounds of salts of oxygen acids with salts containing a single non-metallic element, in which case they are always found under the oxygen acid. Thus the double sulphate and chloride of lead,  $\text{PbSO}_4$ ,  $\text{PbCl}_2$ , is found under lead sulphate (sulphuric acid), and not under lead chloride (lead).

The above method in some cases widely separates analogous compounds but it was found to be the only practical way to a strictly alphabetical arrangement, which is no necessary in a book containing so many very short articles.

The ammonia addition-products furnished another difficulty. While their nature is more or less definitely understood in the cobalt-platinum etc., compounds, and a definite nomenclature is in general use, there is an absolute lack of anything of the kind in the less definite compounds. It is good usage to speak of cuprummonium compounds, but how shall we designate the analogous cadmium compounds? "Cadmummonium" has not yet received the sanction of chemists, and  $\text{AlCl}_3$ ,  $\text{NH}_3$  is a still worse case for naming. I have therefore not attempted to name these compounds, but classified them all under the salts to which the ammonia is added, affixing the word ammonium thus aluminum chloride ammonium, cadmium chloride ammonium, and also cupric chloride ammonium for the salt now almost universally known as cuprummonium chloride.

The ammonia compounds of cobalt, chromium, mercury, and the platinum metals are arranged alphabetically according to their universally accepted names, a list of which is given under each of those elements.

It has further been necessary to settle arbitrarily the question whether a substance should be considered as a double salt or a salt of a compound acid con-

taining one of the metals For example, "fluosilicates" (or silicofluorides, as some may prefer) is the general name for the double fluorides of  $\text{SiF}_4$  and a metal, but this unanimity in usage gradually disappears as the basic elements become more nearly alike, so that it is impossible to draw a line between such compounds and a compound such as the double chloride of magnesium and potassium, for which indeed the name "potassium chloromagnesate" has been proposed The aim has been in all these cases to follow the best usage rather than make an absolutely homogeneous system of nomenclature out of the existing confusion

In the matter of formulæ no attempt at uniformity has been made Thus in the case above some chemists write the formula of the double chloride of magnesium and potassium as  $\text{KMgCl}_3$ , others as  $\text{KCl}, \text{MgCl}_3$  The form here used has been in most cases that of the author from whom the data are taken

The prefixes mono, di, tri, ortho, pyro, etc, have in general been disregarded in the alphabetical arrangement, and have been printed in italics Exceptions to this have been made, however, in the cobalt, chromium, etc, ammonium compounds, and in a few others, as dithionic, perchloric, etc, acids Cross references have been used, so as to prevent any confusion arising from lack of uniformity in this respect

In the Appendix will be found formulæ and tables for the conversion of the degrees of various hydrometer scales into specific gravity, and a Synchronistic Table of the Periodicals to which references are most frequently made





## ABBREVIATIONS

abs —absolute  
atmos —atmosphere  
b-pt —boiling-point  
comp —compound  
conc —concentrated  
corr —corrected  
cryst —crystallised, crystalline  
decomp —decompose, decomposes,  
decomposition, etc  
dil —dilute  
eutec —eutectic  
insol —insoluble  
M —a univalent Metal  
Min —Mineral  
mol —molecule

m-pt —melting-point  
ord —ordinary  
n —normal  
ppt, pptd, etc —precipitate, pre-  
cipitated, etc  
pt —part  
sat —saturated  
sl —slightly  
sol —soluble  
sp gr —specific gravity  
supersat —supersaturated  
t° = temperature in Centigrade degrees  
temp —temperature  
tr pt —transition point  
vol —volume



## ABBREVIATIONS OF REFERENCES

- A —Annalen der Pharmacie, edited by Liebig and others, 1832-39, continued as Annalen der Chemie und Pharmacie, 1840-73, continued as Justus Liebig's Annalen der Chemie, 1874-1915+ 406 vols
- A ch —Annales de Chimie et de Physique Paris 1st series, 1789-1816, 96 vols, 2nd series, 1817-40, 78 vols, 3rd series, 1841-63, 69 vols, 4th series, 1864-73, 30 vols, 5th series, 1874-83, 30 vols, 6th series, 1884-93, 30 vols, 7th series, 1893-1903, 30 vols, 8th series, 1904-13, 30 vols, 9th series, 1914+, 3 vols
- Acta Lund —Acta Universitatis Lundensis, or Lunds Universitets Års-skrift Lund, 1864+
- Am Chemist —The American Chemist New York, 1870-77 7 vols
- Am Ch J —The American Chemical Journal, edited by Remsen Baltimore, 1879-1913 50 vols
- Am J Sci —American Journal of Science and Arts, edited by Silliman, Dana, and others New Haven 1st series, 1818-45, 50 vols, 2nd series, 1846-70, 50 vols, 3rd series, 1871-95, 50 vols, 4th series, 1896-1915+, 40 vols Also numbered consecutively, 190 vols
- Analyst —The Analyst London, 1876-1915+ 45 vols
- Ann chum farm —Annali di chimica e di farmacologia Milan, 1886-90 5 vols
- Ann des Mines —See Ann Min
- Ann Min —Annales des Mines Paris
- Ann Phil —Annals of Philosophy London 1st series, 1813-20, 16 vols, new series, 1821-26, 12 vols
- Ann Phys —See Pogg and W Ann
- Apoth Z —Apotheker-Zeitung Berlin
- Arb Kais Gesundheitsamt —Arbeiten aus dem Kaiserlichen Gesundheitsamt
- Arch Néer Sc —Archives Néerlandaises des Sciences exactes et naturelles
- Arch Pharm —Archiv der Pharmacie, continued from Archiv des Apothekervereins in Norddeutschland, which forms the 1st series 1st series, 1822-34, 50 vols, 2nd series, 1835-72, 150 vols, 3rd series, 1873-94+, 32 vols Also numbered consecutively, which system is exclusively used after 3rd series, vol 253 (1915)
- Arch sc Phys nat —Archives des sciences physiques et naturelles de la Bibliothèque universelle de Genève
- A Suppl —Annalen der Chemie und Pharmacie Supplement-Bande Vol i 1861, vol ii, 1862-63, vol iii 1864-65, vol iv 1865-66, vol v 1867, vol vi 1868, vol vii 1870, vol viii 1872
- B —Berichte der deutschen chemischen Gesellschaft Berlin, 1868-1915+ 48 vols
- Att Acc Linc —Atti della reale accademia dei Lincei, rendconditi, etc
- B A B —Sitzungsberichte der königlichen preussischen Akademie der Wissenschaften zu Berlin
- Belg Acad Bull —Bulletin de l'Académie Royale des Sciences, des Lettres, et des Beaux-Arts de Belgique
- Berz J B —Jahresbericht über die Fortschritte der physischen Wissenschaften, edited by Berzelius 1822-47 30 vols
- Br Arch —Archiv des Apothekervereins im nördlichen Teutschland, etc, edited by Brandes 1st series, 1822-31, 39 vols, corresponds to 1st series of Arch Pharm
- Bull Acad Crac —Bulletin international de l'Académie des Sciences de Cracovie
- Bull Ac St Pétersb —Bulletin de l'Académie Impériale des Sciences de St Petersburg
- Bull Soc —Bulletin des Séances de la Société chimique de Paris 2nd series, 1864-88, 50 vols, 3rd series, 1889-1906, 36 vols, 4th series, 1907-15+, 18 vols
- Bull Soc chim Belg —Bulletin de la Société chimique Belgique
- Bull Soc ind Mulhouse —Bulletin de la Société industrielle de Mulhouse 1828-49 22 vols
- Bull Soc Min —Bulletin de la société française de Minéralogie 1878-1915+ 37 vols
- C A —Chemical Abstracts American Chemical Society New York
- C C —Chemisches Centralblatt, continued from Pharmaceutisches Centralblatt
- C B Miner —Centralblatt für mineralogie, Geologie und Paläontologie Berlin
- Chem Ind —Die Chemische Industrie, edited by Jacobsen Berlin
- Chem Soc —Journal of the Chemical Society of London 1st series, 1849-62, 15 vols, 2nd series, 1863-78, 17 vols, new series, 1878-1915+ The vols are numbered consecutively from 1849 1878 = vol 32 Total, 108 vols

- Chem-tech Centr-Anz—Chemisch-technischer Central-Anzeiger  
 Chem Weekbl—Chemiker Weekblad  
 Chem Z—See Ch Z  
 Chem Zeitschr—Chemische Zeitschrift  
 Ch Gaz—The Chemical Gazette London, 1843-59 17 vols  
 Ch Kal—Chemiker Kalender, edited by Biedermann  
 Ch Z—Chemiker Zeitung  
 Ch Z Repert—Chemisches Repertorium Beiblatt zur Chemiker-Zeitung Gothen  
 Cim—Il Cimento Turin, 1852-54 6 vols  
 C N—The Chemical News London, 1860-1915+ 112 vols  
 Comm—Commentar zur Pharmacopœa germanica by Hager Berlin, 1883  
 Compt chim—Comptes-rendus mensuels des Travaux chimiques, edited by Laurent & Gerhardt 1845-51 7 vols  
 C R—Comptes-rendus hebdomadaires des Séances de l'Académie des Sciences Pa 1835-1915+ 161 vols  
 Crell Ann—Chemische Annalen für die Freunde der Naturlehre, etc, edited by Cr 1784-1803 40 vols  
 Dansk Vid For—Oversigt over det kgl danske Videnskabernes Selskabs Forhandling Copenhagen  
 Dingl—Dingler's Polytechnisches Journal, edited by Dingler and others 1820-1915 330 vols  
 Edinb Trans—Transactions of the Royal Society of Edinburgh 1788-1915+ 51 v  
 Ed J Sci—The Edinburgh Journal of Science 1st series, 1824-29, 10 vols, 2nd ser 1829-32, 6 vols Continued as Phil Mag  
 Electrochem Ind—Electrochemical Industry (Oct, 1902, to Dec, 1904) later Elect chemical and Metallurgical Industry New York  
 Elektrochem Z—Elektrochemische Zeitschrift Berlin  
 Eng Min J—The Engineering and Mining Journal New York  
 Gazz ch it—Gazzeta chimica italiana Palermo, 1871-1915+ 45 vols  
 Gilb Ann—Annalen der Physik, edited by Gilbert 1st series, 1799-1808, 30 vols, 2 series, 1809-18, 30 vols, 3rd series, 1819-24, 26 vols Also numbered consecutive 76 vols Continued as Pogg  
 Gm-K—Gmelin-Kraut's Handbuch der anorganischen Chemie, 6te Auflage 1877-19 7te Auflage, 1907-1915+  
 Gr-Ot—Graham-Otto's ausführliches Lehrbuch der anorganischen Chemie, 5te Auflage, Michaelis 1878-89  
 Jahrb Miner—Jahrbuch für Mineralogie, Geologie und Palæontologie Heidelberg 18 1832 Then Neues Jahrbuch für Mineralogie Stuttgart  
 Jahrb d Pharm—Jahresbericht der Pharmacie  
 J Am Chem Soc—Journal of the American Chemical Society New York, 1876-1915 37 vols  
 J Anal Appl Ch—The Journal of Analytical and Applied Chemistry, edited by H 1887-93 7 vols  
 J B—Jahresbericht über die Fortschritte der Chemie, u s w  
 J Chim méd—Journal de Chimie médicale, de Pharmacie, et de Toxicologie 1st ser 1825-34, 10 vols, 2nd series, 1835-44, 10 vols, 3rd series, 1845-54, 10 vols, series, 1855-64, 10 vols, 5th series, 1865-76 12 vols  
 Jena Zeit—Jenaische Zeitschrift für Medicin und Naturwissenschaften  
 J Pharm—Journal de Pharmacie et de Chimie Paris 2nd series, 1815-41, 27 vols, series, 1842-64, 46 vols, 4th series, 1865-79, 30 vols, 5th series, 1879-94, 6th ser: 1895-1909, 30 vols, 7th series, 1910-15+, 10 vols  
 J Phys—Journal der Physik, edited by Gren 1790-98 12 vols Continued as Gilb A  
 J Phys Ch—The Journal of Physical Chemistry Ithaca, N Y  
 J pr—Journal für praktische Chemie, edited by Erdmann, Kolbe, and v Meyer Leipz 1st series, 1834-69, 108 vols, 2nd series, 1870-1915+ 92 vols  
 J russ phys Chem Soc—Journal de la Société physico-chimique russe St Pétersbou  
 J Russ Soc—Journal of the Russian Chemical Society St Petersburg, 1869-1915 47 vols  
 J Soc Chem Ind—Journal of the Society of Chemical Industry London, 1882-1915 34 vols  
 J S C I—See above  
 J Tok Chem Soc—Journal of the Tokyo Chemical Society  
 Kastn Arch—Archiv für die gesammte Naturlehre, edited by Kastner Nuremberg, 18 35 25 vols  
 Lasty Chemické—Lasty Chemické, edited by Preis and others Prague  
 Lond R Soc Proc—See Roy Soc Proc  
 Lund Univ Arsk—Lunds Universitets Års-skrift Lund

- M — Monatshefte für Chemie und verwandter Theile der anderer Wissenschaften Vienna, 1880-1915+ 36 vols
- M A B — Sitzungsberichte der mathematisch-physikalischen Classe der kgl bayerischen Akademie der Wissenschaften zu München
- Mag Pharm — Magazin der Pharmacie 1823-31 36 vols
- Mém Acad St Pétersb — Mémoires de l'Académie Impériale des Sciences de Saint-Pétersbourg
- M Ch — See M
- Mem Coll Sci Kyoto — Memoirs of the College of Science, Kyoto
- Metall — Metallurgie Halle
- Miner Jahrb — Neues Jahrbuch für Mineralogie, etc 1833-73 40 vols
- Miner Mag — Mineralogical Magazine London
- Miner Mitt — Mineralogische und petrographische Mittheilungen Wien
- Monit Scient — Le Moniteur Scientifique, edited by Quesneville Paris
- N Arch Sc ph nat — Nouvelles Archives des Sciences physiques et naturelles Geneva
- N Cim — Il nuovo Cimento Pisa, 1855-61 14 vols
- N Edinb Phil J — New Edinburgh Philosophical Journal 1819-64 90 vols
- N Jahrb Miner — Neues Jahrbuch für Mineralogie Stuttgart
- N Jahrb Pharm — Neues Jahrbuch der Pharmacie 1796-1840 42 vols
- N J Pharm — Neues Journal der Pharmacie für Aerzte, etc, edited by Trommsdorff 1817-34 27 vols
- N Rep Pharm — Neues Repertorium für Pharmacie 1852-76 25 vols
- Pharm Centralbl — Pharmaceutisches Centralblatt 1830-49 20 vols Continued as C C
- Pharm Era — Pharmaceutical Era
- Pharm J Trans — Pharmaceutical Journal and Transactions
- Pharm Post — Pharmaceutische Post Wien
- Pharm Vierteljb — Pharmaceutische Vierteljahresberichte
- Pharm Weekbl — Pharmaceutisches Weekblad
- Pharm Ztg — Pharmaceutische Zeitung
- Phil Mag — The Philosophical Magazine London 1st series, 1814-26, 26 vols, 2nd series 1827-32, 11 vols, 3rd series, 1832-50, 37 vols, 4th series, 1851-75, 50 vols, 5th series, 1876-1900, 50 vols, 6th series, 1901-1915+, 30 vols
- Phil Mag Ann — The Philosophical Magazine and Annals of Chemistry, etc Corresponds to Phil Mag 2nd series
- Phil Trans — The Philosophical Transactions of the Royal Society of London 1665-1915+
- Phys Rev — The Physical Review
- Pogg — Annalen der Physik und Chemie, edited by Poggendorf 1st series, 1824-43, 60 vols, 2nd series, 1844-53, 30 vols, 3rd series, 1854-63, 30 vols, 4th series, 1864-73, 30 vols, 5th series, 1874-77, 10 vols Continued as W Ann
- Polyt Centralbl — Polytechnisches Centralblatt 1st series, 1835-46, 12 vols, 2nd series, 1847-73, 30 vols
- Proc Am A A S — Proceedings of the American Association for the Advancement of Science
- Proc Am Acad — Proceedings of the American Academy of Arts and Sciences Boston, 1846-1915+ 50 vols
- Proc Am Phil Soc — Proceedings of the American Philosophical Society Philadelphia
- Proc Chem Soc — Proceedings of the Chemical Society of London
- Proc K Akad Wet — See Ver K Akad Wet
- Proc Soc Manchester — Proceedings of the Literary and Philosophical Society of Manchester
- Proc Roy Soc — See Roy Soc Proc
- Q J Sci — Quarterly Journal of Science London, 1816-26 22 vols
- Rass Min — Rassegna mineraria, metallurgica e chimica
- Real Ac Linc — Atti di Reale Accademia dei Lincei Rome
- Rend Ac Linc — See Att Ac Linc
- Rep anal Ch — Repertorium der analytischen Chemie 1881-87 7 vols
- Rep Brit Assn Adv Sci — Reports of the Meetings of the British Association for the Advancement of Science
- Repert — See Rep Pharm
- Répert chim appl — Répertoire de Chimie pure et appliquée Paris, 1858-63 9 vols
- Rep Pharm — Repertorium für die Pharmacie, edited by Buchner 1st series, 1815-34, 50 vols, 2nd series, 1835-48, 50 vols, 3rd series, 1849-51, 10 vols Continued as N Rep Pharm
- Rev gén chim — Revue générale de chimie pure et appliquée
- Rev Mét — Revue de Métallurgie Paris
- Roy Soc Proc — Proceedings of the Royal Society of London 1832-1915+ 92 vols

- Roy Soc Trans—Abstracts of Philosophical Transactions of the Royal Society of London 1832-54 6 vols Continued with Roy Soc Proc
- R t c—Recueil des Travaux chimiques des Pays-Bas Leiden, 1882-1915+ 34 vols
- Russ Zeit Pharm—Pharmaceutische Zeitschrift für Russland
- Scheik Verhandel—Scheikundige Verhandelungen en Onderzoekingen, edited by Mulder Rotterdam, 1857-64 3 vols
- Scher J—Allgemeines Journal der Chemie, edited by Scherer 1798-1810 17 vols Continued as Schw J
- Schw J—Journal für Chemie und Physik, edited by Schweigger 1st series, 1811-20, 30 vols, 2nd series, 1821-30, 30 vols, 3rd series, 1831-33, 9 vols Continued as J pr
- Sill Am J—American Journal of Science, edited by Silliman, etc See Am J Sci
- Sitzungsb bohms Gesell—Sitzungsberichte der königlichen böhmischen Gesellschaft der Wissenschaften in Prag
- Storer's Dict—First Outlines of a Dictionary of Solubilities of Chemical Substances, by F H Storer Boston, 1864
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A DICTIONARY OF CHEMICAL SOLUBILITIES  
INORGANIC





# DICTIONARY

OF

## CHEMICAL SOLUBILITIES

### INORGANIC

#### Actinium emanation

Solubility coefficient of actinium emanation in  $H_2O$  at room temp is 2

If the solubility of actinium emanation in  $H_2O$  is made=1, the relative solubility of the emanation in sat  $KCl+Aq=0.9$ , in conc  $H_2SO_4=0.95$ , in ethyl alcohol=1.1, in amyl alcohol=1.6, in benzaldehyde=1.7, in benzene=1.8, in toluene=1.8, in petroleum=1.9, in  $CS_2=2.1$  at  $18^\circ$

(Hevesy, Phys Zeit 1911, 12 1221)

#### Air, Atmospheric

See also Nitrogen and Oxygen

100 vols  $H_2O$  at  $15^\circ$  and 760 mm absorb about 5 vols atmospheric air (Saussure)

1 vol  $H_2O$  at  $t^\circ$  and 760 mm pressure absorbs V vols atmospheric air reduced to 760 mm and  $0^\circ$

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	0.02471	7	0.02080	14	0.01822
1	0.02406	8	0.02034	15	0.01795
2	0.02345	9	0.01192	16	0.01771
3	0.02287	10	0.01953	17	0.01750
4	0.02237	11	0.01916	18	0.01732
5	0.02179	12	0.01882	19	0.01717
6	0.02128	13	0.01851	20	0.01701

(Bunsen's Gasometry)

1 l  $H_2O$  absorbs cc N and O from air at  $t^\circ$  and 760 mm pressure

$t^\circ$	cc N	cc O	cc N+O
0	16.09	8.62	24.71
5	14.18	7.60	21.78
10	12.70	6.79	19.49
15	11.67	6.25	17.92
20	11.08	5.93	17.01

(Bunsen, Gasometr Methoden, 2te Aufl 209, 220)

1 l  $H_2O$  absorbs cc N and O from air at  $t^\circ$  and 760 mm pressure (dry)

$t^\circ$	cc N	cc O	N+O	%O
10	15.47	7.87	23.34	33.74
15	13.83	7.09	20.92	33.86
20	12.76	6.44	19.20	33.55
25	11.78	5.91	17.69	33.40

(Roscoe and Lunt, Chem Soc 55 568)

1 l  $H_2O$  absorbs cc N and O from air at  $t^\circ$  and 760 mm

$t^\circ$	cc N	cc O	%O
0	19.53	10.01	33.88
6.0	16.34	8.28	33.60
6.32	16.60	8.39	33.35
9.18	15.58	7.90	33.60
13.70	14.16	7.14	33.51
14.10	14.16	7.05	33.24

(Pettersson and Söndén, B 22 1439)

1 l  $H_2O$  absorbs cc N ( $0^\circ$  and 760 mm) from atmospheric air at  $t^\circ$  and 760 mm pressure (dry)

$t^\circ$	cc N	$t^\circ$	cc N	$t^\circ$	cc N
0	19.14	10	15.14	20	12.63
2	18.20	12	14.53	22	12.27
4	17.34	14	13.98	24	11.95
6	16.54	16	13.48	25	11.81
8	15.81	18	13.03		

(Hamberg, J pr (2) 33 447)

1 l  $H_2O$  absorbs cc N from air at  $t^\circ$  and 760 mm pressure

$t^\circ$	cc N	$t^\circ$	cc N	$t^\circ$	cc N
0	19.29	10	15.36	20	12.80
5	17.09	15	13.95	25	11.81

(Dittmar, Challenger Expedition, vol 1 pt 1)

1 l H<sub>2</sub>O sat with air at t° and 760 mm contains cc O (red to 0° and 760 mm)

t°	cc O	t°	cc O	t°	cc O
0	10 187	11	7 692	22	6 114
1	9 910	12	7 518	23	5 999
2	9 643	13	7 352	24	5 886
3	9 387	14	7 192	25	5 776
4	9 142	15	7 038	26	5 669
5	8 907	16	6 891	27	5 564
6	8 682	17	6 730	28	5 460
7	8 467	18	6 614	29	5 357
8	8 260	19	6 482	30	5 255
9	8 063	20	6 356		
10	7 873	21	6 233		

(Winkler, B 22 1773)

1 vol H<sub>2</sub>O absorbs 0 01748 vol air at 24 05° and 760 mm pressure (Winkler, B 21 2851)

Composition of the absorbed air between 0° and 24° is 34 91% O and 65 09% N (Bunsen), between 15° and 16°, 32 17% O and 67 83% N (König and Kranch, Z anal 19 259), 32% O and 68% N (Regnault), at 0°, 35 1% O, 10°, 34 8% O, 20°, 34 3% O, 25°, 33 7% O (Winkler, B 21 2483) See also Roscoe and Lunt, and Pettersson and Söndén, page 1

Solubility of atmos oxygen and nitrogen in 1000 cc H<sub>2</sub>O at 760 mm pressure (calc)

Temp	Oxygen	Nitrogen	Temp	Oxygen	Nitrogen
	cc	cc		cc	cc
0°	10 19	18 45	29°	5 33	10 30
1	9 91	17 99	30	5 24	10 15
2	9 64	17 55	31	5 15	9 99
3	9 39	17 12	32	5 07	9 83
4	9 14	16 71	33	4 99	9 67
5	8 91	16 30	34	4 91	9 52
6	8 68	15 91	35	4 83	9 37
7	8 47	15 54	36	4 76	9 22
8	8 26	15 18	37	4 69	9 08
9	8 06	14 83	38	4 62	8 94
10	7 87	14 50	39	4 55	8 81
11	7 69	14 19	40	4 48	8 67
12	7 52	13 89	41	4 42	8 55
13	7 35	13 61	42	4 35	8 43
14	7 19	13 35	43	4 28	8 31
15	7 04	13 07	44	4 22	8 20
16	6 89	12 83	45	4 15	8 09
17	6 75	12 57	46	4 09	7 97
18	6 61	12 34	47	4 03	7 87
19	6 48	12 12	48	3 97	7 76
20	6 35	11 91	49	3 91	7 65
21	6 23	11 71	50	3 85	7 55
22	6 10	11 52	51	3 79	7 45
23	5 98	11 33	52	3 74	7 34
24	5 86	11 14	53	3 68	7 24
25	5 75	10 96	54	3 62	7 13
26	5 64	10 79	55	3 56	7 03
27	5 54	10 62	56	3 51	6 92
28	5 43	10 46	57	3 45	6 81

Solubility of atmos etc—*Continued*

Temp	Oxygen	Nitrogen	Temp	Oxygen	Nitrogen
	cc	cc		cc	cc
58°	3 39	6 71	80°	1 97	4 03
59	3 34	6 60	81	1 89	3 88
60	3 28	6 50	82	1 81	3 73
61	3 22	6 39	83	1 73	3 57
62	3 16	6 27	84	1 65	3 41
63	3 10	6 16	85	1 57	3 24
64	3 04	6 05	86	1 48	3 07
65	2 98	5 94	87	1 39	2 89
66	2 92	5 82	88	1 30	2 71
67	2 85	5 70	89	1 21	2 52
68	2 79	5 59	90	1 11	2 32
69	2 73	5 47	91	1 02	2 12
70	2 66	5 35	92	0 92	1 91
71	2 60	5 23	93	0 81	1 70
72	2 53	5 10	94	0 71	1 48
73	2 47	4 98	95	0 60	1 25
74	2 40	4 85	96	0 48	1 0
75	2 33	4 72	97	0 37	0 7
76	2 26	4 59	98	0 27	0 5
77	2 19	4 45	99	0 13	0 2
78	2 12	4 32	100	0 00	0 0
79	2 04	4 18			

(Winkler, B 1901, 34 1440)

Absorption of atmospheric air by H<sub>2</sub>O at and 760 mm pressure  $\beta$  = coefficient absorption  $\beta_1$  = "Solubility" ( $\beta$  under oxygen)

t°	$\beta$	$\beta_1$	t	$\beta$	$\beta_1$
0	0 02881	0 02864	55	0 01253	0 010
5	254 3	25 21	60	12 16	09
10	2264	22 37	65	118 2	08
15	2045	20 11	70	1156	08
20	1869	18 21	75	1137	07
25	1724	16 71	80	1126	06
30	1606	15 39	85	1119	04
35	1503	14 20	90	1113	0
40	1418	13 15	95	1109	01
45	1351	12 24	100	110	00
50	1297	11 40			

(Winkler B 1901 34 1409)

Sea-water absorbs less O and N from than pure H<sub>2</sub>O, but the ratio between O and N remains constant. In sea-water sat with at 6 22° the oxygen was 33 50% of the gas absorbed (Pettersson and Söndén)

1 l sea-water absorbs cc N and O from at t° and 760 mm pressure

t	cc N	cc O	N+O	% O
0	14 41	7 77	22 18	35 0
5	13 22	6 95	20 15	34 3
10	12 04	6 29	18 37	34 2
15	11 01	5 70	16 71	34 1

(Tørnøe, Norwegian North Atlantic Exp Chem 18)

1 l sea water absorbs cc N from air at  $t^\circ$  and 760 mm

$t^\circ$	cc N	$t^\circ$	cc N	$t^\circ$	cc N
0	15 60	10	12 47	20	10 41
5	13 86	15	11 34	25	9 62

(Dittmar)

1 l sea-water absorbs cc N ( $0^\circ$  and 760 mm) from atmospheric air at  $t^\circ$  and 760 mm pressure (dry)

t	cc N	$t^\circ$	cc N	t	cc N
0	14 85	10	12 06	20	10 25
2	14 20	12	11 62	22	9 98
4	13 60	14	11 23	24	9 73
6	13 04	16	10 87	25	9 62
8	12 53	18	10 54		

(Hamburg)

Absorption of air which is free from carbonic acid by  $\text{H}_2\text{SO}_4$  at  $18^\circ$  and 760 mm  $\alpha$  = coefficient of solubility

$\text{H}_2\text{SO}_4$	$\alpha$	$\text{H}_2\text{SO}_4$	$\alpha$
98%	0 0173	70%	0 0055
90%	0 0107	60%	0 0059
80%	0 0069	50%	0 0076

(Lower,  $Z$  anorg 1906, 50, 388)

Absolute alcohol absorbs 0 11 vol gas from air  $\frac{1}{3}$  of which is  $\text{O}$  and  $\frac{1}{3}$   $\text{N}$ . On mixing with an equal vol  $\text{H}_2\text{O}$   $\frac{1}{3}$  of the dissolved gas is given off (Dobereiner)  
100 vols alcohol (95 1 %) absorb 14 1 vols air (Robinet C R 58 608)

100 vols petroleum absorb 6 8 vols air  
oil of lavender 6 89  
benzene 14 0  
oil of turpentine 24 15  
(Robinet  $l c$ )

1 vol ether at 760 mm pressure absorbs 0 290 vols air at  $0^\circ$ , 0 267 vols at  $10^\circ$ , 0 286 vols at  $15^\circ$  (Christoff  $Z$  phys Ch 1912, 79 459)

### Alcohol $\text{C}_2\text{H}_5\text{OH}$

$\gamma_p$  gr of pure ethyl alcohol + Aq at  $25^\circ$

% alcohol	$\gamma_p$ gr	% alcohol	$\gamma_p$ gr
0	0 997077	55	0 898502
2	0 993359	60	0 886990
5	0 988166	65	0 875269
6	0 986563	70	0 863399
10	0 980434	75	0 851336
15	0 973345	80	0 839114
20	0 966392	85	0 826596
25	0 958946	90	0 813622
30	0 950672	95	0 799912
35	0 941459	98	0 791170
40	0 931483	99	0 788135
45	0 920850	100	0 785058
50	0 909852	—	—

(Osborne, McKelvy and Bearce, Bureau of Standards, Sci Paper No 197)

### Alum, Ammonia

See Sulphate, aluminum ammonium

### Alum, Chrome

See Sulphate, aluminum chromium

### Alum, Iron

See Sulphate, aluminum ferric

### Alum, Potash

See Sulphate, aluminum potassium

### Alumina

See Aluminum oxide

### Aluminic acid, $\text{H}_2\text{Al}_2\text{O}_4 = \text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$

Aluminum hydroxide possesses acid properties and salts corresponding to an acid of the above formula exist

See Aluminum hydroxide

### Aluminates

All aluminates are insol in  $\text{H}_2\text{O}$  except those of K and Na (Fremy) and Ba (Beckmann, J pr (2) 26 385)

### Barium aluminate, $\text{BaAl}_2\text{O}_4 + 4\text{H}_2\text{O}$

Sol in 10 pts  $\text{H}_2\text{O}$ , can be recryst from alcohol (Deville J pr 87 299)

+5H $_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  with decomp (Allen, Am Ch J 1900, 24 313)

+7H $_2\text{O}$  Sl sol in cold, not completely sol in hot  $\text{H}_2\text{O}$  Sol in cold dil  $\text{HCl} + \text{Aq}$  (Beckmann, J pr (2) 26 385)

$\text{BaAl}_2\text{O}_4 + 5\text{H}_2\text{O}$  Sol in 20 pts  $\text{H}_2\text{O}$  by boiling (Beckmann, B 14 2151)

Insol in alcohol

Sl sol in  $\text{H}_2\text{O}$  with decomp insol in alcohol (Allen, Am Ch J 1900, 24 311)

$\text{Ba}_3\text{Al}_2\text{O}_8 + 7 - 11\text{H}_2\text{O}$  Sol in 15 pts  $\text{H}_2\text{O}$  with decomp into  $\text{BaAl}_2\text{O}_4 + 5\text{H}_2\text{O}$ , insol in alcohol (Beckmann)

### Barium aluminate bromide, $\text{BaAl}_2\text{O}_4 \cdot \text{BaBr} + 11\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Beckmann, J pr (2) 26 385, 474)

### Barium aluminate chloride, $\text{BaAl}_2\text{O}_4 \cdot 3\text{BaCl}_2 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Beckmann  $l c$ )

$\text{BaAl}_2\text{O}_4 \cdot \text{BaCl}_2 + 11\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Beckmann,  $l c$ )

### Barium aluminate iodide, $\text{BaAl}_2\text{O}_4 \cdot \text{BaI}$

Sol in  $\text{H}_2\text{O}$  (Beckmann  $l c$ )

### Calcium aluminate, $\text{CaO} \cdot \text{Al}_2\text{O}_3$

Decomp by  $\text{H}_2\text{O}$  but does not "set" Sol in  $\text{HCl}$ , insol in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HF}$  (Dufay, C R 1900, 131 545)

$\text{Ca}_2\text{Al}_2\text{O}_5 + 7\text{H}_2\text{O}$  Slowly decomp by  $\text{H}_2\text{O}$ , sl sol in  $\text{H}_2\text{O}$  (Allen, Am Ch J 1900, 24 316)

$\text{Ca}_3\text{Al}_2\text{O}_8$  Insol in  $\text{H}_2\text{O}$ , not decomp by  $\text{KOH} + \text{Aq}$ , sol in acids (Tissier, C R 48 627)

+6H<sub>2</sub>O Ppt, sl sol in H<sub>2</sub>O, insol in alcohol (Allen, Am Ch J 1900, **24** 316)  
 3Al<sub>2</sub>O<sub>3</sub>·4CaO+3H<sub>2</sub>O Ppt (Friedel, Bull Soc Min 1903, **26** 121, C C 1904, I 430)

#### Cobalt aluminate

"*Thenard's* or *Leuthner's* blue" Insol in H<sub>2</sub>O

CoAl<sub>2</sub>O<sub>4</sub> Insol in H<sub>2</sub>O and acids (Ebelmen)

Cobalt magnesium aluminate, [MgCo]Al<sub>2</sub>O<sub>4</sub>

"*Spinel Blue*" Insol in H<sub>2</sub>O or HCl+Aq (Ebelmen)

Glucinum aluminate, GlAl<sub>2</sub>O<sub>4</sub>

Min *Chrysoberyll* Not attacked by acids, but decomp by KOH+Aq

Iron (ferrous) aluminate, FeAl<sub>2</sub>O<sub>4</sub>

Min *Hercynite* Not attacked by acids

Lithium aluminate, LiAlO<sub>2</sub>

Sol in H<sub>2</sub>O (Weyberg, C C 1906, II 1659)

Lithium hydrogen aluminate, LiHAl<sub>2</sub>O<sub>4</sub>+5H<sub>2</sub>O

Sl sol in H<sub>2</sub>O, decomp on boiling (Allen, Am Ch J 1900, **24** 310)

Magnesium aluminate, MgAl<sub>2</sub>O<sub>4</sub>

Min *Spinel* Insol in H<sub>2</sub>O

Insol in HNO<sub>3</sub>+Aq, very sl sol in HCl+Aq, partly sol in H<sub>2</sub>SO<sub>4</sub> at boiling temp (Abich, Pogg **23** 316)

Sol by standing 2 hours at 210° with a mixture of 3 pts H<sub>2</sub>SO<sub>4</sub> and 1 pt H<sub>2</sub>O, or by boiling with this mixture together with HF (Mitscherlich, J pr **81** 108)

Sl sol in HCl, HF, and H<sub>2</sub>SO<sub>4</sub>, insol in HNO<sub>3</sub> (Dufau, Bull Soc 1901, (3) **25** 669)

#### Manganous aluminate

Insol in H<sub>2</sub>O and acids (Fbelmen, A ch (3) **22** 225)

MnAl<sub>2</sub>O<sub>4</sub> Insol in HCl+Aq, readily attacked by HF, HNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>

Decomp by fusion with alkali chlorate, nitrate, oxide or carbonate (Dufau, C R 1902, **135** 963)

#### Nickel aluminate

Insol in H<sub>2</sub>O

Potassium aluminate, K<sub>2</sub>Al<sub>2</sub>O<sub>4</sub>+3H<sub>2</sub>O

Decomp by dissolving in pure H<sub>2</sub>O with separation of Al<sub>2</sub>O<sub>3</sub> (Fremy, A ch (3) **12** 362) Can be recrystallised from water containing a little alkali, without decomposition (Fremy)

Insol in alcohol

Sodium aluminate, Na<sub>2</sub>Al<sub>2</sub>O<sub>4</sub>

Easily and completely sol in cold H<sub>2</sub>O (Schaffgotsch, Pogg **43** 117)

+4H<sub>2</sub>O Insol in alcohol (Allen, Am Ch J 1900, **24** 308)

Na<sub>2</sub>Al<sub>2</sub>O<sub>4</sub> Miscible with hot H<sub>2</sub>O, and as sol as NaOH in cold H<sub>2</sub>O Insol in alcohol but decomp thereby (Tissier, C R **43** 102)

Strontium aluminate, Sr<sub>2</sub>Al<sub>2</sub>O<sub>6</sub>+6H<sub>2</sub>O

Sl sol in H<sub>2</sub>O (with slow decomp in Aq solution) (Allen, Am Ch J 1900, **24** 314)

Thallium aluminate, Tl<sub>2</sub>Al<sub>2</sub>O<sub>6</sub>+7H<sub>2</sub>O

Not completely sol in, but slowly hydrolysed by H<sub>2</sub>O

Readily sol in dil acids and in the fixed alkalies

Insol in abs alcohol (Hawley, J Am Chem Soc 1907, **29** 303)

Zinc aluminate, ZnAl<sub>2</sub>O<sub>4</sub>

Insol in acids or alkalies

Min *Gahnite* (*Automolite*)

+2H<sub>2</sub>O Sol in KOH, and NH<sub>4</sub>OH+Aq (Berzelius)

#### Aluminicoantimoniotungstic acid

Ammonium aluminicoantimoniotungstate, 6(NH<sub>4</sub>)<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 3Sb<sub>2</sub>O<sub>5</sub>, 18WO<sub>3</sub>+17H<sub>2</sub>O

A shellac-like gum (Daniels, J Am Chem Soc 1908, **30** 1856)

Barium aluminicoantimoniotungstate, 5BaO, 2Al<sub>2</sub>O<sub>3</sub>, 3Sb<sub>2</sub>O<sub>5</sub>, 18WO<sub>3</sub>+6H<sub>2</sub>O

Somewhat insol in dil HCl (Daniels, J Am Chem Soc 1908, **30** 1857)

Silver aluminicoantimoniotungstate, 6Ag<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 3Sb<sub>2</sub>O<sub>5</sub>, 18WO<sub>3</sub>+12H<sub>2</sub>O

Ppt

Sol in NH<sub>4</sub>OH+Aq but requires HNO<sub>3</sub> (1 10) to dissolve it (Daniels, J Am Chem Soc 1908, **30** 1857)

#### Aluminicoarseniotungstic acid

Ammonium aluminicoarseniotungstate, 6(NH<sub>4</sub>)<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 3As<sub>2</sub>O<sub>5</sub>, 18WO<sub>3</sub>+14H<sub>2</sub>O

Springly sol in H<sub>2</sub>O (Daniels, J Am Chem Soc 1908, **30** 1854)

Barium aluminicoarseniotungstate, 4BaO, 2Al<sub>2</sub>O<sub>3</sub>, 3As<sub>2</sub>O<sub>5</sub>, 18WO<sub>3</sub>+12H<sub>2</sub>O

Vcry sl sol in H<sub>2</sub>O

Sol in very dil HCl or HNO<sub>3</sub> (Daniels, J Am Chem Soc 1908, **30** 1855)

Cadmium aluminicoarseniotungstate, 4CdO, 2Al<sub>2</sub>O<sub>3</sub>, 3As<sub>2</sub>O<sub>5</sub>, 18WO<sub>3</sub>+17H<sub>2</sub>O

Sol in dil mineral acids and in strong NH<sub>4</sub>OH+Aq (Daniels, J Am Chem Soc 1908, **30** 1855)

#### Aluminicomolybdic acid

Ammonium aluminicomolybdate, 3(NH<sub>4</sub>)<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+19H<sub>2</sub>O

Ppt (Hall, J Am Chem Soc 1907, **29** 696)

+20H<sub>2</sub>O More sol in H<sub>2</sub>O than potassium

**aluminicomolybdate** (Struve, Bull Acad St Petersb 12 147)  
+22H<sub>2</sub>O (Marckwald, Dissert 1895)

**Barium aluminicomolybdate**, 4BaO, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+14H<sub>2</sub>O

Ppt (Hall, J Am Chem Soc 1907, 29 712)

**Lead aluminicomolybdate**, 4PbO, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+21H<sub>2</sub>O

Ppt (Hall, J Am Chem Soc 1907, 29 712)

**Potassium aluminicomolybdate**, 3K<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+20H<sub>2</sub>O

1 pt of the salt is sol in 40 67 pts H<sub>2</sub>O at 17°. Very difficultly sol in acids (Struve)  
H<sub>3</sub>Al(MoO<sub>4</sub>)<sub>3</sub>, 2KHM<sub>2</sub>O<sub>4</sub> Sol in H<sub>2</sub>O (Parmentier, C R 94 1713)

**Silver aluminicomolybdate**, 4Ag<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+16H<sub>2</sub>O

Ppt (Hall, J Am Chem Soc 1907, 29 712)

**Sodium aluminicomolybdate**, 3Na<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+22H<sub>2</sub>O

Efflorescent Easily sol in H<sub>2</sub>O (Gentele J pr 81 413)

### Aluminicophosphotungstic acid.

**Ammonium aluminicophosphotungstate**, 9(NH<sub>4</sub>)<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 4P<sub>2</sub>O<sub>5</sub>, 9WO<sub>3</sub>+13H<sub>2</sub>O

Sl sol in cold and in hot H<sub>2</sub>O (Daniels, J Am Chem Soc 1908, 30, 1851)

**Barium aluminicophosphotungstate**, 4BaO, 2Al<sub>2</sub>O<sub>3</sub>, 4P<sub>2</sub>O<sub>5</sub>, 9WO<sub>3</sub>+13H<sub>2</sub>O

Sl sol in H<sub>2</sub>O Sol in very dil HCl or HNO<sub>3</sub> (Daniels, J Am Chem Soc 1908, 30 1853)

**Silver aluminicophosphotungstate**, 4Ag<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 4P<sub>2</sub>O<sub>5</sub>, 9WO<sub>3</sub>+6H<sub>2</sub>O

Nearly insol in H<sub>2</sub>O Sol in NH<sub>4</sub>OH and in dil HNO<sub>3</sub> Insol in acetic acid (Daniels, J Am Chem Soc 1908, 30 1852)

**Zinc aluminicophosphotungstate**, 5ZnO, 2Al<sub>2</sub>O<sub>3</sub>, 4P<sub>2</sub>O<sub>5</sub>, 9WO<sub>3</sub>+11H<sub>2</sub>O

Sol in dil acids and in a large quantity of conc ammonia when NH<sub>4</sub>Cl is present (Daniels, J Am Chem Soc 1908, 30 1853)

### Aluminicotungstic acid

**Ammonium aluminicotungstate**, 3(NH<sub>4</sub>)<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+4H<sub>2</sub>O

Sol in conc HNO<sub>3</sub> and in conc HCl When the solution in conc HCl was boiled, a yellow colored ppt separated (F F Smith J Am Chem Soc 1903, 25 1230)

**Ammonium silver aluminicotungstate**, 11Ag<sub>2</sub>O, 21(NH<sub>4</sub>)<sub>2</sub>O, 4Al<sub>2</sub>O<sub>3</sub>, 36WO<sub>3</sub>

The dry salt is insol in pure H<sub>2</sub>O, but

readily sol in H<sub>2</sub>O containing NH<sub>3</sub> or HNO<sub>3</sub> (E F Smith, J Am Chem Soc 1903, 25 1231)

**Barium aluminicotungstate**, 8BaO, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+7H<sub>2</sub>O

Not sol in acids when dry Somewhat decomp by boiling with conc HCl, HNO<sub>3</sub> or aqua regia (Daniels, J Am Chem Soc 1908, 30 1848)

**Copper aluminicotungstate**, 2CuO, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+16½H<sub>2</sub>O

Sol in large quantities of H<sub>2</sub>O (Daniels, J Am Chem Soc 1908, 30 1847)

**Mercurous aluminicotungstate**, 5Hg<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>

Sl sol in H<sub>2</sub>O Sol in HNO<sub>3</sub> (1 5) (Daniels, J Am Chem Soc 1908, 30 1849)

**Zinc aluminicotungstate**, 1½ZnO, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+8H<sub>2</sub>O

Insol in H<sub>2</sub>O (Daniels, J Am Chem Soc 1908, 30 1850)

ZnO, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+20H<sub>2</sub>O Sol in H<sub>2</sub>O (Daniels)

### Aluminum, Al

Less easily attacked than ordinary metals (iron, copper, lead, zinc, tin) by air, H<sub>2</sub>O, wine, beer, coffee, milk, oil, butter, fats, etc Vinegar dissolves 0 349 g from a sq decimetre in 4 months, and 5 % NaCl+Aq, only 0 045 g in the same time (Ballaud, C R 114 1536)

The action of various substances contained in foods and drinks on compact Al as it occurs in utensils is very slight Hard or soft water, whether cold or hot, showed no action in 8 days, 1 % solutions of tartaric, tannic, and acetic acids had no action in same time, also 5 % boric, carbolic, and salicylic acids 4 % and 10 % acetic acid dissolved only 0 4 mg of Al, while 10 % acetic acid dissolved 2 1 mg from a roughened piece of Al foil in 8 days 1 % soda solution dissolved 15 mg in 8 days (Rupp, Dingl 283 119)

Similar results were obtained by Arche (Dingl 284 255)

Liquids which are ordinarily contained in foods and drinks do not attack sheet Al except in a very small degree The following losses in weight in mg by the action of the given liquids on 100 sq centimetres sheet aluminum for 6 days were obtained

Liquids	Loss in mg
Claret	2 84
Hock	3 27
Brandy	1 08
5 % alcohol	0 61
5 % tartaric acid + Aq	1 69
1 % " " " "	2 58
5 % acetic acid + Aq	3 58
1 % " " " "	4 38

Liquids	Loss in mg
5 % citric acid + Aq	2 15
1 % " " " "	1 90
5 % lactic acid + Aq	4 77
5 % butyric acid + Aq	1 31
Coffee	0 50
Tea	0
Beer	0
4 % boric acid + Aq	1 77
5 % carbolic acid + Aq	0 23
1 % " " " "	0 49
1/2 % salicylic acid + Aq	6 35

(Lunge, C N 65 110)

The apparent solubility of this metal in H<sub>2</sub>O is due to the presence of minute quantities of Na. Absolutely pure Al does not lose any weight to H<sub>2</sub>O and the H<sub>2</sub>O remains perfectly clear. Also dil acids remain perfectly clear (Moissan, C R 1895, **121** 794-98, C C 1896, I 193).

Sl attacked by H<sub>2</sub>O at 80° (W Smith, J Soc Chem Ind 1904, **23** 475).

Easily sol in dil or conc HCl + Aq, whether hot or cold, also in HBr, HI, or HF + Aq. Insol in dil H<sub>2</sub>SO<sub>4</sub> + Aq (de la Rive), sl attacked by cold, easily by hot conc H<sub>2</sub>SO<sub>4</sub>. Not attacked by HNO<sub>3</sub> + Aq even when conc and boiling (Wohler), easily sol in dil H<sub>2</sub>SO<sub>4</sub>, or HNO<sub>3</sub> + Aq in vacuo (Weeren, B **24** 1798), slowly sol in 27 % HNO<sub>3</sub> + Aq, 100 cem HNO<sub>3</sub> + Aq requiring 2 months to dissolve 2 g Al (Montemartini, Gazz ch it **22** 397), very sl sol in most organic acids, but solubility is increased by presence of NaCl.

Not attacked by dil or conc HNO<sub>3</sub> at ord temp, but attacked by hot HNO<sub>3</sub>. Attacked by H<sub>3</sub>PO<sub>4</sub> (Smith, J Soc Chem Ind 1904, **23** 475).

Completely sol at 100° in two hours in HNO<sub>3</sub>, sp gr 1.15-1.16 (Stillman, J Am Chem Soc 1897 **19** 714).

Very easily sol in HNO<sub>3</sub> (contrary to the usual statement in text books) (Woy, C C **190**, II 94).

Slowly attacked by HNO<sub>3</sub> + Aq (20-25 %), at 25-30° (Deventer, Chem Weekbl 1907 **4** 69).

Dil HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub> does not attack Al on account of formation of layer of gas. Action is increased by vacuum. Solutions of metallic chlorides, the metal of which is insol and attaches itself to the Al (Pt, Au, Cu, Hg) increase the solubility, but when metal is soluble in the acid (Fe, Zn, etc.) there is no increase of solubility (Ditte, C P 1890, **110** 573).

Violently attacked by dil or conc H<sub>3</sub>PO<sub>4</sub> + Aq (Winteler).

Not attacked by solution of HCl in liquid HCN (Kahlenberg, J phys Chem 1902, **6** 662).

Very easily sol in conc or dil KOH, or NaOH + Aq. Slowly attacked by NH<sub>4</sub>OH +

Aq (Wohler), sol in BaO<sub>2</sub>H<sub>2</sub> + Aq (Beckmann, J pr (2) **26** 385), slowly sol in CaO H<sub>2</sub> + Aq.

Sol in excess of 10 % KOH + Aq and in NaOH and LiOH + Aq, sol in hot conc Ba(OH)<sub>2</sub>, Sr(OH)<sub>2</sub>, and Ca(OH)<sub>2</sub> + Aq (Allen, Am Ch J 1900, **24** 304-331).

Attacked by hot conc NH<sub>4</sub>OH + Aq (Smith, J Soc Chem Ind 1904, **23** 475).

Sl attacked by sulphates, or nitrates + Aq, but all chlorides, bromides, and iodides, except those of the alkalis and alkaline earths, even AlCl<sub>3</sub> + Aq, dissolve the metal. Insol in alum, or in NaCl + Aq, but sol in alum + NaCl + Aq (Tissier, C R **41** 362), sol in NaCl + Aq (Deville, A ch (3) **43** 14), sol in neutral FeCl<sub>3</sub> + Aq in vacuo (Weeren, B **24** 1798). Violently attacked by CuCl + Aq (Tommasi, Bull Soc (2) **37** 443).

Rapidly sol in K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> + Aq, more slowly sol in (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub> + Aq (Levi, Gazz ch it 1908, **38** (1) 583).

Attacked by (NH<sub>4</sub>)<sub>3</sub>PO<sub>4</sub> + Aq. Sl attacked by NaNO<sub>3</sub> + Aq or KNO<sub>3</sub> + Aq at 100° (Smith, J Soc Chem Ind 1904 **23** 475).

Not affected by NH<sub>4</sub>NO<sub>3</sub> + Aq (Hodgkinson, C N 1904, **90** 142).

Attacked by POCl<sub>3</sub> at 100° (Renzler, B **13** 845).

Insol in liquid NH<sub>3</sub> (Gore, Am Ch J 1898, **20** 826).

Insol in liquid CO (Buchner, J phys Ch 1906, **54** 674).

Attacked by NOCl (Sudborough, Chem Soc 1891, **59** 659).

92 % alcohol attacks Al less than H<sub>2</sub>O. Pure Al is attacked less than commercial (Hugonnet, J Pharm 1895 (6) **1** 537).

Sol in organic acids containing chlorides (Smith, J Soc Chem Ind 1904 **23** 475).

Acetic, tartaric and citric acids attack Al only at first. Metal is covered by layer of hydro de but on addition of haloid salts gradual solution ensues (Ditte, C P 1898, **127** 919).

Not attacked by sugar + Aq (Klein, C R **102** 1170).

### Aluminum arsenide

Decomp by H<sub>2</sub>O with evolution of AsH<sub>3</sub> (Wohler, Pogg **11** 160).

Decomp by H<sub>2</sub>O (Lonzes, Diction C R 1900 **130** 131).

### Aluminum boride, AlB<sub>4</sub>

Very slowly sol in hot conc HCl + Aq and hot NaOH + Aq, but easily in moderately strong warm HNO<sub>3</sub> + Aq (Hamp, A **183** 7).

AlB<sub>4</sub> Not attacked by HCl or KOH + Aq. Scarcely attacked by boiling H<sub>2</sub>SO<sub>4</sub>. Hot conc HNO<sub>3</sub> + Aq dissolves gradually but completely (Hamp, l c).

### Aluminum borocarbide, Al<sub>3</sub>C B<sub>4</sub>s

Insol in H<sub>2</sub>O, HCl + Aq, H<sub>2</sub>SO<sub>4</sub> + Aq, or

KCH + Aq, slowly sol in hot conc  $\text{HNO}_3$  + Aq (Hampe, l c)

### Aluminum bromide, $\text{AlBr}_3$

*Anhydrous* Dissolved by  $\text{H}_2\text{O}$  with great violence and evolution of much heat Very sol in alcohol More sol in  $\text{CS}_2$  than  $\text{AlI}_3$  (Weber, Pogg 103 264)

Sol in  $\text{SOCl}_2$  (Besson, C R 1896, 123 884)

Sol in  $\text{C}_2\text{H}_5\text{Br}$  (Plotnikoff, C C 1902, II 617)

Sol in acetone (Naumann, B 1904, 37 4328), (Fidmann, C C 1899, II 1014)

### Solubility of $\text{AlBr}_3$ in organic liquids

Solvent	t°	Mols per 100	t°	Mols per 100	t°	Mols per 100
Benzo-phenone	48°	0	130°	43 2	50°	66 0
	45	8 5	140	48 4	38	67 2
	42	13 8	142	50	50	70 7
	38	18 3	140	52 1	60	74 2
	50	21	130	54 5	70	78 3
	60	23 4	120	56 7	80	83 3
	70	25 7	110	58 6	85	86 7
	80	28 1	100	60 3	90	90 7
	90	30 6	90	61 7	93	94 8
	100	33 4	80	62 9	96	100
	110	36 3	70	64 1		
	120	39 6	60	65 1		
Ethylene bromide	10°	0	20°	33 9	70°	72 7
	6	8 4	30	40 1	80	82 3
	2	16 0	40	47 2	90	92 2
	—2	22 9	50	55 1	96	100
	10	28 4	60	63 6		
Benzoyl chloride	—0 5	0	5	47	40°	72 6
	—2 5	6 5	90	50 8	60	79 4
	5	13 0	80	52 8	70	83 9
	10	17 4	60	56	80	89 2
	30	24 6	40	59 5	90	95 5
	50	31 8	20	63 1	96	100
	70	40	7	65 5		
	80	44 3	20	67 9		

(Menschutkin, Ann Inst Pol P-1-c-Ga, 13 1)

+6H O Very sol in H O

+15H O (Plotnikoff, J B 1895 785)

### Aluminum antimony bromide, $2\text{AlBr}_3 \cdot \text{SbBr}_3$ + 24H O

Hygroscopic Decomp by  $\text{H}_2\text{O}$  (Wenland, B 1903, 36 258)

### Aluminum potassium bromide, $\text{AlBr}_3 \cdot \text{KBr}$

Sol in H O (Weber, Pogg 103 267)

### Aluminum bromide ammonia, $\text{AlBr}_3 \cdot x\text{NH}_3$

Decomp by H O (Weber, Pogg 103 267)

### Aluminum perbromide carbon bisulphide, $\text{AlBr}_3 \cdot \text{Br}_4 \cdot \text{CS}_2$

Sol in ether, ethyl bromide, ethylene bromide and benzene, decomp by H O (Plotnikoff, J Russ phys Chem Soc 1901, 33 91, C C 1901, I 1193)

$2\text{AlBr}_3 \cdot \text{Br}_4 \cdot \text{CS}_2$  Sol in ether and benzene, insol in petroleum ether (Plotnikoff, l c)

### Aluminum bromochloride, $\text{AlClBr}$

Deliquescent Somewhat less violently dissolved by H O than is  $\text{AlBr}_3$  (v Bartal, Z anorg 1907, 55 154)

+6H O Deliquescent Sol in H O without evolution of heat (v Bartal, Z anorg 1907, 55 155)

### Aluminum carbide, $\text{Al}_4\text{C}_3$

Decomp by fused KOH at 100°, insol in fuming  $\text{HNO}_3$  in the cold, decomp by  $\text{H}_2\text{O}$ , and dil acids (Moissan, Bull Soc 1894, (3) 11 1012, C R 1894, 119 16-20)

Insol in acetone (Naumann, B 1904, 37 4328)

### Aluminum chloride, basic, $\text{AlO}_4\text{H}_{10}$ , HCl

Easily sol in H O (Schlumberger, Bull Soc 1895, (3) 13 56)

### Aluminum chloride, $\text{AlCl}_3$

*Anhydrous* Very deliquescent Sol in  $\text{H}_2\text{O}$  with a hissing noise and evolution of heat Solution of  $\text{AlCl}_3$  in H O loses HCl on evaporation, and  $\text{AlCl}_3$  is finally wholly converted into  $\text{AlO}_3$

Sol in 1 432 pts  $\text{H}_2\text{O}$  at 15° (Gerlach)

$\text{AlCl}_3$  + Aq containing 19 15 %  $\text{AlCl}_3$  boils at 103 4°  $\text{AlCl}_3$  + Aq containing 38 3 %  $\text{AlCl}_3$  boils at 112 8° (Gerlach)

### Sp gr of $\text{AlCl}_3$ + Aq at 15°

% $\text{AlCl}_3$	Sp gr	% $\text{AlCl}_3$	Sp gr
1	1 0072	22	1 1709
2	1 0144	23	1 1795
3	1 0216	24	1 1881
4	1 0289	25	1 1968
5	1 0361	26	1 2058
6	1 0435	27	1 2149
7	1 0510	28	1 2241
8	1 0585	29	1 2331
9	1 0659	30	1 2422
10	1 0734	31	1 2518
11	1 0812	32	1 2615
12	1 0890	33	1 2711
13	1 0968	34	1 2808
14	1 1047	35	1 2905
15	1 1125	36	1 3007
16	1 1207	37	1 3109
17	1 1290	38	1 3211
18	1 1372	39	1 3313
19	1 1455	40	1 3415
20	1 1537	41	1 3522
21	1 1632		

(Gerlach, Z anal 8 281)



Sp gr at 20° of  $\text{AlCl}_3 + \text{Aq}$  containing mg  
mols  $\text{AlCl}_3$  per liter

M	Sp gr
0 01	1 00104
0 025	1 00282
0 05	1 00588
0 075	1 00870
0 10	1 01158
0 25	1 02911
0 55	1 05706
1 0	1 11054
1 5	1 16308
2 0	1 21378

(Jones & Pearce, Am Ch J 1907, 38 726)

Sol in 1 pt strong alcohol at 12.5° (Wenzel), easily sol in ether, sl sol in  $\text{CS}_2$ , insol in ligroine or benzene

Difficultly sol in  $\text{AsBr}_3$  (Walden, Z anorg 1902, 29 374)

Sol in  $\text{AlBr}_3$  (Isbekow, Z anorg 1913, 84 26)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1893, 20 826)

Insol in  $\text{CS}_2$  at ord temp (Arctowski, Z anorg 1894, 6 257)

Sol in benzonitrile (Naumann, B 1914, 47 1369)

Difficultly sol in acetone (Naumann, B 1904, 37 4328)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Insol in methylal (Eidmann, C C 1899, II 1014)

#### Solubility of $\text{AlCl}_3$ in organic liquids

Solvent	t°	Mols per 100	t°	Mols per 100	t	Mols per 100
Benzo-phenone	48°	0	130°	43 2	130°	66 0
	44	8 5	125	48 4	140	67 2
	39 5	13 8	120	50	150	70 7
	50	18 3	110	52 1	160	74 2
	60	21	100	54 5	170	78 3
	70	23 4	90	56 7	180	83 3
	80	25 7	80	58 6	185	86 7
	90	28 1	70	60 3	190	90 7
	100	30 6	60	61 7	192	94 8
	110	33 4	50	62 9	194	100
	120	36 3	100	64 1		
	125	39 6	120	65 1		
Benzoyl chloride	-0 5°	0	60°	33 0	80°	52 9
	-4	7 9	70	37 5	70	55 1
	-7 5	12 7	80	42 2	60	57 2
	0	14 1	90	47 1	40	61 0
	20	18 8	93	48 7		
	40	25 0	90	50 6		

(Menschutkin, Ann Inst Pol P-le-Gr, 13 1)

+6H<sub>2</sub>O Very deliquescent, very sol in H<sub>2</sub>O Sol in 0.25 pt H<sub>2</sub>O (Thomson)  
Sol in 2 pts abs alcohol at ordinary temp, and 1.5 pts at b-pt (Thomson)

Completely insol in a solution of ether in H<sub>2</sub>O sat with HCl (Havens, Am J Sci 1898, (4) 6 46)

**Aluminum ammonium chloride**,  $\text{AlCl}_3, \text{NH}_4\text{Cl}$   
(Baud, A ch 1904, (8) 1 46)

**Aluminum antimony chloride**

See Chlorantimonate, aluminum

**Aluminum barium chloride**,  $2\text{AlCl}_3, \text{BaCl}_2$   
(Baud, C R 1901, 133 869)

**Aluminum calcium chloride, basic**

$3\text{CaO}, \text{CaCl}_2, \text{Al}_2\text{O}_3 + 10\text{H}_2\text{O}$  (Steinmetz, Z phys Ch 1905, 52 466)

$10\text{CaO}, \text{CaCl}_2, 6\text{Al}_2\text{O}_3$  Slowly decomp by boiling H<sub>2</sub>O (Gorgeu, Bull Soc 1887, (2) 48 51)

**Aluminum calcium chloride**,  $4\text{AlCl}_3, 3\text{CaCl}_2$   
(Baud, A ch 1904, (8) 1 51)

**Aluminum nitrosyl chloride**,  $\text{AlCl}_3, \text{NOCl}$

Deliquescent, and decomp by H<sub>2</sub>O (Weber Pogg, 118 471)

**Aluminum palladium chloride**,  $\text{AlCl}_3, \text{PdCl}_2 + 10\text{H}_2\text{O}$

See Chloropalladite, aluminum

**Aluminum phosphorus pentachloride**,  $\text{AlCl}_3, \text{PCl}_5$

Decomp violently by H<sub>2</sub>O (Baudrimont)

**Aluminum phosphoryl chloride**,  $\text{AlCl}_3, \text{POCl}_3$

Deliquescent Sol in H<sub>2</sub>O with decomp Sol in warm  $\text{POCl}_3$ , from which it separates on cooling (Casselmann, A 98 220)

**Aluminum platinum chloride**,  $\text{AlCl}_3, \text{PtCl}_4 + 15\text{H}_2\text{O}$

See Chloroplatinite, aluminum

**Aluminum potassium chloride**,  $\text{AlCl}_3, \text{KCl}$

Slowly deliquescent Sol in H<sub>2</sub>O with evolution of heat and decomp (Degen, A 18 332)

**Aluminum selenium chloride**,  $2\text{AlCl}_3, \text{SeCl}_4$

Sol in H<sub>2</sub>O with evolution of heat and separation of traces of selenium (Weber, Pogg 104 427)

**Aluminum sodium chloride**,  $\text{AlCl}_3, \text{NaCl}$

Much less deliquescent than  $\text{AlCl}_3$  Sol in H<sub>2</sub>O with evolution of heat Upon evaporating, NaCl crystallises out (Wohler)

**Aluminum strontium chloride**,  $4\text{AlCl}_3, 3\text{SrCl}_2$   
(Baud, A ch 1909, (8) 1 52)

**Aluminum sulphur chloride**,  $2\text{AlCl}_3, \text{SCl}_4$

Decomp by H<sub>2</sub>O with evolution of much

Heat and separation of some sulphur (Weber, Pogg, 104 421)

$\text{AlCl}_3, \text{SCL}_4$  Decomp by  $\text{H}_2\text{O}$  (Ruff, B 901, 34 1757)

**Aluminum tellurium chloride**,  $2\text{AlCl}_3, \text{TeCl}_4$   
Very sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Weber, J pr 16 313)

**Aluminum chloride ammonia**,  $\text{AlCl}_3, \text{NH}_3$

Sol in  $\text{H}_2\text{O}$  (Rose, Pogg, 24 248)

Completely sol in  $\text{H}_2\text{O}$  (Baud, C R 1901, 132 135)

$\text{AlCl}_3, 2\text{NH}_3$  Very hygroscopic (Stillman, Am Ch J 1895, 17 750)

$\text{AlCl}_3, 3\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$

$\text{AlCl}_3, 5\text{NH}_3$  M pt  $380^\circ$  (Baud, C R 1901, 132 135)

$\text{AlCl}_3, 6\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$  (Stillman, Am Ch J 1895, 17 752) Somewhat hygroscopic (Baud, C R 1901, 132 135)

**Aluminum chloride nitric oxide**,  $2\text{AlCl}_3, \text{NO}$

Very hygroscopic Decomp rapidly in the air Sol in  $\text{KOH} + \text{Aq}$  (Thomas, C R 1895, 121 130)

**Aluminum chloride phosphine**,  $3\text{AlCl}_3, \text{PH}_3$

Decomp by  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  (Rose Pogg, 24 295)

**Aluminum chloride hydrogen sulphide**

Deliquescent Decomp by  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  (Wohler)

**Aluminum chloride sulphur dioxide**,  $\text{AlCl}_3, \text{SO}_2$

Decomp by  $\text{H}_2\text{O}$ , alcohol, or benzene (Adrianowski, B 12 688)

$2\text{AlCl}_3, \text{SO}$  (Baud, A ch 1904, (8) 1 32)

**Aluminum cobalt**,  $\text{Co}_3\text{Al}_4$

Sol in strong acids (Brunck, B 1901, 34 2734)

**Aluminum copper**,  $\text{Cu}_4\text{Al}_9$

Sol in aqua regia, decomp by  $\text{HCl}$  (Brunck, B 1901, 34 2733)

**Aluminum fluoride**,  $\text{AlF}_3$

*Anhydrous* Not attacked by  $\text{H}_2\text{O}$  or acids, and only very slightly by boiling conc  $\text{H}_2\text{SO}_4$  Insol in boiling  $\text{KOH} + \text{Aq}$  (Deville, C R 42 49)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Insol in acetone (Naumann, B 1904, 37 4328)

$+ \frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sl sol in  $\text{HF}$  (Baud, C R 1902, 135 1104)

$+ \text{H}_2\text{O}$  Completely but only sparingly sol in  $\text{H}_2\text{O}$  (Mazzuchelli, Real Ac Linc 1907, (5) 16, I 775, Chem Soc 1907, 92, (2) 549)

$+ 3\frac{1}{2}\text{H}_2\text{O}$  Two modifications (1) Easily sol in  $\text{H}_2\text{O}$  Sol in  $\text{HF}$  (2) Insol in  $\text{H}_2\text{O}$  Sl sol in  $\text{HF}$  (Baud, C R 1902, 135 1104)

$+ 7\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Deville, A ch (3) 61 329)

Min *Fluellite*

$+ 8\frac{1}{2}\text{H}_2\text{O}$  Very efflorescent Sat solution contains 3.85 g  $\text{AlF}_3$  per 100 g at  $11^\circ$  and 1.2 g at  $-0.2^\circ$  (Mazzuchelli, Real Ac Linc 1907, (5) 16, I 775, Chem Soc 1907, (2), 92 549)

**Aluminum hydrogen fluoride**,  $3\text{AlF}_3, 2\text{HF} + 5\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , precipitated by alcohol (Deville)

$2\text{AlF}_3, \text{HF} + 5\text{H}_2\text{O}$  (Deville, A ch (6) 61 329)

**Aluminum ammonium fluoride**,  $\text{AlF}_3, \text{NH}_4\text{F}$

Somewhat sol in  $\text{H}_2\text{O}$ , insol in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$  or  $\text{NH}_4\text{F}$  (Berzelius, Pogg 1 45)

$\text{AlF}_3, 2\text{NH}_4\text{F} + 15\text{H}_2\text{O}$  Sol in 100 pts  $\text{H}_2\text{O}$  at  $16^\circ$  (Baud, C R 1902, 135 1338)

$\text{AlF}_3, 3\text{NH}_4\text{F}$  Nearly insol in  $\text{H}_2\text{O}$ , easily sol in dil acids (Petersen, J pr (2) 40 35)

Quite easily sol in  $\text{H}_2\text{O}$ , but insol in  $\text{NH}_4\text{F} + \text{Aq}$  (Helmholtz, Z anorg 3 129)

**Aluminum barium fluoride**

Apparently not obtained in pure state (Roder)

**Aluminum calcium fluoride**,  $\text{AlF}_3, \text{CaF} + \text{H}_2\text{O}$

Min *Engtokite*

**Aluminum calcium sodium fluoride**,  $\text{AlF}_3, \text{CaF}_2, \text{NaF} + \text{H}_2\text{O}$

Min *Pachnolite*

**Aluminum cobaltous fluoride**,  $\text{AlF}_3, \text{CoF} + 7\text{H}_2\text{O}$

Sol in dil  $\text{HF} + \text{Aq}$  (Weinland, Z anorg 1899, 22 272)

**Aluminum cupric fluoride**,  $2\text{AlF}_3, \text{CuF}$

Very slowly but completely sol in  $\text{H}_2\text{O}$  (Berzelius)

$\text{AlF}_3, 2\text{CuF} + 11\text{H}_2\text{O}$  Sol in dil  $\text{HF} + \text{Aq}$  (Weinland, Z anorg 1899, 22 272-76)

$2\text{AlF}_3, 3\text{CuF} + 18\text{H}_2\text{O}$  Sol in dil  $\text{HF} + \text{Aq}$  (Weinland)

**Aluminum cupric hydrogen fluoride**,  $\text{AlF}_3, \text{CuF}, \text{HF} + 8\text{H}_2\text{O}$

Efflorescent in the air Sol in dil  $\text{HF} + \text{Aq}$  (Weinland, Z anorg 1899, 22 272)

**Aluminum iron (ferrous) fluoride**,  $\text{AlF}_3, \text{FeF}_2 + 7\text{H}_2\text{O}$

Sl sol in dil  $\text{HF} + \text{Aq}$  (Weinland, Z anorg 1899, 22 270)

**Aluminum lithium fluoride**

Insol in  $\text{H}_2\text{O}$  (Berzelius)

**Aluminum magnesium fluoride**

$2\text{AlF}_3, \text{MgF}$  (?) (Roder)

**Aluminum nickel fluoride,  $\text{AlF}_3, \text{NiF}_2 + 7\text{H}_2\text{O}$** 

Sl sol in dil HF + Aq (Weinland, Z anorg 1899, **22** 271)

**Aluminum potassium fluoride,  $\text{AlF}_3, 3\text{KF}$** 

Very sl sol in acid solutions, and still less in  $\text{H}_2\text{O}$  (Gay-Lussac and Thénard)

$\text{AlF}_3, 2\text{KF}$  As above

**Aluminum silicon fluoride**

See Fluosilicate, aluminum

**Aluminum sodium fluoride**

$2\text{AlF}_3, 3\text{NaF}$  Min *Chiolite*  
 $\text{AlF}_3, 2\text{NaF}$  Min *Chodnevite*  
 $\text{AlF}_3, 3\text{NaF}$  Min *Cryolite* Sl sol in  $\text{H}_2\text{O}$  Insol in  $\text{HCl}$  + Aq Decomp by  $\text{H}_2\text{SO}_4$ , or by boiling with  $\text{NaOH}$  + Aq

**Aluminum strontium fluoride**

As the Ba salt (Roder)

**Aluminum thalious fluoride,  $2\text{AlF}_3, 3\text{TlF}$** 

Ppt Sl sol in  $\text{H}_2\text{O}$  (Ephraim, Z anorg 1909, **61** 243)

**Aluminum zinc fluoride,  $\text{AlF}_3, \text{ZnF}_2 + 7\text{H}_2\text{O}$** 

Sol in dil HF + Aq (Weinland, Z anorg 1899, **22** 272)

$2\text{AlF}_3, \text{ZnF}_2$  Slowly but completely sol in  $\text{H}_2\text{O}$  (Berzelius)

**Aluminum hydroxide,  $\text{Al}_2\text{O}_3, \text{H}_2\text{O}$** 

$= \text{Al}_2\text{O}_3(\text{OH})_3$

Dehydrated by conc acids, without dissolving (Bequerel, C R, **67** 108)

Min *Diaspore* Insol in  $\text{HCl}$  + Aq, and not attacked by boiling conc  $\text{H}_2\text{SO}_4$ , unless it has been ignited

$\text{Al}_2\text{O}_3, 2\text{H}_2\text{O} = \text{Al}_2\text{O}_3(\text{OH})_3$  Pptd Al hydroxide, when boiled twenty hours with  $\text{H}_2\text{O}$  is insol in acids and alkalis and has the above composition (St Gilles, A ch **3**) **46** 57)

Min *Bauxite*

**Soluble modifications**—(1) *Meta aluminum hydroxide from basic Al acetate* Sol in  $\text{H}_2\text{O}$  and more readily in  $\text{HC}_2\text{H}_3\text{O}_2$ . The aqueous solution is coagulated by traces of alkalis, many acids, and salts, while other acids and salts have no effect. Thus, 1 pt  $\text{H}_2\text{SO}_4$  in 1000 pts  $\text{H}_2\text{O}$  added to 7000 pts of above solution containing 20 pts  $\text{Al}_2\text{O}_3$ , converts the liquid into a nearly solid mass. Citric, tartaric, oxalic, chromic, molybdic, racemic, suberic, salicylic, benzoic, gallic, lactic, cinnamic, butyric, valeric, camphoric, picric, uric, meconic, comenic, and hemipinic acids act in the same way.  $\text{HCl}$  and  $\text{HNO}_3$  have far less action, 600 mols being necessary to produce the same effect as 1 mol  $\text{H}_2\text{SO}_4$ , while acetic, formic, boric, arsenious, pyro-

meconic, and opianic acids do not coagulate the solution, except when moderately conc. 1 pt  $\text{KOH}$  in 1000 pts  $\text{H}_2\text{O}$  coagulates 9000 pts of the solution.  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ , and  $\text{Ca}(\text{OH})_2$  have the same effect.

The solution is not coagulated by acetates, unless added in large quantity, and even then the ppt is redissolved when treated with  $\text{H}_2\text{O}$ . Nitrates and chlorides coagulate with difficulty,  $\text{Na}_2\text{SO}_4$ ,  $\text{MgSO}_4$ , and  $\text{CaSO}_4$  + Aq, however, have as strong an action as a liquid containing the same amount of  $\text{H}_2\text{SO}_4$ . A teaspoonful of the solution introduced into the mouth solidifies at once from the action of the saliva. The ppt formed by acids is not sol in an excess of the acid, but by the long continued action of conc  $\text{H}_2\text{SO}_4$  especially if hot, the ppt is dissolved, boiling conc  $\text{HCl}$  + Aq also dissolves it, but less readily than  $\text{H}_2\text{SO}_4$ . The ppt is sol in boiling conc  $\text{KOH}$  + Aq. The residue, when the solution is evaporated at  $100^\circ$ , has composition  $\text{Al}_2\text{O}_3, 2\text{H}_2\text{O}$ , and is insol in acids (Cium, Chem Soc **6** 225)

(b) *By Dialysis* Sol in  $\text{H}_2\text{O}$  from which it is separated by extremely small amounts of various substances, as acids, ammonia, salts (especially  $\text{K}_2\text{SO}_4$ ), caramel, etc. An excess of acid dissolves the coagulum. If the solution contains 0.5%  $\text{Al}_2\text{O}_3$  or less, it may be boiled without change, but the hydroxide separates out suddenly when it is reduced to  $\frac{1}{2}$  its vol, and even very dil solutions gelatinise spontaneously in a few days. The solution is not coagulated by alcohol or sugar (Graham A **121** 41)

$\text{Al}_2\text{O}_3, 3\text{H}_2\text{O} = \text{Al}(\text{OH})_3$  **Crystallised** Difficultly sol in acids and alkalis (Cossa N Csm **2**) **3** 228) Insol in boiling  $\text{HCl}$  + Aq (Wohler, A **113** 249) Sl sol in  $\text{KOH}$  + Aq nearly insol in cold  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HNO}_3$  + Aq very slowly sol in hot  $\text{HCl}$  + Aq more readily in hot  $\text{H}_2\text{SO}_4$  (v. Bonsdorff, Pogg. **27** 27)

**$\alpha$ -modification** Unstable. Changes into  **$\beta$ -modification**. Sol in  $\text{N-NaOH}$  at ord temp. Sol in  $\text{N-NaOH}$  and in hot  $\text{NaOH}$  of concentration 5N (O 100H O) (Russ Z anorg 1904 **41** 226)

**$\beta$ -modification** Insol in  $\text{N-H}_2\text{SO}_4$  at ord temp. Difficulty sol in warm  $\text{N-NaOH}$  but easily sol in hot  $\text{NaOH}$  of concentration 5N (O 100H O). Its solubility in  $\text{NaOH}$  increases with increase in concentration of the hydroxyl ions (Russ)

**$\delta$ -modification** Easily sol in conc  $\text{H}_2\text{SO}_4$ , only sl sol in  $\text{HCl}$ ,  $\text{HNO}_3$ , or acetic acids, or in alkali + Aq (Commens C C **1905**, II 605)

Min *Gibbsite* Sol in  $\text{HCl}$  + Aq and dil  $\text{H}_2\text{SO}_4$  + Aq. Readily sol in conc  $\text{KOH}$  and  $\text{NaOH}$  + Aq

**Preprecipitated** Completely insol in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{CO}_3$  + Aq. Easily sol in acids when freshly pptd, but solubility diminishes on standing.

Easily sol in  $\text{KOH}$  or  $\text{NaOH}$  + Aq (Sonnenschein)

Herz (Z anorg 25 155) found that aluminum hydroxide which has been dried in a vacuum desiccator requires for solution in  $\text{NaOH} + \text{Aq}$  3 atoms Na to 1 atom Al (Z Elektrochem 1911, 17 261) was unable to obtain this result. Herz says Slade's error is due to insufficient shaking of the solution (Herz, Z Elektrochem 1911, 17 403).

New solubility determinations verify the statement of Herz (Z anorg 25, 155) that the solubility of  $\text{Al}(\text{OH})_3$  in  $\text{NaOH} + \text{Aq}$  is proportional to the concentration of  $\text{NaOH}$ . They do not, however, verify his statement that the ratio Na : Al in the solutions is always 3 : 1, for the author finds that the ratio Na : Al varies from 2 : 1 to 10 : 1 depending on the conditions of precipitation and the method and duration of drying of the  $\text{Al}(\text{OH})_3$  (Slade, Z Elektrochem, 1912, 18 1).

Sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  when freshly pptd, but presence of  $\text{NH}_4$  salts diminish its solubility, and it separates out completely after long standing (Fresenius).

Somewhat sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , the more readily the larger the vol of  $\text{H}_2\text{O}$ . Somewhat sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , but less than in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sl sol in dil  $\text{NH}_4\text{Cl} + \text{Aq}$ , unless that salt be in large excess. It is finally wholly pptd if allowed to stand several days.

18752 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (4 %  $\text{NH}_4\text{OH}$ ) dissolve an amt of  $\text{Al}(\text{OH})_3$  corresponding to one pt  $\text{Al}_2\text{O}_3$ .  $\text{NH}_4\text{Cl}$  prevents this solubility almost completely (Hanamann, Pharm Verh 12 527).

$\text{Al}(\text{OH})_3$ , prepared by ppt of a solution of  $\text{Al}(\text{NO}_3)_3$  with  $\text{NH}_4\text{OH}$ , filtered and washed, is insol in  $\text{NH}_4\text{OH} + \text{Aq}$ .

$\text{Al}(\text{OH})_3$ , prepared by pptn of a solution of potassium aluminate with  $\text{NH}_4\text{Cl}$  is sol in a large excess of  $\text{NH}_4\text{OH}$  if this is added to the ppt at once. This modification which is sol in  $\text{NH}_4\text{OH}$  is unstable and easily goes over into the modification which is insol in  $\text{NH}_4\text{OH}$  (Renz, B 1903, 36 2751).

Conc  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  does not dissolve  $\text{Al}(\text{OH})_3$  and not vice versa dissolved by boiling conc  $\text{NH}_4\text{Cl} + \text{Aq}$  (Weber, Pogg 92 97).

With  $\text{NH}_4\text{I} + \text{Aq}$ , it forms a double salt,  $\text{AlI}_3 \cdot 3\text{NH}_4\text{I}$  which is sol in  $\text{H}_2\text{O}$  but not in  $\text{NH}_4\text{I} + \text{Aq}$  (Helmholtz, Z anorg 3 127).

Insol in  $(\text{NH}_4)_2\text{S} + \text{Aq}$  (Mullguth and Durocher, A ch (3) 17 421). Fuchs found, on the contrary, that it is not wholly insol in  $(\text{NH}_4)_2\text{S} + \text{Aq}$  (Fresenius, Quant).

Insol in  $\text{FeCl}_3 + \text{Aq}$  (Bechamp).

Determinations of the solubility of aluminum hydroxide in  $\text{AlCl}_3 + \text{Aq}$  show that put goes into solution to form a compound while the greater part is in the colloidal form (Fischer, Z anorg 1904, 40 46).

Only sl sol in conc  $\text{Al}(\text{SO}_4)_3 + \text{Aq}$ , but solubility increases with decrease in concentration of  $\text{Al}_2(\text{SO}_4)_3$  until it reaches a maximum at a concentration of 32 %  $\text{Al}(\text{SO}_4)_3$  at 20°, 28 % at 40°, and 38 % at 60°. With further decrease in concentration of  $\text{Al}(\text{SO}_4)_3$

the solubility of  $\text{Al}(\text{OH})_3$  in  $\text{Al}_2(\text{SO}_4)_3$  diminishes (Kremann, C A 1909 2422).

Sol in  $\text{Ba}(\text{OH})_2 + \text{Aq}$  (Rose).

Sol in boiling  $\text{Fe}(\text{NO}_3)_3$ ,  $\text{Cr}(\text{NO}_3)_3$ ,  $\text{Bi}(\text{NO}_3)_3$ ,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{HgNO}_3$ ,  $\text{SnCl}_2$ , and  $\text{SbCl}_3 + \text{Aq}$  (Persoz).

Insol in  $\text{HCN}$  or cold  $\text{KCN} + \text{Aq}$ , but sl sol in hot  $\text{KCN} + \text{Aq}$  (Rose).

Insol in  $\text{KC}_2\text{H}_3\text{O} + \text{Aq}$  (Osann, 1821).

When moist, sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$ , from which it is pptd on boiling (Berthier, A ch (3) 7 76).

Somewhat sol in  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Mercer).

Not pptd by  $\text{NH}_4\text{OH} + \text{Aq}$  in presence of Na citrate (Spiller).

Sol in ethyl amine, amyl amine, sinkaline, ethyl picoline hydroxide, stubethylum hydroxide, triethyltoluanyl ammonium hydroxide +  $\text{Aq}$  (Friedlander).

Sol in alkyl amines (Renz, B 1903, 36 2751).

Insol in acetone (Naumann, B 1904, 37 4328).

Sol to a considerable extent in  $\text{K}_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$ .

Very sl sol in cane sugar +  $\text{Aq}$  (Ramsey).

Solubility in glycerine +  $\text{Aq}$  containing about 60 % by vol of glycerine. 100 cc of the solution contain 0.25 g  $\text{Al}_2\text{O}_3$  (Muller, Z anorg 1905, 43 322).

$\text{Al}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  and alcohol. Sol in  $\text{HCl}$  and  $\text{HNO}_3 + \text{Aq}$  (Zunino, Gazz ch it 1900 30 (1) 194).

$\text{Al}_6\text{O}_{14}\text{H}_{10}$ , Tri-aluminum hydroxide

Not sol in conc acids in the cold, not sol in  $\text{KOH}$  (cold) and only sl sol in hot  $\text{KOH}$ . Characterized by its solubility in exactly one mol dil  $\text{HCl}$ . Dil solutions do not gelatinize even on long standing. Conc solution of  $\text{NH}_4\text{Cl}$  and other salts cause ppt which redissolves on addition of  $\text{H}_2\text{O}$ .

Alkalis and alkali carbonates decompose the salt with  $\text{HCl}$  and ppt tri-aluminum hydroxide.  $\text{H}_2\text{SO}_4$  and sol sulphates give insol compds with the hydrate.  $\text{HNO}_3$  like  $\text{HCl}$  gives soluble compds with the hydrate (Structural formula given) (Schlumberger, Bull Soc 1895 (5) 13 41-65. C C 1895, 1 421).

#### Aluminum iodide, $\text{AlI}_3$

*Anhydrous*. Fumes on air and deliquesces. Sol in  $\text{H}_2\text{O}$  with evolution of much heat. Sol in  $\text{CS}_2$  and crystallizes from the hot sat solution on cooling (Weber). Sol in alcohol (Weber), ether and tetrachloroethane (Gustafson).

Sol in  $\text{AlBr}_3$  (Isbckow, Z anorg 1913 84 26).

+6 $\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$

#### Aluminum mercuric iodide, $\text{AlI}_3 \cdot \text{HgI}_2 + 8\text{H}_2\text{O}$

Very deliquescent, sol in  $\text{H}_2\text{O}$  without decomposition (Duboin, C R 1908, 146 1028).

**Aluminum potassium iodide,  $AlI_3$ , KI**

Sol in  $H_2O$  with evolution of much heat (Weber, Pogg **101** 469)

**Aluminum iodide ammonia,  $AlI_3$ ,  $3NH_3$** 

Decomp by  $H_2O$  (Weber, Pogg **103** 263)

**Aluminum iodide mercuric oxyiodide,  $2AlI_3$ ,  $HgO$ ,  $3HgI_2 + 15H_2O$** 

(Duboin, C R **1907**, **145** 714)

**Aluminum iron,  $FeAl_3$** 

Readily sol in strong  $HNO_3$  (Brunck, B **1901**, **34** 2734)

**Aluminum manganese,  $Mn_2Al_7$** 

Sol in strong  $HCl$  (Brunck, B **1901**, **34** 2735)

**Aluminum molybdenum,  $Al_4Mo$** 

Easily sol in hot  $HNO_3$  or  $HCl$  (Wohler, A **1860**, **115** 103)

$Al_2Mo$  (Guillet, C R **1901**, **133** 293)

$AlMo$  (Guillet)

$AlMo_4$  Not attacked by dil  $HCl + Aq$  (Guillet)

$AlMo_{20}$  Not attacked by  $HCl + Aq$  (Guillet)

**Aluminum nickel,  $Al_3Ni$** 

Sol in strong acids (Brunck, B **1901**, **34** 2734)

**Aluminum nitride,  $Al_2N$** 

Slowly attacked by hot or cold  $H_2O$ . Decomp by acids and aqueous solutions of the alkalis, especially when they are concentrated (Mallet, A **186** 155)

Easily decomp  $H_2O$  when finely powdered (Rossi, C R **1895**, **121** 942)

Decomp by moist air and by boiling  $H_2O$  and by alkalis +  $Aq$  (Frank, Ch Z **1897**, **21** 263)

**Aluminum oxide,  $Al_2O_3$** 

*Crystalline* Min *Corundum*, *sapphire*, *ruby*, *emery* Insol in acids

*Amorphous* Ignited  $Al_2O_3$  is insol in acids except that it dissolves slowly when heated with a mixture of 1 pt  $H_2SO_4$  and 1 pt  $H_2O$  (Berzelius). Slowly sol in boiling  $HCl + Aq$  (Rose, Pogg **52** 595)

Sol in 22 pts of a mixture of 8 pts  $H_2SO_4$  and 1 pt  $H_2O$  (Mitscherlich). The lower the temperature at which  $Al_2O_3$  has been heated, the more sol is it in acids and alkalis

Solubility in (calcium succate + sugar) +  $Aq$

1 l solution containing 418.6 g sugar and 34.3 g  $CaO$  dissolves 1.35 g  $Al_2O_3$ , 1 l solution containing 296.5 g sugar and 24.2 g  $CaO$  dissolves 0.32 g  $Al_2O_3$ , 1 l solution containing 174.4 g sugar and 14.1 g  $CaO$  dis-

solves 0.19 g  $Al_2O_3$  (Bodenbender, J B **1865** 600)

Insol in acetone (Naumann, B **1904**, **37** 4328)

See also **Aluminum hydroxide**

**Aluminum peroxide,  $Al_2O_3$ ,  $Al_2O_4 + 10H_2O$** 

Ppt, sol in acids with decomp (Term, C A **1912** 3068)

**Aluminum oxybromide**

Basic aluminum bromides containing three equivalents or less of  $Al_2O_3$  to one of  $AlBr_3$  are sol in  $H_2O$ . Those containing more than three equivalents are insol (Ordway, Am J Sci (2) **26** 203)

**Aluminum oxychloride**

Sol in dil acids or alkalis. Decomp by  $H_2O$  (Hautefeuille and Perrey, C R **100** 1220)

Basic aluminum chlorides containing two equivalents or less of  $Al_2O_3$  to one of  $AlCl_3$  are sol in  $H_2O$ . Those containing more than two equivalents are insol (Ordway)

$Al_2O_3$ ,  $3AlCl_3 + 3H_2O$  (Tommasi, Bull Soc (2) **37** 443)

$Al_2O_3$ ,  $8AlCl_3 + 3H_2O$  (Tommasi)

$3Al_2O_3$ ,  $AlCl_3 + 15H_2O$  (Tommasi)

**Aluminum phosphide,  $Al_3P$** 

Unstable (Frank, Ch Z **1898**, **22** 240)  
 $Al_2P_2$  Decomp by  $H_2O$  (Fonze-Diacon, C R **1900**, **130** 1315)

Unstable (Frank, Ch Z **1898**, **22** 240)  
 $Al_3P_7$  Decomp by  $H_2O$  and acids (Frank)

$Al_3P_7$  Decomp by  $H_2O$  and acids (Frank, Ch Z **1898**, **22** 255)

$Al_5P_3$  Unstable (Frank, Ch Z **1898**, **22** 240)

**Aluminum platinum,  $Pt_3Al_{10}$** 

The  $Al$  is dissolved out by  $HCl$  (Brunck, B **1901**, **34** 2735)

**Aluminum selenide,  $Al_2Se_3$** 

Decomp by  $H_2O$  (Fonze-Diacon, C R **1900**, **130** 1315)

**Aluminum silicide,  $AlSi_4$** 

More easily sol in acids than  $Al$  (Winkler, J pr **91** 193)

**Aluminum chromium silicide,  $AlCr_4Si_6$** 

Insol in hot conc  $HCl$ ,  $HNO_3$ ,  $H_2SO_4$  and aqua regia. Sol in cold  $HF$  or in  $HF + HNO_3$ . Sol in molten alkali. Insol in  $NaOH + Aq$ ,  $KOCl + Aq$  or fused  $KClO_3$  or  $KHSO_4$  (Manchot and Kieser, A **1904**, **337**, **356**)

$Al_2Cr_4Si_6$  Insol in hot conc  $HCl$ ,  $HNO_3$ ,  $H_2SO_4$  and aqua regia. Sol in  $HF$  and in molten alkali (Manchot and Kieser, A **1904**, **337**, **358**)

**Aluminum tungsten silicide**

Insol in most acids and aqua regia. Easily sol in HF, HNO<sub>3</sub> and in molten alkali. Not attacked by dil NaOH + Aq (Manchot and Kieser, A 1904, **337** 360)

**Aluminum vanadium silicide, Al<sub>2</sub>V<sub>3</sub>Si<sub>13</sub>**

Sol in HF. Not attacked by hot conc HCl, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub> or aqua regia. Decomps by fusing with NaOH. Stable toward fused KClO<sub>3</sub> (Manchot, A 1907, **357** 134)

**Aluminum sulphide, Al<sub>2</sub>S<sub>3</sub>**

Decomp by H<sub>2</sub>O. Sol in acids and alkalis (Regelsberger, Z Elektrochem, 1898, **4** 548). Al<sub>2</sub>S<sub>3</sub>. Decomp in moist air and by H<sub>2</sub>O (Wohler). Insol in acetone (Naumann, B 1904, **37** 4328)

**Aluminum chromium sulphide, Al<sub>2</sub>S<sub>3</sub>.CrS**

Sl attacked by HCl + Aq. Gradually decomp by HNO<sub>3</sub> (Houdard, C R 1907, **144** 1115)

**Aluminum magnesium sulphide, Al<sub>2</sub>S<sub>3</sub>.MgS**

Decomp by H<sub>2</sub>O, alcohol and acids (Houdard, C R 1907, **144** 1116)

**Aluminum potassium sulphide**

Violently decomposed by H<sub>2</sub>O (St Clare Deville, J pr **71** 293)

Does not exist (Gratama, R t c **3** 4)

**Aluminum silver sulphide, 5Al<sub>2</sub>S<sub>3</sub>.4Ag<sub>2</sub>S**

(Cambì, Real Ac Linc (5) **21**, II 838)

**Aluminum telluride**

Decomp by H<sub>2</sub>O (Wohler, Pogg **11** 160)

**Aluminum titanide, Al<sub>4</sub>Ti**

Not attacked by H<sub>2</sub>O or by cold HNO<sub>3</sub>. Sl sol in warm HNO<sub>3</sub>. Sol in cold conc H<sub>2</sub>SO<sub>4</sub> or HCl. Sol in warm KOH + Aq (Levy, A ch 1902, (6) **25** 449)

Sol in HCl and in aqua regia (Guillet). Al<sub>3</sub>Ti. Sol in hot dil H<sub>2</sub>SO<sub>4</sub> and in hot KOH + aq. Sol in hot conc acids (Manchot, A 1907, **357** 142)

Al<sub>3</sub>Ti<sub>2</sub>. Aluminothermic product is sol in HCl and aqua regia (Guillet)

**Aluminosulphuric acid, Al<sub>2</sub>(SO<sub>4</sub>H)<sub>6</sub> + 7 H<sub>2</sub>O**

Sol in H<sub>2</sub>O with decomp into Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub> (Silberberger, M 1904, **25** 222)

**Diamide, N<sub>2</sub>H<sub>4</sub>**

See Hydrazine

**Amidochromic acid****Amidochromates**

Do not exist. Those described by Darm-

städter and Lowenthal are impure bichromates (Wyrouboff, Bull Soc 1894, (3) **11** 845-53, C C 1894, II 610)

**Ammonium amidochromate, (NH<sub>4</sub>)NH<sub>2</sub>CrO<sub>3</sub>**

Very sol in H<sub>2</sub>O (Lowenthal, Z anorg 1894, **6** 363)

Is ammonium dichromate (Wyrouboff, Bull Soc (3) **11** 845)

**Lithium amidochromate, LiNH<sub>2</sub>CrO<sub>3</sub>**

Very sol in H<sub>2</sub>O and acids (Lowenthal, Z anorg 1894, **6** 364)

**Potassium amidochromate, KCrO<sub>3</sub>NH<sub>2</sub>**

Sol only in H<sub>2</sub>O. Sat solution in H<sub>2</sub>O contains 13 % of the salt (Heintze, J pr (2) **4** 214)

**Amidophosphoric acid, HPO<sub>3</sub>(NH<sub>2</sub>) = PO(NH<sub>2</sub>)(OH)<sub>2</sub>**

Sol in H<sub>2</sub>O, but decomp on standing or by heat (Stokes, Am Ch J **15** 198)

**Aluminum amidophosphate**

Ppt. Sol in NH<sub>4</sub>OH + Aq (Stokes)

**Ammonium amidophosphate,**

Very sol in H<sub>2</sub>O (Stokes)

**Barium amidophosphate, BaPO<sub>3</sub>(NH) + H<sub>2</sub>O**

Very sl sol in H<sub>2</sub>O (Stokes). BaH<sub>2</sub>(PO<sub>3</sub>NH<sub>2</sub>)<sub>2</sub> + 2½ H<sub>2</sub>O. Quite difficultly sol in H<sub>2</sub>O (Stokes)

**Calcium amidophosphate, CaPO<sub>3</sub>(NH<sub>2</sub>)**

Much less sol in H<sub>2</sub>O than Ba salt (Stokes)

CaH<sub>2</sub>(PO<sub>3</sub>NH<sub>2</sub>)<sub>2</sub>. Much less sol in H<sub>2</sub>O than the Ba salt (Stokes)

**Chromic amidophosphate**

Ppt. Sol in warm NH<sub>4</sub>OH + Aq (Stokes)

**Cobalt amidophosphate**

Neutral Ppt

Acid Sl sol in H<sub>2</sub>O, sol in NH<sub>4</sub>OH + Aq

**Cupric amidophosphate**

Neutral Sl sol in H<sub>2</sub>O

Acid Nearly insol in H<sub>2</sub>O

**Ferrous amidophosphate**

Neutral Sol in much H<sub>2</sub>O, and in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, or NH<sub>4</sub>OH + Aq

Acid Nearly insol in H<sub>2</sub>O or NH<sub>4</sub>Cl + Aq. Sol in NH<sub>4</sub>OH + Aq

**Ferric amidophosphate**

Neutral Ppt. Sol in excess of alkali

amidophosphate and in  $\text{NH}_4\text{OH} + \text{Aq}$  Insol  
in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$

*Acid* As the neutral salt

**Hydroxylamine amidophosphate,**  
 $(\text{NH}_3\text{O})\text{HPO}_3(\text{NH}_2)$

Sl sol in  $\text{H}_2\text{O}$  (Stokes)

**Lithium amidophosphate,  $\text{LiHPO}_3(\text{NH})$**

Sl sol in  $\text{H}_2\text{O}$  (Stokes)

**Magnesium amidophosphate,  $\text{MgPO}_3(\text{NH}_2) + 7\text{H}_2\text{O}$**

Very sl sol in  $\text{H}_2\text{O}$ , quite easily sol in dil  
 $\text{NH}_4\text{Cl} + \text{Aq}$  Sol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Stokes)

$\text{MgH}_2(\text{PO}_3\text{NH}_2)_2 + 3\frac{1}{4}\text{H}_2\text{O}$  Insol in  
 $\text{NH}_4\text{Cl} + \text{Aq}$  (Stokes)

**Manganese amidophosphate**

*Neutral* Ppt

*Acid* Sl sol in  $\text{H}_2\text{O}$

**Nickel amidophosphate**

*Neutral* Ppt Sol in  $\text{HC}_2\text{H}_3\text{O}_2$  or  
 $\text{NH}_4\text{OH} + \text{Aq}$

*Acid* Sl sol in  $\text{H}_2\text{O}$

**Potassium amidophosphate,  $\text{K PO}_3(\text{NH}_2)$**

Very sol in  $\text{H}_2\text{O}$  and not decomp by boiling (Stokes)

$\text{KHPO}_3(\text{NH}_2)$  Easily sol in cold  $\text{H}_2\text{O}$ ,  
insol in alcohol (Stokes)

**Silver amidophosphate,  $\text{Ag}_2\text{PO}_3(\text{NH})$**

Almost insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  or  
 $\text{NH}_4\text{OH} + \text{Aq}$

$\text{AgHPO}_3(\text{NH}_2)$  Sl sol in  $\text{H}_2\text{O}$ , easily sol  
in dil  $\text{HNO}_3$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , also in  
 $\text{NH}_4\text{OH} + \text{Aq}$

**Sodium amidophosphate,  $\text{Na}_2\text{PO}_3(\text{NH})$**

Not deliquescent, very sol in  $\text{H}_2\text{O}$  pptd  
from aqueous solution by alcohol (Stokes)

$\text{NaHPO}_3(\text{NH}) + \frac{1}{4}(\text{?})\text{H}_2\text{O}$  Newly insol  
in cold, and decomp by hot  $\text{H}_2\text{O}$  Insol in  
alcohol

**Zinc amidophosphate**

*Neutral* Perceptibly sol in  $\text{H}_2\text{O}$

*Acid* Sl sol in  $\text{H}_2\text{O}$ , sol in  $\text{NH}_4\text{OH}$  or  
 $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$

**Diamidophosphoric acid,  $\text{PO}(\text{NH}_2)_2\text{OH}$**

Sol in cold  $\text{H}_2\text{O}$ , almost insol in alcohol,  
stable in the air but decomp when heated and  
by boiling in aq solution (Stokes, Am Ch  
J 1894, 16 130)

**Barium diamidophosphate,  $[\text{PO}(\text{NH}_2)_2\text{O}]_2\text{Ba}$**

Very sol in  $\text{H}_2\text{O}$ , insol in alcohol, aq  
solution decomp slowly (Stokes, Am Ch  
J 1894, 16 134)

**Magnesium diamidophosphate,  $[\text{PO}(\text{NH}_2)_2\text{O}]_2\text{Mg}$**

Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Stokes)

**Potassium diamidophosphate,  $\text{PO}(\text{NH}_2)_2\text{OK}$**

Sol in  $\text{H}_2\text{O}$ , not deliquescent, insol in  
alcohol (Stokes)

**Silver diamidophosphate,  $\text{PO}(\text{NH}_2)_2\text{OAg}$**

Very stable, insol in  $\text{H}_2\text{O}$  Very sol in  
 $\text{NH}_4\text{OH} + \text{Aq}$  (Stokes)

**Sodium diamidophosphate,  $\text{PO}(\text{NH}_2)_2\text{ONa}$**

Sol in  $\text{H}_2\text{O}$ , not deliquescent, insol in  
alcohol (Stokes)

**Diamidotrihydroxylphosphoric acid**

**Silver diamidotrihydroxylphosphate,**

$(\text{AgO})_3\text{P}(\text{NHAg})_2$

(Stokes, Am Ch J 1894, 16 147)

$(\text{AgO})_3\text{P}(\text{NH}_2)(\text{NHAg})$  Insol in cold  
 $\text{H}_2\text{O}$  (Stokes)

$(\text{AgO})_3\text{P}(\text{NH}_2)_2$  Decomp by cold  $\text{H}_2\text{O}$   
(Stokes)

$+ 2\text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}$   
(Stokes)

**Amidoimidophosphoric acid**

**Amidohexiimidoheptaphosphoric acid,  $\text{OH}$   
 $\text{PO}(\text{NH}_2)[\text{NH PO}(\text{OH})]_5\text{NH PO}(\text{OH})_2$   
 $= \text{P}_7\text{N}_7\text{O}_{15}\text{H}_{16}$**

Known only in solution in  $\text{H}_2\text{O}$  (Stokes  
Am Ch J 1898 20 758)

**Silver diamidopyrimidophosphate,**

$\text{NH}(\text{PO NH OAg})$

Almost insol in  $\text{H}_2\text{O}$ , sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
(Stokes, Am Ch J 1894 16 136)

**Silver amidoheptamido pentaphosphate,**

$\text{P}_5\text{N}_5\text{O}_{11}\text{H}_5\text{Ag}_5$

Ppt (Stokes Am Ch J 1898 20 752)

**Silver amidohexiimidoheptaphosphate,**

$\text{P}_7\text{N}_7\text{O}_{15}\text{H}_5\text{Ag}_7$

Ppt, decomp by acetic acid (Stokes  
Am Ch J 1898, 20 759)

**Sodium amidoimidodiphosphate,**

$\text{NH PO}(\text{ONa})$

$\text{PO ONa} < \text{NHPO}(\text{ONa})\text{NH}$

$= \text{P}_3\text{N}_3\text{O}_7\text{H}_4\text{N}_4 + \text{H}_2\text{O}$

Unstable sol in  $\text{H}_2\text{O}$ , insol in alcohol  
(Stokes, Am Ch J 1896, 18 643)

**Sodium amidohexiimidoheptaphosphate,**

$\text{P}_7\text{N}_7\text{O}_{15}\text{H}_5\text{Na}_7$

Sol in  $\text{H}_2\text{O}$ , pptd by alcohol (Stokes,  
Am Ch J 1898, 20 758)

**Amidophosphoric acid****Silver amidophosphimate**,  $P(NH)NH_2(OAg)_2$ Decomp by heat, decomp in contact with  $H_2O$  (Stokes, Am Ch J 1894, 16 139)  
 $(AgO)_2P(NAg)(NHAg)$  (?) Sl sol in  $NH_4OH + Aq$  (Stokes, Am Ch J 1894, 16 149)**Amidosulphonic acid**,  $HOSO_2NH_2$ Easily sol in  $H_2O$ , less easily in alcohol (Berglund, B 9 252 and 1896)Very stable, less easily sol in  $H_2O$  than its K salt (Raschig, A 241 177)Stable in air Non-deliquescent when cold Sol in 5 pts  $H_2O$  at  $0^\circ$  and in  $2\frac{1}{2}$  pts  $H_2O$  at  $70^\circ$  Solution in  $H_2O$  can be boiled several minutes without decomp Solubility is decreased by addition of  $H_2SO_4$ , so that if  $1\frac{1}{5}$ – $1\frac{1}{4}$  pt  $H_2SO_4$  is added to  $H_2O$ , 100 pts of the liquid dissolve only 3 pts  $HOSO_2NH_2$  in the cold Pptd from solution by  $HNO_3$  or glacial acetic acid, but not by  $HCl$  Solubility is decreased by presence of  $NaHSO_4$  (Divers and Haga, Chem Soc 1896, 69 1641)**Amidosulphonates**Easily sol in  $H_2O$ , sl sol in alcohol**Aluminum amidosulphonate**Very sol in  $H_2O$  (Berglund, Bull Soc (2) 29 422)**Ammonium amidosulphonate**,  $(NH_4)NH_2SO_3$ Deliquescent Sol in  $H_2O$ , insol in alcohol**Ammonium silver amidosulphonate**, $NH_4SO_3(NH_5)$ ,  $AgSO_3(NH)$ 

(Ephraïm &amp; Grunewitsch, B 1910, 43 148)

**Barium amidosulphonate**,  $Ba(NH SO_3)_2$ Sol in 3 pts  $H_2O$  (Berglund, l c)**Cadmium amidosulphonate**,  $Cd(NH SO_3)_2 + 5H_2O$ Very sol in  $H_2O$  (B)**Calcium amidosulphonate**,  $Ca(NH SO_3)_2 + 4H_2O$ Very sol in  $H_2O$  (B)**Cobalt amidosulphonate**,  $Co(NH SO_3)_2 + 3H_2O$ Sol in  $H_2O$  (B)**Copper amidosulphonate**,  $Cu(NH SO_3)_2 + 2H_2O$ Sol in  $H_2O$  (B)**Gold (auric) potassium amidosulphonate**,  $K_3Au_2(NSO_3)_3$ 

Very sl sol in cold, more easily sol in hot

 $H_2O$  Sol in dil  $HCl + Aq$  (Hofmann, B 1912, 45 1735)**Lead amidosulphonate**,  $Pb(NH_2SO_3)_2 + H_2O$   
The most sol of all amidosulphonates (B)**Lithium amidosulphonate**  $LiNH SO_3$   
Deliquescent (B)**Magnesium amidosulphonate**  
Very sol in  $H_2O$ **Manganese amidosulphonate**,  $Mn(NH_2SO_3)_2 + 3H_2O$   
Very sol in  $H_2O$  (B)**Mercuric amidosulphonate, basic**,  
 $Hg(HgOSO_3NH_2)_2$ Insol in 35 %  $HNO_3 + Aq$  Very sol in 3 %  $HCl + Aq$  (Hofmann, B 1912, 45 1733)  
 $+ 2H_2O$  Insol in hot  $H_2O$  Sol in  $KOH + Aq$  (Divers and Haga, Chem Soc 1896, 69 1649)**Mercuric potassium amidosulphonate**,  
 $KHgNSO_3$ Very sl sol in cold  $H_2O$  and cold dil  $KOH + Aq$  Sol in 3 %  $HCl + Aq$  (Hofmann, B 1912, 45 1732)**Mercuric sodium amidosulphonate**,  
 $NaHgNSO_3$ Nearly completely sol in hot  $H_2O$  (Hofmann, B 1912, 45 1734)**Nickel amidosulphonate**,  $Ni(NH SO_3)_2 + 3H_2O$ Sol in  $H_2O$  (B)**Potassium amidosulphonate**,  $KNH SO_3$   
Sol in  $H_2O$  (Berglund)**Potassium silver amidosulphonate**,  
 $NHAgSO_3K + H_2O$ Decomp by  $H_2O$ , sol in  $NH_4OH + Aq$  (Hofmann, B 1912, 45 1734)**Silver amidosulphonate**,  $AgNH SO_3$   
Sol in 15 pts  $H_2O$  at  $19^\circ$  (B)**Sodium amidosulphonate**,  $NaNH_2SO_3$   
Sol in  $H_2O$ **Strontium amidosulphonate**,  $Sr(NH SO_3)_2 + 4H_2O$   
Sol in  $H_2O$ **Thallium amidosulphonate**,  $TlNH SO_3$   
Sol in  $H_2O$ **Uranyl amidosulphonate**  
Sol in  $H_2O$ **Zinc amidosulphonate**,  $Zn(NH SO_3)_2 + 4H_2O$   
Sol in  $H_2O$



**Amidosulphurous acid****Ammonium amidosulphite,  $\text{NH}_4 \text{SO}_2 \text{NH}_4$** 

Very deliquescent Decomps in the air with loss of  $\text{NH}_3$  Sol in  $\text{H}_2\text{O}$  with decomp Sol in anhydrous alcohol Sl sol in dry ether (Divers, Chem Soc 1900, 77 330)

**Ammonia,  $\text{NH}_3$** 

Very sol in  $\text{H}_2\text{O}$ , with evolution of much heat

1 vol  $\text{H}_2\text{O}$  absorbs 670 vols ( $\frac{1}{2}$  pt by weight)  $\text{NH}_3$  at  $+10^\circ$  and 29.8 in pressure sp gr of solution = 0.875 (Davy)

At low temperatures  $\text{H}_2\text{O}$  absorbs more than  $\frac{1}{2}$  its weight of  $\text{NH}_3$  and sp gr of solution = 0.850 (Dalton)

100 pts  $\text{H}_2\text{O}$  absorb 8.41 pts  $\text{NH}_3$  at  $24^\circ$  5.96 pts at  $55^\circ$  (Osann)

1 vol  $\text{H}_2\text{O}$  absorbs 780 vols  $\text{NH}_3$  6 vols  $\text{H}_2\text{O}$  increasing to 10 vols sat  $\text{NH}_4\text{OH} + \text{Aq}$  1 vol sat  $\text{NH}_4\text{OH} + \text{Aq}$  contains 468 vols  $\text{NH}_3$  (Thomson)

1 vol  $\text{H}_2\text{O}$  absorbs 450 vols  $\text{NH}_3$  at  $15^\circ$  (Dumas)

1 vol  $\text{H}_2\text{O}$  absorbs 700 vols  $\text{NH}_3$  at ordinary temperature (Otto)

100 pts  $\text{H}_2\text{O}$  absorb in  $\text{NH}_3$  gas 47.7 pts  $\text{NH}_3$  by weight (Berzelius)

1 vol  $\text{H}_2\text{O}$  absorbs 505 vols  $\text{NH}_3$  and vol is increased to 1.5 vol and sp gr becomes 0.900 (Ure)

1 vol  $\text{H}_2\text{O}$  at  $0^\circ$  and 760 mm absorbs 1177.3 vols  $\text{NH}_3$  (Sims)

1 vol  $\text{H}_2\text{O}$  at  $0^\circ$  and 760 mm absorbs 1146 vols  $\text{NH}_3$  (Roscoe and Dittmar)

1 vol  $\text{H}_2\text{O}$  at  $0^\circ$  and 760 mm absorbs 1049.6 vols  $\text{NH}_3$  (Carius)

1 vol  $\text{H}_2\text{O}$  at  $0^\circ$  and 760 mm absorbs 1270 vols  $\text{NH}_3$  (Berthelot)

1 vol  $\text{H}_2\text{O}$  at  $0^\circ$  and 760 mm absorbs 1050 vols  $\text{NH}_3$  (Bunsen)

100 cc  $\text{H}_2\text{O}$  absorb 64.50 g  $\text{NH}_3$  (Raoult)

**Solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  at 760 mm and  $t^\circ$** 

1 g  $\text{H}_2\text{O}$  absorbs g  $\text{NH}_3$ , according to Roscoe and Dittmar (A 122 347) (RD), and according to Sims (A 118 345) (S)

$t^\circ$	g $\text{NH}_3$ RD	g $\text{NH}_3$ S	$t^\circ$	g $\text{NH}_3$ RD	g $\text{NH}_3$ S
0	0.875	0.899	36	0.343	0.363
2	0.833	0.853	38	0.324	0.350
4	0.792	0.809	40	0.307	0.338
6	0.751	0.765	42	0.290	0.326
8	0.713	0.724	44	0.275	0.315
10	0.679	0.684	46	0.259	0.304
12	0.645	0.646	48	0.244	0.294
14	0.612	0.611	50	0.229	0.284
16	0.582	0.578	52	0.214	0.274
18	0.554	0.546	54	0.200	0.265
20	0.526	0.518	56	0.186	0.256
22	0.499	0.490	58		0.247
24	0.474	0.467	60		0.238
26	0.449	0.446	70		0.194
28	0.426	0.426	80		0.154
30	0.403	0.408	90		0.114
32	0.382	0.393	98		0.082
34	0.362	0.378	100		0.074

Solubility of  $\text{NH}_3$  by vol in  $\text{H}_2\text{O}$  at 760 mm and  $t^\circ$  1 vol  $\text{H}_2\text{O}$  at 760 mm and  $t^\circ$  dissolves V vols  $\text{NH}_3$  gas, vols reduced to  $0^\circ$  and 760 mm

$t^\circ$	V	$t^\circ$	V
0	1049.60	13	759.55
1	1020.78	14	743.11
2	993.26	15	727.22
3	966.98	16	711.82
4	941.88	17	696.85
5	917.90	18	682.26
6	894.99	19	667.99
7	873.09	20	653.99
8	852.14	21	640.19
9	831.98	22	626.54
10	812.76	23	612.98
11	794.32	24	599.46
12	776.60	25	585.94

(Carius, A 99 144)

Solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  at P mm pressure and  $0^\circ$  1 pt  $\text{H}_2\text{O}$  absorbs pts  $\text{NH}_3$  at P mm pressure and  $0^\circ$

P	Pts $\text{NH}_3$	P	Pts $\text{NH}_3$
10	0.044	900	0.968
20	0.084	950	1.101
30	0.120	1000	1.037
40	0.149	1050	1.075
50	0.175	1100	1.117
75	0.228	1150	1.161
100	0.275	1200	1.208
125	0.315	1250	1.258
150	0.351	1300	1.310
175	0.382	1350	1.361
200	0.411	1400	1.415
250	0.465	1450	1.469
300	0.515	1500	1.526
350	0.561	1550	1.584
400	0.607	1600	1.645
450	0.646	1650	1.707
500	0.690	1700	1.770
550	0.731	1750	1.835
600	0.768	1800	1.906
650	0.804	1850	1.976
700	0.840	1900	2.046
750	0.872	1950	2.120
800	0.906	2000	2.195
850	0.937		

(Roscoe and Dittmar, A 112 349)

In proportion as the temperature is higher, so much the more nearly does the solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  conform to the law of Henry and Dalton, but only obeys it completely when the temperature is  $100^\circ$ , as is seen in the following table

solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  at various pressures and temperatures  $P$ =partial pressure,  $1 e$  total pressure minus the tension of aqueous vapour at the given temperature,  $G$ =grams  $\text{NH}_3$  dissolved in 1 g  $\text{H}_2\text{O}$  at the given pressure,  $G$  at 760=grams  $\text{NH}_3$  that would be contained in 1 g  $\text{H}_2\text{O}$  if the solubility was proportional to the pressure

P	0°		20°		40°		100°	
	G at P	G at 760	G at P	G at 760	G at P	G at 760	G at P	G at 760
20	0 082	3 113						
30	0 117	2 960						
40	0 148	2 820						
60	0 169	2 522	0 119	1 513				
80	0 240	2 280	0 141	1 337	0 052	0 497		
100	0 280	2 127	0 158	1 200	0 064	0 490		
120	0 316	2 000	0 173	1 095	0 076	0 483		
140	0 346	1 880	0 187	1 017	0 088	0 476		
160	0 375	1 780	0 202	0 962	0 099	0 470		
180	0 398	1 684	0 207	0 918	0 109	0 462		
200	0 421	1 598	0 232	0 881	0 120	0 454		
250	0 472	1 434	0 266	0 810	0 145	0 440		
300	0 519	1 315	0 296	0 750	0 168	0 426		
350	0 563	1 223	0 325	0 705	0 191	0 414		
400	0 606	1 152	0 353	0 670	0 211	0 402		
450	0 650	1 100	0 378	0 638	0 232	0 399		
500	0 692	1 052	0 403	0 612	0 251	0 382		
550	0 732	1 012	0 425	0 587	0 269	0 372		
600	0 770	0 975	0 447	0 566	0 287	0 363		
650	0 809	0 946	0 470	0 550	0 304	0 355		
700	0 850	0 923	0 492	0 534	0 320	0 347	0 068	0 074
750	0 891	0 903	0 514	0 521	0 335	0 339	0 073	0 074
760	0 899	0 899	0 518	0 518	0 338	0 338	0 074	0 074
800	0 937	0 888	0 535	0 504	0 349	0 332	0 078	0 074
850	0 980	0 876	0 556	0 497	0 363	0 325	0 083	0 074
900	1 029	0 869	0 574	0 485	0 378	0 319	0 088	0 074
950	1 077	0 862	0 594	0 475	0 391	0 313	0 092	0 073
1000	1 126	0 855	0 613	0 466	0 404	0 307	0 096	0 073
1050	1 177	0 852	0 632	0 457	0 414	0 300	0 101	0 073
1100	1 230	0 850	0 651	0 450	0 425	0 294	0 106	0 073
1150	1 283	0 848	0 669	0 442	0 434	0 287	0 110	0 073
1200	1 336	0 846	0 685	0 433	0 445	0 282	0 115	0 073
1250	1 338	0 844	0 704	0 428	0 454	0 276	0 120	0 073
1300	1 442	0 843	0 722	0 422	0 463	0 271	0 125	0 073
1350	1 496	0 842	0 741	0 417	0 472	0 266	0 130	0 073
1400	1 549	0 841	0 761	0 413	0 479	0 260	0 135	0 073
1450	1 603	0 840	0 780	0 409	0 486	0 255		
1500	1 656	0 839	0 801	0 406	0 493	0 250		
1600	1 755	0 835	0 842	0 400	0 511	0 242		
1700	1 861	0 832	0 881	0 394	0 530	0 237		
1800	1 966	0 830	0 919	0 388	0 547	0 231		
1900	2 070	0 828	0 955	0 382	0 565	0 226		
2000			0 992	0 377	0 579	0 220		
2100					0 594	0 215		

Solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  at temps below  
 $0^\circ$  One gram  $\text{H}_2\text{O}$  dissolves  
 grams  $\text{NH}_3$  Temp  
 0 947  $-3.9^\circ$   
 1 115  $-10^\circ$   
 1 768  $-20^\circ$   
 2 781  $-30^\circ$   
 2 946  $-40^\circ$

(Mallet, Am Ch J 1897, 19 807)

The solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  does not follow Dalton's law at ord temp, but does at temp near  $100^\circ$  (Konowaloff, J Russ Phys Chem Soc 1894, 26 48, Chem Soc 1896, 70 (2) 351)

#### Sp gr of $\text{NH}_4\text{OH} + \text{Aq}$

% $\text{NH}_3$	Sp gr	% $\text{NH}_3$	Sp gr
32 3*	0 8750	14 53	0 9435
29 25	0 8857	13 46	0 9476
26	0 9000	12 40	0 9513
25 37*	0 9054	11 56	0 9545
22 07	0 9166	10 82	0 9573
19 54	0 9255	10 17	0 9597
17 52	0 9326	9 6	0 9616
15 88	0 9385	9 5*	0 9632

(H Davy, Elements, 1 241)

\* By direct experiment. The other numbers were obtained by calculation making no allowance for compensation

#### Sp gr of $\text{NH}_4\text{OH} + \text{Aq}$ at $16^\circ$ , according to Otto in his Lehrbuch

% $\text{NH}_3$	Sp gr	% $\text{NH}_3$	Sp gr
12 000	0 9517	8 500	0 9650
11 875	0 9521	8 375	0 9654
11 750	0 9526	8 250	0 9659
11 625	0 9531	8 125	0 9664
11 500	0 9536	8 000	0 9669
11 375	0 9540	7 875	0 9673
11 250	0 9545	7 750	0 9678
11 125	0 9550	7 625	0 9683
11 000	0 9555	7 500	0 9688
10 950	0 9556	7 375	0 9692
10 875	0 9559	7 250	0 9697
10 750	0 9564	7 125	0 9702
10 625	0 9569	7 000	0 9707
10 500	0 9574	6 875	0 9711
10 375	0 9578	6 750	0 9716
10 250	0 9583	6 625	0 9721
10 125	0 9588	6 500	0 9726
10 000	0 9593	6 375	0 9730
9 875	0 9597	6 250	0 9735
9 750	0 9602	6 125	0 9740
9 625	0 9607	6 000	0 9745
9 500	0 9612	5 875	0 9749
9 375	0 9616	5 750	0 9754
9 250	0 9621	5 625	0 9759
9 125	0 9626	5 500	0 9764
9 000	0 9631	5 375	0 9768
8 875	0 9636	5 250	0 9773
8 750	0 9641	5 125	0 9778
8 625	0 9645	5 000	0 9783

#### Sp gr of $\text{NH}_4\text{OH} + \text{Aq}$ , according to Ure in Dict of Arts

% $\text{NH}_3$	Sp gr	% $\text{NH}_3$	Sp gr
27 940	0 8914	15 900	0 9363
27 633	0 8937	14 575	0 9410
27 038	0 8967	13 250	0 9455
26 751	0 8983	11 925	0 9510
26 500	0 9000	10 600	0 9564
25 175	0 9045	9 275	0 9614
23 850	0 9090	7 950	0 9662
22 525	0 9133	6 625	0 9716
21 200	0 9177	5 300	0 9768
19 875	0 9227	3 975	0 9828
18 550	0 9275	2 650	0 9887
17 225	0 9320	1 325	0 9945

#### Sp gr, b-pt, and vols gas in $\text{NH}_4\text{OH} + \text{Aq}$

% $\text{NH}_3$	Sp gr	B pt	Vols gas in 1 vol liquid
35 3	0 85	$-3.3^\circ$	494
32 6	0 86	$+3.3^\circ$	456
29 9	0 87	$10^\circ$	419
27 3	0 88	$16.6^\circ$	382
24 7	0 89	$23.3^\circ$	346
22 2	0 90	$30^\circ$	311
19 8	0 91	$36.6^\circ$	277
17 4	0 92	$43.3^\circ$	244
15 1	0 93	$50^\circ$	211
12 8	0 94	$56.6^\circ$	180
10 5	0 95	$63.3^\circ$	147
8 3	0 96	$70^\circ$	116
6 2	0 97	$78.3^\circ$	87
4 1	0 98	$86.1^\circ$	57
2 0	0 99	$91.1^\circ$	28

(Dalton, in New System 2 422)

#### Sp gr of $\text{NH}_4\text{OH} + \text{Aq}$ at t

t	Sp gr	t	Sp gr	t	Sp gr
0	0 8533	9	0 8746	18	0 8901
1	0 8561	10	0 8766	19	0 8916
2	0 8587	11	0 8785	20	0 8928
3	0 8611	12	0 8804	21	0 8940
4	0 8633	13	0 8823	22	0 8952
5	0 8658	14	0 8841	23	0 8965
6	0 8681	15	0 8858	24	0 8974
7	0 8703	16	0 8874	25	0 8984
8	0 8725	17	0 8889		

(Carius, A 99 141)

#### Sp gr of $\text{NH}_4\text{OH} + \text{Aq}$ at $14^\circ$ according to Carius (A 99 148)

% $\text{NH}_3$	Sp gr	% $\text{NH}_3$	Sp gr
36 0	0 8844	35 2	0 8860
35 8	0 8848	35 0	0 8864
35 6	0 8852	34 8	0 8868
35 4	0 8856	34 6	0 8872

gr of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $14^\circ$ , etc—*Cont*

$\text{NH}_3$	Sp gr	% $\text{NH}_3$	Sp gr
34 4	0 8877	22 2	0 9185
34 2	0 8881	22 0	0 9191
34 0	0 8885	21 8	0 9197
33 8	0 8889	21 6	0 9203
33 6	0 8894	21 4	0 9209
33 4	0 8898	21 2	0 9215
33 2	0 8903	21 0	0 9221
33 0	0 8907	20 8	0 9227
32 8	0 8911	20 6	0 9233
32 6	0 8916	20 4	0 9239
32 4	0 8920	20 2	0 9245
32 2	0 8925	20 0	0 9251
32 0	0 8929	19 8	0 9257
31 8	0 8934	19 6	0 9264
31 6	0 8938	19 4	0 9271
31 4	0 8944	19 2	0 9277
31 2	0 8948	19 0	0 9283
31 0	0 8953	18 8	0 9289
30 8	0 8957	18 6	0 9296
30 6	0 8962	18 4	0 9302
30 4	0 8967	18 2	0 9308
30 2	0 8971	18 0	0 9314
30 0	0 8976	17 8	0 9321
29 8	0 8981	17 6	0 9327
29 6	0 8986	17 4	0 9333
29 4	0 8991	17 2	0 9340
29 2	0 8996	17 0	0 9347
29 0	0 9001	16 8	0 9353
28 8	0 9006	16 6	0 9360
28 6	0 9011	16 4	0 9366
28 4	0 9016	16 2	0 9373
28 2	0 9021	16 0	0 9380
28 0	0 9026	15 8	0 9386
27 8	0 9031	15 6	0 9393
27 6	0 9036	15 4	0 9400
27 4	0 9041	15 2	0 9407
27 2	0 9047	15 0	0 9414
27 0	0 9051	14 8	0 9420
26 8	0 9057	14 6	0 9427
26 6	0 9063	14 4	0 9434
26 4	0 9068	14 2	0 9441
26 2	0 9073	14 0	0 9449
26 0	0 9078	13 8	0 9456
25 8	0 9083	13 6	0 9463
25 6	0 9089	13 4	0 9470
25 4	0 9094	13 2	0 9477
25 2	0 9100	13 0	0 9484
25 0	0 9106	12 8	0 9491
24 8	0 9111	12 6	0 9498
24 6	0 9116	12 4	0 9505
24 4	0 9122	12 2	0 9512
24 2	0 9127	12 0	0 9520
24 0	0 9133	11 8	0 9527
23 8	0 9139	11 6	0 9534
23 6	0 9145	11 4	0 9542
23 4	0 9150	11 2	0 9549
23 2	0 9156	11 0	0 9556
23 0	0 9162	10 8	0 9563
22 8	0 9168	10 6	0 9571
22 6	0 9174	10 4	0 9578
22 4	0 9180	10 2	0 9586

Sp gr of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $14^\circ$ , etc—*Cont*

% $\text{NH}_3$	Sp gr	% $\text{NH}_3$	Sp gr
10 0	0 9593	5 0	0 9790
9 8	0 9601	4 8	0 9799
9 6	0 9608	4 6	0 9807
9 4	0 9616	4 4	0 9815
9 2	0 9623	4 2	0 9823
9 0	0 9631	4 0	0 9831
8 8	0 9639	3 8	0 9839
8 6	0 9647	3 6	0 9847
8 4	0 9654	3 4	0 9855
8 2	0 9662	3 2	0 9863
8 0	0 9670	3 0	0 9873
7 8	0 9677	2 8	0 9882
7 6	0 9685	2 6	0 9890
7 4	0 9693	2 4	0 9899
7 2	0 9701	2 2	0 9907
7 0	0 9709	2 0	0 9915
6 8	0 9717	1 8	0 9924
6 6	0 9725	1 6	0 9932
6 4	0 9733	1 4	0 9941
6 2	0 9741	1 2	0 9950
6 0	0 9749	1 0	0 9959
5 8	0 9757	0 8	0 9967
5 6	0 9765	0 6	0 9975
5 4	0 9773	0 4	0 9983
5 2	0 9781	0 2	0 9991

Hager also gives a table in his *Commentar zur Pharmacopoea*, which is practically identical with those here given

Strength of  $\text{NH}_4\text{OH} + \text{Aq}$  of certain sp gr at  $12^\circ$

Sp gr	1 kg solution contains g $\text{NH}_3$	1 l solution contains g $\text{NH}_3$	1 litre consists of	
			H O in cc	liquid $\text{NH}_3$ in cc
0 870	384 4	334 5	535 5	464 5
0 880	347 2	305 5	574 5	425 5
0 890	311 6	277 3	612 7	387 3
0 900	277 3	249 5	650 5	349 5
0 910	244 9	222 8	687 2	312 8
0 920	213 4	196 3	723 7	276 3
0 930	182 9	170 1	759 9	240 1
0 940	152 9	143 7	796 3	203 7
0 950	124 2	118 0	832 0	168 0
0 960	97 0	93 1	866 9	133 1
0 970	70 2	68 0	902 0	98 0
0 980	45 3	44 3	935 7	64 3
0 990	21 0	20 7	969 3	30 7

(Wachsmuth, *Arch Pharm* (3) 8 510)

Sp gr of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$   
(Most careful experiments)

Sp gr	% $\text{NH}_3$	Sp gr	% $\text{NH}_3$
0 990	2 15	0 926	19 50
0 974	6 10	0 916	22 50
0 950	12 54	0 910	24 40

Sp gr of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ —*Continued*

Sp gr	% $\text{NH}_3$	Sp gr	% $\text{NH}_3$
0 900	27 70	0 882	34 8
0 890	31 40	0 880	35 5
0 885	33 5		

(Gruneberg, Chem Ind 12 97)

The following table is calculated from the above by interpolation —

Sp gr	% $\text{NH}_3$	Sp gr	% $\text{NH}_3$
0 995	1 05	0 935	16 90
0 990	2 15	0 930	18 35
0 985	3 30	0 925	19 80
0 980	4 50	0 920	21 30
0 975	5 75	0 915	22 85
0 970	7 05	0 910	24 40
0 965	8 40	0 905	26 00
0 960	9 80	0 900	27 70
0 955	11 20	0 895	29 50
0 950	12 60	0 890	31 40
0 945	14 00	0 885	33 40
0 940	15 45	0 880	35 50

(Gruneberg)

Sp gr of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $14^\circ$ 

% $\text{HN}_3$	Sp gr	% $\text{NH}_3$	Sp gr
31	0 8933	15 6	0 9400
23 8	0 9116	11 7	0 9536
20 4	0 9246	5 1	0 9780

(Iunge and Smith, B 17 777)

Sp gr of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ , according to Iunge and Wiernik (Zeit f angew Ch 1889 183)

(Most carefully worked out and calculated)

Sp gr	% $\text{NH}_3$	1 l contains g $\text{NH}_3$	Correction for $\pm 1^\circ$
1 000	0 00	0 0	0 00018
0 998	0 45	4 5	0 00018
0 996	0 91	9 1	0 00019
0 994	1 37	13 6	0 00019
0 992	1 84	18 2	0 00020
0 990	2 31	22 9	0 00020
0 988	2 80	27 7	0 00021
0 986	3 30	32 5	0 00021
0 984	3 80	37 4	0 00022
0 982	4 30	42 2	0 00022
0 980	4 80	47 0	0 00023
0 978	5 30	51 8	0 00023
0 976	5 80	56 6	0 00024
0 974	6 30	61 4	0 00024
0 972	6 80	66 1	0 00025
0 970	7 31	70 9	0 00025
0 968	7 82	75 7	0 00026

Sp gr of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ , etc—*Continued*

Sp gr	% $\text{NH}_3$	1 l contains g $\text{NH}_3$	Correction for $\pm 1^\circ$
0 966	8 33	80 5	0 00026
0 964	8 84	85 2	0 00027
0 962	9 35	89 9	0 00028
0 960	9 91	95 1	0 00029
0 958	10 47	100 3	0 00030
0 956	11 03	105 4	0 00031
0 954	11 60	110 7	0 00032
0 952	12 17	115 9	0 00033
0 950	12 74	121 0	0 00034
0 948	13 31	126 2	0 00035
0 946	13 88	131 3	0 00036
0 944	14 46	136 5	0 00037
0 942	15 04	141 7	0 00038
0 940	15 63	146 9	0 00039
0 938	16 22	152 1	0 00040
0 936	16 82	157 4	0 00041
0 934	17 42	162 7	0 00041
0 932	18 03	168 1	0 00042
0 930	18 64	173 4	0 00042
0 928	19 25	178 6	0 00043
0 926	19 87	184 2	0 00044
0 924	20 49	189 3	0 00045
0 922	21 12	194 7	0 00046
0 920	21 75	200 1	0 00047
0 918	22 39	205 6	0 00048
0 916	23 03	210 9	0 00049
0 914	23 68	216 3	0 00050
0 912	24 33	221 9	0 00051
0 910	24 99	227 4	0 00052
0 908	25 65	232 9	0 00053
0 906	26 31	238 3	0 00054
0 904	26 98	243 9	0 00055
0 902	27 65	249 4	0 00056
0 900	28 33	255 0	0 00057
0 898	29 01	260 5	0 00058
0 896	29 69	266 0	0 00059
0 894	30 37	271 5	0 00060
0 892	31 05	277 0	0 00060
0 890	31 75	282 6	0 00061
0 888	32 50	288 6	0 00062
0 886	33 25	294 6	0 00063
0 884	34 10	301 4	0 00064
0 882	34 95	308 3	0 00065

$\text{NH}_3$  is much less sol in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  than in  $\text{H}_2\text{O}$

Solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$ , and  $\text{KOH} + \text{Aq}$  of various strengths 100 pts solvent absorbs g  $\text{NH}_3$  at  $t^\circ$

$t^\circ$	$\text{H}_2\text{O}$	$\text{KOH} + \text{Aq}$ 11.2% $\text{K}_2\text{O}$	$\text{KOH} + \text{Aq}$ 25.5% $\text{K}_2\text{O}$
0	90 00	72 00	49 50
8	72 75	57 00	37 50
16	59 75	46 00	28 50
24	49 50	37 25	21 75

(Raoult, A ch (5) 1 262)

100 pts sat KOH + Aq dissolve only 1 pt  $\text{NH}_3$

Solubility in NaOH + Aq is the same as in KOH + Aq of the same strength

$\text{NH}_4\text{Cl}$  + Aq absorbs slightly less  $\text{NH}_3$  than the same vol  $\text{H}_2\text{O}$   $\text{NaNO}_3$ , and  $\text{NH}_4\text{NO}_3$  + Aq absorb almost the same amount  $\text{NH}_3$  as the same vol  $\text{H}_2\text{O}$  (Raoult, *l c*)

Solubility of  $\text{NH}_3$  in 100 pts  $\text{Ca}(\text{NO}_3)_2$  + Aq

$t^\circ$	$\text{H}_2\text{O}$	$\text{Ca}(\text{NO}_3)_2$ + Aq 29 38% $\text{Ca}(\text{NO}_3)_2$	$\text{Ca}(\text{NO}_3)_2$ + Aq 59 03% $\text{Ca}(\text{NO}_3)_2$
0	90 00	96 25	104 50
8	72 75	78 50	84 75
16	59 75	65 00	70 50

(Raoult, *l c*)

Solubility in salt solutions at  $25^\circ\text{C}$

Salt	Mols $\text{NH}_3$ soluble in 1 liter of		
	0 normal solution	1 normal solution	1 5 normal solution
KCl	0 930	0 866	0 809
KBr	0 950	0 904	0 857
KI	0 970	0 942	0 900
KOH	0 852	0 716	0 607
NaCl	0 938	0 889	0 843
NaBr	0 965	0 916	0 890
NaI	0 995	0 992	0 985
NaOH	0 876	0 789	0 716
LiCl	0 980	1 008	1 045
LiBr	1 001	1 040	1 090
LiI	1 030	1 094	1 190
$\text{LiOH}$	0 861	0 808	0 768
KF	0 539	0 722	0 626
$\text{KNO}_3$	0 923	0 862	0 804
$\text{KNO}$	0 920	0 855	0 798
$\text{KCN}$	0 926	0 858	0 802
$\text{KCNs}$	0 932	0 868	0 814
$\frac{1}{2}\text{K}_2\text{SO}_4$	0 875	0 772	0 678
$\frac{1}{2}\text{K}_2\text{SO}_3$	0 865	0 768	0 675
$\frac{1}{2}\text{K}_2\text{CO}_3$	0 788	0 650	0 554
$\frac{1}{2}\text{K}_2\text{C}_2\text{O}_4$	0 866	0 771	0 675
$\frac{1}{2}\text{K}_2\text{C}_2\text{O}_4$	0 866	0 771	0 675
$\text{CH}_3\text{COOK}$	0 866	0 765	0 685
HCOOK	0 868	0 760	0 678
$\text{KBO}_2$	0 814	0 677	0 560
$\frac{1}{2}\text{K}_2\text{HPO}_4$	0 860	0 749	0 664
$\frac{1}{2}\text{Na}_2\text{S}$	0 887	0 795	0 726
$\text{KClO}_3$ 0 25-norm	0 927		
$\text{KBrO}_3$ 0 25-norm	0 940		
$\text{KIO}_3$ 0 25-norm	0 951		

(Abegg & Riesenfeld, Z phys Ch 1902, 40 100)

Solubility in salts + Aq at  $35^\circ\text{C}$

Salt	Concentration of the aq solution	Mols $\text{NH}_3$ soluble in 1 liter of solution
KCl	0 5 normal	0 923
NaCl	"	0 966
$\text{CH}_3\text{COOK}$	"	0 902
$\frac{1}{2}(\text{COOK})_2$	"	0 902
KOH	"	0 870
NaOH	"	0 896
$\frac{1}{2}\text{K}_2\text{CO}_3$	0 426 normal	0 914
$\frac{1}{2}\text{Na}_2\text{CO}_3$	"	0 932

(Riesenfeld, Z phys Ch 1903, 45 462)

The solubility of  $\text{NH}_3$  in  $\text{NaNO}_3$ ,  $\text{NH}_4\text{NO}_3$  and in  $\text{AgNO}_3 \cdot 2\text{NH}_3$  + Aq is nearly the same as in pure  $\text{H}_2\text{O}$  (Konowaloff, C C 1898, II 659)

Distribution-coefficient of  $\text{NH}_3$  between water and  $\text{CHCl}_3 = 26.3$  at  $20^\circ$ ,  $24.9$  at  $25^\circ$ ,  $23.2$  at  $30^\circ$

The distribution-coefficient of  $\text{NH}_3$  between  $\text{CHCl}_3$  and a number of salt solutions has been determined for the purpose of studying the nature of metal-ammonia compounds in aqueous solution (Dawson, Chem Soc 1900, 77 1242)

Distribution of  $\text{NH}_3$  between  $\text{H}_2\text{O}$  and  $\text{CHCl}_3$  at  $18^\circ$

$\text{NH}_3$ concentration in aqueous solution mols / litre	$\text{NH}_3$ concentration in $\text{CHCl}_3$ solution mols / litre
0 9280	0 03506
1 921	0 07703
2 064	0 08350
2 274	0 09317
2 590	0 1083
3 700	0 1639
4 333	0 1996

(Dawson, Z phys Ch 1909, 69 120)

Distribution of  $\text{NH}_3$  between hydroxides + Aq and  $\text{CHCl}_3$  at  $18^\circ$

Aqueous solution	$\text{NH}_3$ concentration in the aqueous solution mols / litre	$\text{NH}_3$ concentration in the $\text{CHCl}_3$ solution mols / litre
0 2-N KOH	1 949	0 0841
0 5-N KOH	1 978	0 0951
0 2-N NaOH	2 016	0 0869
0 5-N NaOH	1 944	0 0907
0 2-N $\frac{1}{2}\text{Ba}(\text{OH})_2$	2 076	0 08905
0 5-N $\frac{1}{2}\text{Ba}(\text{OH})_2$	3 397	0 1560

(Dawson, *l c*)

Distribution of  $\text{NH}_3$  between  $\text{Cu}(\text{OH})_2 + \text{Aq}$  and  $\text{CHCl}_3$  at  $18^\circ$ 

Conc of $\text{Cu}(\text{OH})_2$ equivalents/litre	$\text{NH}_3$ concentration in aqueous solution mols /litre	$\text{NH}_3$ concentration in $\text{CHCl}_3$ solution mols /litre
0 041	2 014	0 07968
0 0705	2 653	0 1087
0 081	3 011	0 1247

(Dawson, *l c*)

## Sol in alcohol and ether

Sol in 3 pts alcohol of  $38^\circ$  (Boullay)  
 1 vol alcohol of 0 829 sp gr absorbs about 50 vols  $\text{NH}_3$  (Davy)

Much less sol in ethyl, propyl, or amyl alcohol than in  $\text{H}_2\text{O}$  (Paghano and Emo, Gazz ch it 13 278)

Solubility of  $\text{NH}_3$  in ethyl alcohol ( ) solut at  $t^\circ$ 

$t^\circ$	% $\text{NH}_3$	Pts $\text{NH}_3$ pts	per 100 ohol
0	19 7	2	5
6	17 1	2	6
11 7	14 1	1	4
14 7	13 2	1	2
17	12 6	1	7
22	10 9	1	2
28 4	9 2	1	1

(de Bruyn, R t e 11 112)

1 vol abs alcohol at  $20^\circ$  and ' 0 mm pressure absorbs 340 vols  $\text{NH}_3$  gas Müller W Ann 1891, 43 567)

1 l methyl alcohol sat with  $\text{NH}_3$  contain = 0 77C  
 218 g  $\text{NH}_3$  at  $0^\circ$ , sp gr of solution = 0 77C  
 coefficient of solubility = 425 0 (De pine)

Solubility of  $\text{NH}_3$  in alcohol at  $t^\circ$  weight  $\text{NH}_3$  = weight  $\text{NH}_3$  contained in a litre of solution sat at 760 mm and  $t^\circ$ , sp gr = sp gr of solution, C = coefficient of solubih

Temp	Degree of Alcohol	100°	90°	80°	70°	60°	50°
0°	Weight $\text{NH}_3$	130 5	146 0	206 5		246 0	04 5
	Sp gr	0 782	0 783	0 808		0 830	835
	C	209 5	245 0	390 0		504 5	97 7
10°	Weight $\text{NH}_3$	108 5	120 0	167 0		198 25	27 0
	Sp gr	0 787	0 803	0 800		0 831	850
	C	164 3	186 0	288 0		373 0	38 6
20°	Weight $\text{NH}$	75 0	97 5	119 75	137 5	152 5	82 7
	Sp gr	0 791	0 788	0 821	0 829	0 842	869
	C	106 6	147 8	190 5	223 0	260 8	38 2
30°	Weight $\text{NH}_3$	51 5	74 0	81 75	100 3	129 5	52 0
	Sp gr	0 798	0 791	0 826		0 846	883
	C	97 0	186 7	121 6		211 6	52 0

(Delépine, J Pharm (5) 25 496)

Solubility of  $\text{NH}_3$  in methyl alcohol (absolute) at  $t^\circ$ 

$t^\circ$	% $\text{NH}_3$	Pts $\text{NH}_3$ per 100 pts alcohol
0	29 3	41 5
6	26 0	35 2
11 7	23 5	30 7
14 7	21 8	27 9
17	20 8	26 3
22	18 3	22 4
28 4	14 8	17 4

(de Bruyn, *l c*)

## Readily sol in ether

Sol in 0 4 vol petroleum from Amiano (Saussure)

1 vol oil of turpentine absorbs 7 5 vols  $\text{NH}_3$  at  $16^\circ$

1 vol oil of lemon absorbs 8 5 vols  $\text{NH}_3$  at  $16^\circ$

1 vol oil of rosemary absorbs 9 5 vols  $\text{NH}_3$  at  $29^\circ$

1 vol oil of lavender absorbs 47 v s  $\text{NH}_3$  at  $20^\circ$  (Saussure)

1 vol caoutchine absorbs 3 vo  $\text{NH}_3$  (Himly)

Valerol absorbs much  $\text{NH}_3$  (Carr irdt, A ch (3) 7 278)

1 vol ether at 760 mm pressure absorbs 17 13 vols  $\text{NH}_3$  at  $0^\circ$ , 12 35 vols at  $0^\circ$  and 10 27 vols at  $15^\circ$  (Christoff, Z p ys Ch 1912 79 459)

+  $\text{H}_2\text{O}$  Colorless crystals

+  $\frac{1}{2}\text{H}_2\text{O}$  Large transparent crystals (Rupert, J Am Chem Soc 1909, 3 868)

## Ammonia, with metal salts

For the ammonia addition-products of metal salts, see under the respective metal salts, except in the case of Co, Cr, Hg and the Pt metals, for which see cobalt ammonium, chromium ammonium, etc, compounds, for

further reference New data on Co and Cr ammonium compounds and those of the Pt metals, published since the first edition, has not been included in the present edition

### Ammonium amalgam, $\text{NH}_4, \text{zHg}$

Decomp by  $\text{H}_2\text{O}$ , but more easily in presence of naphtha, alcohol, or ether

### Ammonium azoimide, $\text{N}_4\text{H}_4=\text{NH}_4\text{N}_3$

Easily sol in  $\text{H}_2\text{O}$ , sl sol in absolute alcohol, easily in 80% alcohol Insol in ether or benzene (Curtius, B 24 3344)

### Ammonium cobalt azoimide, $\text{NH}_4\text{N}_3, \text{CoN}_3$

Rather sol in  $\text{H}_2\text{O}$  (Curtius and Rissom, J pr 1898, (2) 58 302)

### Ammonium bromide, $\text{NH}_4\text{Br}$

Easily sol in  $\text{H}_2\text{O}$  with absorption of much heat

1 pt  $\text{NH}_4\text{Br}$  dissolves in pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{H}_2\text{O}$	$t^\circ$	Pts $\text{H}_2\text{O}$	$t^\circ$	Pts $\text{H}_2\text{O}$
10	1 51	30	1 23	100	0 78
16	1 39	50	1 06		

(Eder, W A B 82 (2) 1284)

$\text{NH}_4\text{Br} + \text{Aq}$  containing 41.09%  $\text{NH}_4\text{Br}$  is sat at  $15^\circ$  (Gerlach)

Sp gr of  $\text{NH}_4\text{Br} + \text{Aq}$  at  $15^\circ$

% $\text{NH}_4\text{Br}$	Sp gr	% $\text{NH}_4\text{Br}$	Sp gr
5	1 0326	20	1 1285
10	1 0652	30	1 1921
15	1 0960	41.09	1 2920

(Eder)

Sp gr of  $\text{NH}_4\text{Br} + \text{Aq}$  at  $16^\circ$

% $\text{NH}_4\text{Br}$	Sp gr	% $\text{NH}_4\text{Br}$	Sp gr
2	1 0119	22	1 1375
3	1 0181	23	1 1440
4	1 0242	24	1 1506
5	1 0303	25	1 1573
6	1 0364	26	1 1642
7	1 0425	27	1 1713
8	1 0486	28	1 1787
9	1 0547	29	1 1862
10	1 0609	30	1 1938
11	1 0672	31	1 2018
12	1 0735	32	1 2098
13	1 0798	33	1 2180
14	1 0862	34	1 2260
15	1 0926	35	1 2342
16	1 0988	36	1 2425
17	1 1051	37	1 2509
18	1 1115	38	1 2594
19	1 1181	39	1 2679
20	1 1246	40	1 2765
21	1 1310	41	1 2850

(Hager, Comm 1883)

25 g  $\text{NH}_4\text{Br} + 50$  g  $\text{H}_2\text{O}$  lower the temp from  $15.1^\circ$  to  $-1.1^\circ$  (Rudorff)

Sol in liquid  $\text{NH}_3$  at  $-50^\circ$  (Moissan C R 1901, 133 713)

Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 826)

Sl sol in alcohol

1 pt  $\text{NH}_4\text{Br}$  dissolves in 32.3 pts alcohol (0.806 sp gr) at  $15^\circ$ , 9.5 pts at  $78^\circ$  (Eder, l c)

100 pts absolute methyl alcohol dissolve 12.5 pts at  $19^\circ$ , 100 pts absolute ethyl alcohol dissolve 3.22 pts at  $19^\circ$  (de Bruyn, Z phys Ch 10 783)

Solubility in mixtures of methyl and ethyl alcohol at  $25^\circ$

P = % methyl alcohol in the solvent  
G = g  $\text{NH}_4\text{Br}$  in 10 cc of the solution  
S = sp gr of the sat solution at  $25^\circ/4^\circ$

P	G	S
0 00	0 255	0 8065
4 37	0 299	0 8083
10 40	0 321	0 8117
41 02	0 506	0 8252
80 69	0 813	0 8501
84 77	0 847	0 8508
91 25	0 934	0 8551
100 00	0 983	0 8605

(Herz, Z anorg 1908, 60 156)

Solubility in mixtures of methyl and propyl alcohol at  $25^\circ$

P = % propyl alcohol in the solvent  
G = g  $\text{NH}_4\text{Br}$  in 10 cc of the solution  
S = Sp gr of the sat solution at  $25^\circ/4^\circ$

P	G	S
0	0 983	0 8605
11 11	0 551	0 8521
23 5	0 690	0 8426
65 2	0 308	0 8181
91 5	0 128	0 8097
93 75	0 125	0 8089
100	0 095	0 8059

(Herz, l c)

Solubility in mixtures of propyl and ethyl alcohol at  $25^\circ$

P = % propyl alcohol in the solvent  
G = g  $\text{NH}_4\text{Br}$  in 10 cc of the solution  
S = Sp gr of the sat solution at  $25^\circ/4^\circ$

P	G	S
0	0 255	0 8065
8 1	0 251	0 8062
17 85	0 237	0 8032
56 6	0 163	0 8018
88 6	0 111	0 8012
91 2	0 105	0 8019
95 2	0 101	0 8039
100	0 095	0 8059

(Herz, l c)



Sol in 809 pts ether (0.729 sp gr) (Eder, *lc*)  
 Sol in acetone (Eidmann, C C 1899 II, 1014), (Naumann, B 1904, 37 4328)  
 Insol in benzonitrile (Naumann, B 1914, 47 1370)  
 Insol in methyl acetate (Naumann, B 1909, 42 3790)  
 Insol in ethylacetate (Naumann, B 1910, 43 314)

### Ammonium tribromide, $\text{NH}_4\text{Br}_3$

Gives off Br in air Sol in  $\text{H}_2\text{O}$  (Roozeboom, B 14 2398)

Decomp in the air Very sol in  $\text{H}_2\text{O}$  (Chattaway, Chem Soc 1915, 107 106)

### Ammonium antimony bromide, $3\text{NH}_4\text{Br} \cdot 2\text{SbBr}_3$

Easily sol in abs alcohol (Caven, C C 1905 II, 293)

$7\text{NH}_4\text{Br} \cdot 3\text{SbBr}_3$  Easily sol in abs alcohol (Caven, C C 1905 II, 293)

See also Bromantimonate, ammonium

### Ammonium bismuth bromide, $\text{NH}_4\text{Br} \cdot \text{BiBr}_3 + \text{H}_2\text{O}$

Deliquescent Decomp by  $\text{H}_2\text{O}$  Sol in alcohol (Nicklès, C R 51 1097)

### Ammonium cadmium bromide, $\text{NH}_4\text{Br} \cdot \text{CdBr}_2 + \frac{1}{2}\text{H}_2\text{O}$

Sol in 0.73 pt  $\text{H}_2\text{O}$ , 5.3 pts abs alcohol, 280 pts ether (sp gr 0.729), and 24 pts alcohol ether (1 l) (Eder, Dingl 221 89)

Sol in  $\text{H}_2\text{O}$  without decomp between 1° and 110.1°

100 pts of the solution contain at

1° 14.8° 52.2° 110.1°

53.82 58.01 65.32 75.83 pts of the salt (Rimbach, B 1905, 38 1555)

$4\text{NH}_4\text{Br} \cdot \text{CdBr}_2$  Sol in 0.96 pt  $\text{H}_2\text{O}$ , from which it is pptd by alcohol or ether (Eder)

Solubility in  $\text{H}_2\text{O}$  at t°

Below 160° the salt is decomp by  $\text{H}_2\text{O}$ , at 160° it is sol in  $\text{H}_2\text{O}$  without decomp

t°	100 pts of the solution contain			Solid phase
	Pts Cd	Pts Br	Pts $\text{NH}_4$	
0.8	14.72	50.46	6.67	Double salt + $\text{NH}_4\text{Br}$
13.0	14.94	51.48	6.85	"
44.5	15.01	53.85	7.35	"
76.4	14.60	55.28	7.80	"
123.5	15.50	59.50	8.45	"
160.0	14.70	62.67	9.43	Double salt

(Rimbach, B 1905, 38 1558)

Not sol in  $\text{HBr} + \text{Aq}$  without decomp (Rimbach)

Not sol without decomp in  $\text{LiBr} + \text{Aq}$ ,  $\text{CaBr}_2 + \text{Aq}$ ,  $\text{MgBr}_2 + \text{Aq}$ ,  $\text{NiBr}_2 + \text{Aq}$ , or

$\text{CoBr}_2 + \text{Aq}$ , even though very conc solution are used Sol without decomp in  $\text{ZnBr}_2 + \text{Aq}$  (Rimbach, B 1905, 38 1551)

### Ammonium chloromolybdenum bromide, $2\text{NH}_4\text{Br} \cdot \text{Cl}_4\text{Mo}_3\text{Br}_2$

Decomp by pure  $\text{H}_2\text{O}$  Can be crystallized from  $\text{HBr} + \text{Aq}$  Apparently sol without decomp in alcohol (Blomstrand)

### Ammonium cuprous bromide

$4\text{NH}_4\text{Br} \cdot \text{Cu}_2\text{Br}_2$  Fairly stable in air  
 $2\text{NH}_4\text{Br} \cdot \text{Cu}_2\text{Br}_2 + \text{H}_2\text{O}$  Fairly stable in air (Wells, Z anorg 1895, 10 159)

### Ammonium cuprous bromide ammonium, $\text{NH}_4\text{Br} \cdot \text{Cu}_2\text{Br}_2 \cdot 3\text{NH}_3$

(Fleurent, C R 1891, 113 107)

### Ammonium cupric bromide, $2\text{NH}_4\text{Br} \cdot \text{CuBr}_2 + 2\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (de Koningck, B 21 777 R)

### Ammonium iridium bromide

See Bromiridate, ammonium

### Ammonium iron (ferric) bromide, $(\text{NH}_4)_2\text{FeBr}_4 + 2\text{H}_2\text{O}$

Very deliquescent, sol in  $\text{H}_2\text{O}$  (Walden Z anorg 1894, 7 332)

### Ammonium lead bromide, $12\text{NH}_4\text{Br} \cdot 7\text{PbBr}_2 + 7\text{H}_2\text{O}$

Decomp on air, or with cold  $\text{H}_2\text{O}$  (André G R 96 1502)

$6\text{NH}_4\text{Br} \cdot \text{PbBr}_2 + \text{H}_2\text{O}$  Decomp by cold  $\text{H}_2\text{O}$  (A)

$7\text{NH}_4\text{Br} \cdot \text{PbBr}_2 + 1\frac{1}{2}\text{H}_2\text{O}$  Stable on air decomp by cold  $\text{H}_2\text{O}$  (A)

None of the above compounds 1st (Wells Sill Am J 146 25)

$2\text{NH}_4\text{Br} \cdot \text{PbBr}_2$  Decomp by  $\text{H}_2\text{O}$  Sol in conc  $\text{KOH} + \text{Aq}$  and in strong acids (Fonze-Diacon, Bull Soc 1897 3) 17 351)  
 $\text{NH}_4\text{Br} \cdot 3\text{PbBr}_2$  (Wells)

### Ammonium magnesium bromide, $\text{NH}_4\text{Br} \cdot \text{MgBr}_2 + 6\text{H}_2\text{O}$

Deliquescent Sol in  $\text{H}_2\text{O}$  (Rich, J pr (2) 28 338)

### Ammonium mercuric bromide, $2\text{HgBr}_2 \cdot \text{NH}_4\text{Br}$

Decomp by  $\text{H}_2\text{O}$  into its constituent salts (Rây, Chem Soc 1902, 81 648)

### Ammonium molybdenum bromide, $2\text{NH}_4\text{Br} \cdot \text{MoBr}_3 + \text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1905, 46 322)

### Ammonium molybdenum bromide chloride See Ammonium chloromolybdenum bromide

**Ammonium osmium bromide***See Bromosmate, ammonium***Ammonium osmyl bromide**,  $(\text{NH}_4)_2\text{OsO}_2\text{Br}_4$   
Sol in  $\text{H}_2\text{O}$  (Wintrebert, A ch 1903, (7) 28 95)**Ammonium osmyl oxybromide**,  
 $(\text{NH}_4)_2\text{OsO}_3\text{Br}_2$ 

(Wintrebert, A ch 1903 (7) 28 117)

**Ammonium palladium bromide***See Bromopalladate, ammonium, and  
Bromopalladite, ammonium***Ammonium platinum bromide***See Bromoplatinate, ammonium***Ammonium rhodium bromide***See Bromorhodite, ammonium***Ammonium selenium bromide***See Bromoselenate, ammonium***Ammonium tellurium bromide***See Bromotellurate, ammonium***Ammonium thallic bromide**,  $\text{NH}_4\text{Br}$ ,  $\text{TlBr}_3 + 2\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  (Willm.)  
+  $4\text{H}_2\text{O}$  Efflorescent Sol in  $\text{H}_2\text{O}$   
(Nicklès)  
+  $5\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Nicklès)**Ammonium stannous bromide (ammonium  
bromostannite)**,  $\text{NH}_4\text{Br}$ ,  $\text{SnBr}_2 + \text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  (Benas, C C 1884 958)  
 $2\text{NH}_4\text{Br}$ ,  $\text{SnBr}_2$  Sol in  $\text{H}_2\text{O}$  (Raymann  
and Preis, A 223 323)  
+  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Benas, l c)  
+  $2\text{H}_2\text{O}$  (Richardson, Am Ch J 14 96)  
 $\text{NH}_4\text{Br}$ ,  $2\text{SnBr}_2(?)$  (Benas)**Ammonium stannic bromide**,  $2\text{NH}_4\text{Br}$ ,  $\text{SnBr}_4$ *See Bromostannate, ammonium***Ammonium uranyl bromide**,  $2\text{NH}_4\text{Br}$ ,  $\text{UO}_2\text{Br}_2 + 2\text{H}_2\text{O}$ Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Schantz)**Ammonium zinc bromide**,  $2\text{NH}_4\text{Br}$ ,  $\text{ZnBr}_2$ Deliquescent, and sol in  $\text{H}_2\text{O}$  (Bodeker, J B 1860 17)+  $\text{H}_2\text{O}$  Very deliquescent, and sol in  $\text{H}_2\text{O}$   
(André, A ch (6) 3 104)+  $\text{zH}_2\text{O}$  (Lphrum, Z anorg 1908, 59 66)  
+  $\text{NH}_4\text{Br}$ ,  $\text{ZnBr}_2$  Sol in  $\text{H}_2\text{O}$  Decomp  
only by great dilution (Jones & Knight, Am  
Ch J 1899, 22 136)+  $\text{H}_2\text{O}$  Not hygroscopic (Lphrum, Z  
anorg 1908, 59 66)**Ammonium bromide arsenic trioxide***See Arsenite bromide, ammonium***Ammonium bromide mercuric chloride**, $\text{NH}_4\text{Br}$ ,  $2\text{HgCl}_2$ 

Ppt (Ray, Chem Soc 1902, 81 649)

**Ammonium bromide mercuric iodide**, $2\text{NH}_4\text{Br}$ ,  $\text{HgI}_2$ Decomp by  $\text{H}_2\text{O}$  Sol in alcohol without  
decomp (Grossmann, B 1903, 36 1602) $3\text{NH}_4\text{Br}$ ,  $2\text{HgI}_2$  Decomp by  $\text{H}_2\text{O}$  Sol  
in alcohol without decomp (Grossmann, B  
1903, 36 1602)**Ammonium lead bromochloride**, $\text{NH}_4\text{Pb}_2\text{Br}_2\text{Cl}$ Decomp by  $\text{H}_2\text{O}$  (Fonzes-Diacon, Bull  
Soc 1897, (3) 17 350) $\text{NH}_4\text{Pb}_2\text{Cl}_4\text{Br}$  Decomp by  $\text{H}_2\text{O}$  (Fonzes-  
Diacon, Bull Soc 1897, (3) 17 349)**Ammonium bromochloroiodide**,  $\text{NH}_4\text{ClBrI}$ Very stable, sol in  $\text{H}_2\text{O}$  (Chattaway,  
Chem Soc 1915, 107 108)**Ammonium lead bromoiodide**,  $\text{NH}_4\text{PbBrI}_2 + 2\text{H}_2\text{O}$  and  $\text{NH}_4\text{Pb}_2\text{BrI}_4$ Decomp by  $\text{H}_2\text{O}$  Sol in conc  $\text{KOH} + \text{Aq}$   
and in strong acids (Fonzes-Diacon, Bull  
Soc 1897, (3) 17 352)**Ammonium bromodibromide**,Decomp in the air Sol in  
son, Am Ch J 1900, 24 28)**Ammonium chloride**,  $\text{NH}_4\text{Cl}$ (Sal-ammoniac) Not deliquescent Sol  
in  $\text{H}_2\text{O}$  with reduction of tempSol in 2.24 pts  $\text{H}_2\text{O}$  (Wenzel)  
 $\text{NH}_4\text{Cl} + \text{Aq}$  sat at  $10^\circ$  has sp gr = 1.072 (l)  
Sol in 2.72 pts cold and 1 pt boiling  $\text{H}_2\text{O}$  (M R  
and P)Sol in 3 pts  $\text{H}_2\text{O}$  at  $18.7^\circ$  (Abl)  
Sol in 6 cc<sup>1</sup> 11 pt boiling  $\text{H}_2\text{O}$  (Lourcro)100 pts dissolve 36.7 pts  $\text{NH}_4\text{Cl}$   
 $\text{NH}_4\text{Cl} + \text{Aq}$  sat at its b pt (114.2) contains 88.9  
pts  $\text{NH}_4\text{Cl}$  in 100 pts of the solution (Berzelius)100 pts  $\text{H}_2\text{O}$  at  $15^\circ$  dissolve 33.36 pts and at 100  
100 pts  $\text{NH}_4\text{Cl}$  (Ures Diet) $\text{NH}_4\text{Cl} + \text{Aq}$  sat at  $15^\circ$  has sp gr 1.07209 and  
contains at least 31.88 pts  $\text{NH}_4\text{Cl}$  dissolved in every  
100 pts  $\text{H}_2\text{O}$  (Michel and Kraft, A ch (3) 41 178) $\text{NH}_4\text{Cl} + \text{Aq}$  sat at  $10^\circ$  contains 23.86  $\text{NH}_4\text{Cl}$   
(Liller) $\text{NH}_4\text{Cl} + \text{Aq}$  sat in the cold contains 11.3  $\text{NH}_4\text{Cl}$   
(Lourcro)Sol in 1 pt  $\text{H}_2\text{O}$  at 113  $^\circ$  b pt of sat solution  
(Cristoflus)Sol in 2.7 pts  $\text{H}_2\text{O}$  at  $18.7^\circ$  forming a liquid of 1.08  
sp gr (Karsten 1810)Sol in 2.727 pts  $\text{H}_2\text{O}$  at  $10^\circ$  (Claus Hambruch)

100 pts $\text{H}_2\text{O}$ at 718 mm pressure melt dissolve pts $\text{NH}_4\text{Cl}$							
$t^\circ$	Pts $\text{NH}_4\text{Cl}$	$t^\circ$	Pts $\text{NH}_4\text{Cl}$	$t^\circ$	Pts $\text{NH}_4\text{Cl}$	$t^\circ$	Pts $\text{NH}_4\text{Cl}$
0	28.40	30	41.72	60	55.04	90	68.36
10	32.84	40	46.16	70	59.48	100	72.80
20	37.28	50	50.60	80	63.92	110	77.24

(Allard C R 59 500)

Solubility in 100 pts H<sub>2</sub>O at t°

t°	Pts NH <sub>4</sub> Cl	t°	Pts NH <sub>4</sub> Cl	t°	Pts NH <sub>4</sub> Cl	t°	Pts NH <sub>4</sub> Cl
0	29 7	30	41 4	60	55 2	90	71 3
1	30 0	31	41 8	61	55 7	91	71 9
2	30 3	32	42 2	62	56 2	92	72 5
3	30 6	33	42 7	63	56 7	93	73 1
4	31 0	34	43 1	64	57 2	94	73 7
5	31 4	35	43 6	65	57 7	95	74 3
6	31 8	36	44 0	66	58 2	96	74 9
7	32 2	37	44 4	67	58 7	97	75 5
8	32 6	38	44 9	68	59 2	98	76 1
9	33 0	39	45 3	69	59 7	99	76 7
10	33 3	40	45 8	70	60 2	100	77 3
11	33 7	41	46 2	71	60 7	101	78 0
12	34 1	42	46 7	72	61 2	102	78 6
13	34 5	43	47 1	73	61 7	103	79 2
14	34 8	44	47 6	74	62 3	104	79 9
15	35 2	45	48 0	75	62 8	105	80 5
16	35 6	46	48 5	76	63 4	106	81 2
17	36 0	47	49 0	77	63 9	107	81 8
18	36 4	48	49 5	78	64 5	108	82 5
19	36 8	49	49 9	79	65 1	109	83 1
20	37 2	50	50 4	80	65 6	110	83 8
21	37 6	51	50 9	81	66 2	111	84 4
22	38 0	52	51 3	82	66 7	112	85 1
23	38 4	53	51 8	83	67 3	113	85 7
24	38 8	54	52 3	84	67 8	114	86 4
25	39 3	55	52 8	85	68 4	115	87 1
			53 2	86	69 0	115 65	87 3
			53 7	87	69 6		
			54 2	88	70 2		
			54 7	89	70 7		
40 9	59						

Mulder, calculated from his own and other observations Scheik Verhandel 1864 57)

Solubility in 100 pts H<sub>2</sub>O at t°

t°	Pts NH <sub>4</sub> Cl	t°	Pts NH <sub>4</sub> Cl	t°	Pts NH <sub>4</sub> Cl
0	29 7	10 8	33 9	64 9	57 9
6 2	32 2	31 6	42 2	90 6	67 2

(Lindstrom, Pogg 136 315)

NH<sub>4</sub>Cl + Aq sat at 13–16° contains 26 16% NH<sub>4</sub>Cl (v Hauer, J pr 103 114)

Sol in 272 pts H<sub>2</sub>O at 19° (Schiff, A 109 326)

Sol in 2 803 pts H<sub>2</sub>O at 15° (Gerlach)

Sat NH<sub>4</sub>Cl + Aq at 75° contains 38 23% NH<sub>4</sub>Cl (Tschugaeff, Z anorg 1914, 86 161)

NH<sub>4</sub>Cl + Aq sat at 30° contains 29 5% NH<sub>4</sub>Cl (Meerburg, C C 1904 II, 1362)

Solubility in H<sub>2</sub>O at t°

t°	1000 mols H <sub>2</sub> O dissolve mols NH <sub>4</sub> Cl	100 g H <sub>2</sub> O dissolve g NH <sub>4</sub> Cl
3 5	105 2	31 25
25 0	129 7	38 5
50 0	167 0	49 6

(Biltz and Marcus, Z anorg 1911, 71 169)

Solubility of NH<sub>4</sub>Cl in H<sub>2</sub>O

t°	g NH <sub>4</sub> Cl in 100 g of the solution	Sc	l phase
— 0 45	0 7 <sup>8</sup>		Ice
— 1 25	1 9 <sup>8</sup>		"
— 1 70	2 7 <sup>5</sup>		"
— 3 05	4 6		"
— 4 45	6 6 <sup>7</sup>		"
— 6 4	9 2 <sup>3</sup>		"
— 8 25	11 4		"
— 9 7	13 1		"
— 11 9	15 3		"
— 13 25	16 7		"
— 14 70	18 1 <sup>5</sup>		"
— 15 4	18 9		"
± 16 0	± 19 5	Ice	NH <sub>4</sub> Cl
— 15 0	19 7		NH <sub>4</sub> Cl
— 12 2	20 0		"
— 10 9	20 3		"
— 7 4	21 1		"
— 5 7	21 7		"
— 2 3	22 3		"
± 1 1	22 6		"
0	22 7		"

(Meerburg, Z anorg 1903, 37 33)

100 g H<sub>2</sub>O dissolve 29 5 g NH<sub>4</sub>Cl at 30° (Schrenemakers, Arch near Sc (2 15 17)

Spec gravity of NH<sub>4</sub>Cl + Aq G = according to Gerlach at 15° (Z anal 8 31), S = according to Schiff at 19° (A 1 74)

% NH <sub>4</sub> Cl	Sp gr		% NH <sub>4</sub> Cl	Sp gr	
	G	S		G	S
1	1 00316	1 0029	17	1 050	1 0495
2	1 00632	1 0058	18	1 053	1 0523
3	1 00948	1 0087	19	1 056	1 0551
4	1 01264	1 0116	20	1 059	1 0579
5	1 01580	1 0145	21	1 062	1 0606
6	1 01880	1 0174	22	1 064	1 0633
7	1 02180	1 0203	23	1 067	1 0660
8	1 02481	1 0233	24	1 070	1 0687
9	1 02781	1 0263	25	1 073	1 0714
10	1 03081	1 0293	26	1 073	1 0741
11	1 03370	1 0322	26 297	1 076	
12	1 03658	1 0351	27		1 0768
13	1 03947	1 0380	28		1 0794
14	1 04325	1 0409	29		1 0802
15	1 04524	1 0438	30		1 0846
16	1 04805	1 0467			

For older determinations, see Storck's Diet

Sp gr of NH<sub>4</sub>Cl + Aq at 18°

% NH <sub>4</sub> Cl	Sp gr	% NH <sub>4</sub> Cl	Sp gr
5	1 0142	20	0571
10	1 0289	25	0710
15	1 0430		

(Kohlrausch, W Ann 1879 1

Sp gr at 20°/4° of a normal solution of  $\text{NH}_4\text{Cl}$  = 1.01454 (Haigh, J Am Chem Soc 1912, **34** 1151)

$\text{NH}_4\text{Cl}$  + Aq containing 6.52%  $\text{NH}_4\text{Cl}$  has sp gr 20°/20° = 1.0195 (Le Blanc & Rohland, Z phys Ch 1896, **19** 272)

Temp of maximum density of $\text{NH}_4\text{Cl}$ + Aq	g mol $\text{NH}_4\text{Cl}$ in 1000 g $\text{H}_2\text{O}$
2.640°	0.1899
0.055°	0.5407

(de Coppet, C R 1900, **131** 178)

Sp gr of dil  $\text{NH}_4\text{Cl}$  + Aq at 20.004° and 731 mm (corr)  
Conc = g equiv  $\text{NH}_4\text{Cl}$  per l at 20.004°

Conc	Sp gr
0.0000	1.000,000,0
0.0001	1.000,001,8
0.0002	1.000,003,7
0.0005	1.000,009,3
0.0010	1.000,018,5
0.0020	1.000,036,9
0.0050	1.000,091,3
0.0100	1.000,180,3

(Lamb and Lee, J Am Chem Soc 1913, **35** 1688)

Sp gr of dil  $\text{NH}_4\text{Cl}$  + Aq

$\text{NH}_4\text{Cl}$ g in 1000 g of solution	Sp gr 16°/16°
0	1.000000
0.4431	1.000150
0.9061	1.000304
1.5055	1.000606
3.5947	1.001196
7.7845	1.002562
13.3425	1.004994
31.2364	1.010018

(Dijkcn, Z phys Ch 1897, **24** 107)

B-pt of  $\text{NH}_4\text{Cl}$  + Aq, containing pts  $\text{NH}_4\text{Cl}$  to 100 pts  $\text{H}_2\text{O}$  G = according to Gerlach (Z anal **26** 439), I = according to Isgard (A ch (2) **59** 436)

B pt	G	I	B pt	G	L
101°	6.5	7.8	109°	50.6	53.5
102	12.8	13.9	110	56.2	59.9
103	19.0	19.7	111	61.9	66.4
104	24.7	25.2	112	67.8	73.3
105	29.7	30.5	113	74.2	80.5
106	34.6	35.7	114	81.3	88.1
107	39.6	41.3	114.2		88.9
108	45.0	47.3	114.8	87.1	

Sat  $\text{NH}_4\text{Cl}$  + Aq boils at 115.8° at 718 mm pressure (Alluard, C R **59** 500)

$\text{NH}_4\text{Cl}$  + Aq containing 74.2 pts  $\text{NH}_4\text{Cl}$  to 100 pts  $\text{H}_2\text{O}$  forms a crust at 113°, highest temperature observed, 114.8° (Gerlach, Z anal **26** 426)

$\text{NH}_4\text{Cl}$  + Aq containing 10%  $\text{NH}_4\text{Cl}$  boils at 101.7°, 20%  $\text{NH}_4\text{Cl}$  at 104.4° (Gerlach)  
 $\text{NH}_4\text{Cl}$  + Aq containing 10.6%  $\text{NH}_4\text{Cl}$  gives off  $\text{NH}_3$  at 37° (Leeds, Am J Sci (3) **7** 197)

When  $\text{NH}_4\text{Cl}$  + Aq is boiled, or even evaporated on water bath, a little  $\text{NH}_3$  is expelled (Fresenius)

30 pts  $\text{NH}_4\text{Cl}$  mixed with 100 pts  $\text{H}_2\text{O}$  lower the temp from 13.3° to -5.1°, that is 18.4° (Rudorff, B **2** 68)

Freezing-point of sat solution is -15.4°, the same temp which is caused by mixing 25 pts  $\text{NH}_4\text{Cl}$  with 100 pts snow (Rudorff, Pogg **122** 337)

Conc  $\text{HCl}$  + Aq precipitates part of  $\text{NH}_4\text{Cl}$  from sat  $\text{NH}_4\text{Cl}$  + Aq (Vogel, J pr **2** 199)

Solubility of  $\text{NH}_4\text{Cl}$  in  $\text{HCl}$  + Aq at 0°  $\text{NH}_4\text{Cl}$  = mols  $\text{NH}_4\text{Cl}$  (in milligrammes) dissolved in 10 cc of the liquid,  $\text{HCl}$  = mols  $\text{HCl}$  (in milligrammes) dissolved in 10 cc of the liquid

$\text{NH}_4\text{Cl}$	$\text{HCl}$	Sum of mols	Sp gr
46.125	0.0	46.125	1.076
43.6	2.9	46.5	1.0695
41.0	5.5	46.5	1.0705
39.15	7.85	47.0	1.0715
36.45	10.85	47.30	1.073
27.57	21.4	48.77	1.078
10.875	53.0	63.875	1.106
8.8	61.0	69.8	1.114

(Engel, Bull Soc (2) **45** 655)

Solubility of  $\text{NH}_4\text{Cl}$  in  $\text{HCl}$  + Aq

t	$\text{HCl}$ concentration g mol per 100 g $\text{H}_2\text{O}$	Weight $\text{NH}_4\text{Cl}$ in 100 g	Molecular solubility
0°	0	298.40	5.59
"	1.1	286.45	5.56
"	1.2	271.23	5.08
"	1	245.35	4.60
25°	0	395.10	7.40
"	1.1	350.85	7.13
"	1	366.00	6.85
"	1	339.05	6.35

(Armstrong & Evre, Proc R Soc (A) **84** 127)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$   $\text{NH}_4\text{Cl} = \text{mols}$   
 $\text{NH}_4\text{Cl}$  (in mgs) in 10 cc solution,  
 $\text{NH}_3 = \text{mols}$   $\text{NH}_3$  (in mgs) in 10 cc  
 solution

$\text{NH}_4\text{Cl}$	$\text{NH}_3$	Sp gr
46 125	0	1 076
45 8	5 37	1 067
45 5	12 025	1 054
45 125	23 4	1 044
44 5	38 0	1 031
44 0	47	1 025
43 625	54 5	1 017
43 125	80 0	0 993
44 0	90 0	0 992
44 375	95 5	0 983
49 75	130	0 953
60 0	169 75	0 931

(Engel, Bull Soc (3) 6 17)

$\text{NH}_4\text{Cl} + \text{BaCl}_2$  100 pts  $\text{H}_2\text{O}$  dissolve 33 8  
 pts  $\text{NH}_4\text{Cl} + 11$  6 pts  $\text{BaCl}_2$  at  $20^\circ$  (Rudorff,  
 Pogg 148 467)

Solubility of  $\text{NH}_4\text{Cl}$  and  $\text{BaCl}_2$  in  $\text{H}_2\text{O}$

$t^\circ$	Wt per 100		Solid phase
	$\text{NH}_4\text{Cl}$	$\text{BaCl}_2$	
-16 $2^\circ$	16 10	8 07	$\text{NH}_4\text{Cl} +$ $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
0	19 26	8 22	
30	24 89	8 19	
40	26 93	8 40	
	29 53	8 55	

Schreinemakers, Chem Weekbl 1910, 7 333 )  
 See also  $\text{BaCl}_2 + \text{NH}_4\text{Cl}$  under  $\text{BaCl}_2$

$\text{NH}_4\text{Cl} + \text{CdCl}_2$  Solubility of  $\text{NH}_4\text{Cl}$  and  
 $\text{CdCl}_2$   
 See Ammonium cadmium chloride

$\text{NH}_4\text{Cl} + \text{CuCl}_2$  Solubility of  $\text{NH}_4\text{Cl}$  in  
 $\text{H}_2\text{O}$  at  $30^\circ$  in presence of varying amounts of  
 $\text{CuCl}_2$

% by wt $\text{CuCl}_2$	% by wt $\text{NH}_4\text{Cl}$	Solid phase
0	29 5	$\text{NH}_4\text{Cl}$ $\text{NH}_4\text{Cl} + \text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ $\text{CuCl}_2 \cdot 2\text{NH}_4\text{Cl} \cdot 2\text{H}_2\text{O}$
1 9	28 6	
3 6	25 9	
7 7	19 8	
10 5	16 5	
12 3	14 9	$\text{CuCl}_2 \cdot 2\text{NH}_4\text{Cl} \cdot 2\text{H}_2\text{O} + \text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
15 6	12 1	
19 9	9 4	
24 0	7 1	
29 4	4 9	
35 1	3 4	
41 4	2 1	
43 2	2 0	
43 9	0	

(Meerburg, Z anorg 1905, 45 3)

$\text{NH}_4\text{Cl} + \text{PbCl}_2$  Solubility of  $\text{NH}_4\text{Cl}$  and  
 $\text{PbCl}_2$  in  $\text{H}_2\text{O}$  at  $22^\circ$

g equivalent in 1000 g $\text{H}_2\text{O}$		Solid phase
$\text{NH}_4\text{Cl}$	$\text{PbCl}_2$	
0 0	0 0749	$\text{PbCl}_2$
0 1	0 0325	"
0 2	0 0194	"
0 3	0 0153	"
0 4	0 0138	"
0 5	0 0130	"
0 52	0 0127	$\text{PbCl}_2 + \text{NH}_4\text{Cl}$
0 55	0 0123	$\text{NH}_4\text{Cl} \cdot 2\text{H}_2\text{O}$
0 6	0 0113	"
0 65	0 0105	"
0 7	0 0099	"
0 8	0 0087	"
0 9	0 0083	"
1 0	0 0080	"
1 2	0 0075	"
1 5	0 0073	"
2 0	0 0077	"
2 5	0 0092	"
3 0	0 0112	"
4 0	0 0182	"
5 0	0 0296	"
6 0	0 0473	"
7 0	0 0774	"
7 29	0 0898	$\text{NH}_4\text{Cl} + \text{NH}_4\text{Cl}$
7 29	0 0000	$\text{NH}_4\text{Cl}$

(Bronstedt, Z phys Ch 1911, 77 132)

Solubility of  $\text{NH}_4\text{Cl}$  and  $2\text{PbCl}_2$  in  
 $\text{H}_2\text{O}$  at  $100^\circ$

$\text{NH}_4\text{Cl}$ g equivalent		$\text{PbCl}_2$ g equivalent		Solid phase
in 1000 g solution	in 1000 g $\text{H}_2\text{O}$	in 1000 g solution	in 1000 g $\text{H}_2\text{O}$	
1 277	1 404	0 160	0 176	$\text{NH}_4\text{Cl}$ $+ 2\text{PbCl}_2$

(Bronstedt, l c)

$\text{NH}_4\text{Cl} + \text{MgCl}_2$  Solubility of  $\text{NH}_4\text{Cl}$  and  
 $\text{NH}_4\text{MgCl}_3 \cdot 6\text{H}_2\text{O}$

$t^\circ$	In 1000 g mols $\text{H}_2\text{O}$		Solid phase
	mols $\text{NH}_4\text{Cl}$	mols $\text{MgCl}_2$	
3 $5^\circ$	27 5	55 7	$\text{NH}_4\text{Cl} + \text{NH}_4\text{MgCl}_3$
25	42 1	56 4	$6\text{H}_2\text{O}$
50	62 9	59 1	"

(Biltz and Marcus, Z anorg 1911, 170)

Solubility of  $\text{NH}_4\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$  and  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$

$t^\circ$	In 1000 g mol $\text{H}_2\text{O}$		Solid phase
	g mol $\text{NH}_4\text{Cl}$	g mol $\text{MgCl}_2$	
$3\ 5^\circ$	0 5	99 5	$\text{MgCl}_2 \cdot 6\text{H}_2\text{O} + \text{NH}_4\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
$25^\circ$	0 5	103 8	
$50^\circ$	0 8	111 2	

(Biltz and Marcus, Z anorg 1911, 71 170)

$\text{NH}_4\text{Cl} + \text{NH}_4\text{NO}_3$  100 pts  $\text{H}_2\text{O}$  dissolve 29 1 pts  $\text{NH}_4\text{Cl} + 173$  8 pts  $\text{NH}_4\text{NO}_3$  at  $19\ 5^\circ$  (Rudorff, B 6 482)

$\text{NH}_4\text{Cl} + \text{Ba}(\text{NO}_3)_2$  100 pts  $\text{H}_2\text{O}$  dissolve at  $18\ 5^\circ$ —

	1	2	3	4	5
$\text{NH}_4\text{Cl}$	36 7	38 6	38 06	39 18	
$\text{Ba}(\text{NO}_3)_2$		8 6	16 73	17 02	8 9

2, sat  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  treated with  $\text{NH}_4\text{Cl}$ , 3, sat  $\text{NH}_4\text{Cl} + \text{Aq}$  treated with  $\text{Ba}(\text{NO}_3)_2$ , 4, simultaneous treatment of both salts with  $\text{H}_2\text{O}$  (Karsten)

$\text{NH}_4\text{Cl} + \text{KNO}_3$  100 pts  $\text{H}_2\text{O}$  dissolve at  $18\ 5^\circ$ —

	1	2	3	4	5	6
$\text{KNO}_3$	29 9	30 56	37 68	38 62		34 2
$\text{NH}_4\text{Cl}$		44 33	37 98	39 84	36 7	38 8
		74 89	75 66	78 46		73 0

1 and 5, according to Mulder, 2, sat  $\text{KNO}_3 + \text{Aq}$  treated with  $\text{NH}_4\text{Cl}$ , 3, sat  $\text{NH}_4\text{Cl} + \text{Aq}$  treated with  $\text{KNO}_3$ , 4, simultaneous treatment of  $\text{NH}_4\text{Cl}$  and  $\text{KNO}_3$  (Karsten), 6, by warming solution with excess of both salts, and cooling to  $14\ 8^\circ$ . The amount of excess of one or the other salt has no influence (Rudorff)

$\text{NH}_4\text{Cl} + \text{NaN}_3$  Slowly sol in sat  $\text{NaN}_3 + \text{Aq}$  at first to a clear solution, but afterwards  $\text{NaN}_3$  separates out (Karsten)

$\text{NH}_4\text{Cl} + \text{KCl}$  100 pts  $\text{H}_2\text{O}$  dissolve—

	(Rudorff) 15	(Karsten) 18 75
$\text{KCl}$	16 97	34 4
$\text{NH}_4\text{Cl}$	25 90	16 27 29 83
		37 02

	(Rudorff) 22	(Mulder) At b pt
$\text{KCl}$	19 1	58 5
$\text{NH}_4\text{Cl}$	30 4	21 9 67 7
		87 3

100 pts sat solution of  $\text{NH}_4\text{Cl} + \text{KCl}$  contain 30 61 pts of the two salts at  $13$ – $16^\circ$  (v Hauer, J pr 103 114)

$\text{NH}_4\text{Cl} + \text{NaCl}$  100 pts  $\text{H}_2\text{O}$  dissolve—

	10–20°	(Mulder) 10°	10°	(v Hauer) 13–16°
$\text{NH}_4\text{Cl}$		19 50	33 3	18 8–20 3
$\text{NaCl}$	35 8	30 00		24 6–26 1
		49 50		43 4–46 4

	(Karsten) 18 75°	(Rudorff) 18 7°	(Mulder) At b pt
$\text{NH}_4\text{Cl}$	22 06	22 9	87 3
$\text{NaCl}$	37 02	23 9	78 5
	26 38		22 3
	48 44	46 8	100 8

Sp gr of sat solution of  $\text{NH}_4\text{Cl} + \text{NaCl}$  is 1 179 (Karsten)

$\text{NH}_4\text{Cl} + (\text{NH}_4)_2\text{SO}_4$  100 pts  $\text{H}_2\text{O}$  dissolve 26 8 pts  $\text{NH}_4\text{Cl} + 46$  5 pts  $(\text{NH}_4)_2\text{SO}_4$  at  $21\ 5^\circ$  (Rudorff, B 6 484)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$

Composition of the solution		Solid phase
% by wt $\text{NH}_4\text{Cl}$	% by wt $(\text{NH}_4)_2\text{SO}_4$	
0	44	$(\text{NH}_4)_2\text{SO}_4$
6 86	36 15	
14 62	28 6	
17 60	25 69	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{Cl}$
17 93	25 81	
19 07	23 22	$\text{NH}_4\text{Cl}$
19 97	21 3	
22 3	16 33	
24 06	12 72	
29 5	0	

(Schreinmakers, Z phys Ch 1909, 69 562)

$\text{NH}_4\text{Cl} + \text{CuSO}_4$  Sol in sat  $\text{CuSO}_4 + \text{Aq}$ , at first to a clear solution, but a double sulphate of  $\text{NH}_4$  and  $\text{Cu}$  soon separates (Karsten)

$\text{NH}_4\text{Cl} + \text{MgSO}_4$  Slowly and difficultly sol in sat  $\text{MgSO}_4 + \text{Aq}$  with subsequent separation of double sulphate (Karsten)

$\text{NH}_4\text{Cl} + \text{K}_2\text{SO}_4$  100 pts  $\text{H}_2\text{O}$  dissolve, at  $18\ 75^\circ$ —

		a	b	c	
$\text{K}_2\text{SO}_4$	10 8	11 1	13 26	15 25	
$\text{NH}_4\text{Cl}$		38 2	37 94	37 92	36 7
		49 3	51 20	51 20	

In (a)  $\text{NH}_4\text{Cl}$  was added to sat  $\text{K}_2\text{SO}_4 + \text{Aq}$   
In (b)  $\text{K}_2\text{SO}_4$  was added to sat  $\text{NH}_4\text{Cl} + \text{Aq}$   
In (c)  $\text{NH}_4\text{Cl}$  and  $\text{K}_2\text{SO}_4$  were treated together with  $\text{H}_2\text{O}$  (Karsten)

100 pts H<sub>2</sub>O at 14° dissolve 14.1 pts K<sub>2</sub>SO<sub>4</sub>+36.8 pts NH<sub>4</sub>Cl=50.9 pts K<sub>2</sub>SO<sub>4</sub>+NH<sub>4</sub>Cl under all conditions (Rudorff, Pogg 148 565)

100 pts H<sub>2</sub>O dissolve at b-pt —

K <sub>2</sub> SO <sub>4</sub>	26.75	33.3—33.9	87.3
NH <sub>4</sub> Cl		90.4—111.8	
		123.7—145.7	

(Mulder)

NH<sub>4</sub>Cl+Na<sub>2</sub>SO<sub>4</sub> 100 pts H<sub>2</sub>O dissolve 28.9 pts NH<sub>4</sub>Cl+24.7 pts Na<sub>2</sub>SO<sub>4</sub>, if NH<sub>4</sub>Cl +Aq sat at 10° is sat with Na<sub>2</sub>SO<sub>4</sub> at 11°

100 pts H<sub>2</sub>O dissolve 31.8 pts NH<sub>4</sub>Cl+9.0 pts Na<sub>2</sub>SO<sub>4</sub>, if Na<sub>2</sub>SO<sub>4</sub>+Aq sat at 10° is sat with NH<sub>4</sub>Cl at 11° (Mulder, J B 1866 68)

Sol in sat Na<sub>2</sub>SO<sub>4</sub>+Aq (Karsten)

Sol in sat ZnSO<sub>4</sub>+Aq (Karsten)

Sl sol in liquid NH<sub>3</sub> at -50° (Moissan, C R 1901, 133 713)

Very sol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 826)

Very sl sol in absolute alcohol

100 pts alcohol of 0.939 sp gr dissolve—  
at 4° 8° 27° 38° 56°

11.2 12.6 19.4 23.6 30.1 pts NH<sub>4</sub>Cl  
(Gerardin, A ch (4) 5 129)

boiling highest rectified spirit dissolve 1 pt  
(Wenzel)

alcohol of—  
900 sp gr dissolve 6.5 pts NH<sub>4</sub>Cl

0.872 4.75

0.834 1.5

(Kirwan)

Though somewhat sol in pure absolute alcohol, NH<sub>4</sub>Cl is absolutely insol in alcohol in presence of methyl amine chlorides (Winkles, A 93 324)

100 pts absolute methyl alcohol dissolve 3.35 pts at 19°

100 pts absolute ethyl alcohol dissolve 0.62 pt at 19° (de Bruyn, Z phys Ch 10 783)

#### Solubility of NH<sub>4</sub>Cl in methyl alcohol

t°	Alcohol concentration mol g alcohol for 1000 g H <sub>2</sub> O	Solubility in 1000 g H <sub>2</sub> O	Molecular solubility
0°	0	298.40	5.59
"	1/4	297.35	5.57
"	1/2	296.55	5.55
"	1	292.60	5.47
"	3	283.15	5.30
25°	0	395.10	7.40
"	1/4	394.75	7.39
"	1/2	393.55	7.37
"	1	392.90	7.36
"	3	386.20	7.23

(Armstrong and Eyre, Proc R Soc Lond (A)

84 127)

#### Solubility of NH<sub>4</sub>Cl in ethyl alcohol 0°

Alcohol concentration mol g alcohol for 1000 g H <sub>2</sub> O	Solubility in 1000 g H <sub>2</sub> O	Mol sol	ular lity
0	298.40	5.59	
1/4	295.50	5.53	
1/2	291.95	5.47	
1	286.40	5.37	
3	266.25	4.99	

(Armstrong and Eyre, l c)

See also ammonium cupric chloride

#### Solubility of NH<sub>4</sub>Cl in propyl alcohol

t°	Alcohol concentration mol g alcohol for 1000 g H <sub>2</sub> O	Solubility in 1000 g H <sub>2</sub> O	Mol sol	ular lity
0°	0	298.46	5.59	
"	1/4	295.40	5.53	
"	1/2	291.30	5.45	
"	1	284.00	5.32	
25°	0	395.10	7.40	
"	1/4	393.50	7.37	
"	1/2	390.80	7.32	
"	1	384.80	7.21	

(Armstrong and Eyre, l c)

#### Solubility in mixtures of methyl and ethyl alcohol at 25°

P = % methyl alcohol in the solvent

G = g NH<sub>4</sub>Cl in 10 cc of the solution

S = sp gr of the sat solution at 25°

P	G	S
0.00	0.0533	0.790
4.37	0.0583	0.790
10.40	0.0658	0.791
41.02	0.118	0.795
50.69	0.217	0.802
84.77	0.227	0.802
91.25	0.247	0.804
100.00	0.276	0.806

(Herz, Z anorg 1908, 60 155)

#### Solubility in mixtures of methyl and propyl alcohol at 25°

P = % propyl alcohol in the solvent

G = g NH<sub>4</sub>Cl in 10 cc of the solution

S = sp gr of the sat solution at 25°

P	G	S
0	0.276	0.806
11.11	0.231	0.803
23.8	0.182	0.800
65.2	0.071	0.800
91.8	0.026	0.800
93.75	0.023	0.800
100.00	0.018	0.800

(Herz, Z anorg 1908, 60 157)

Solubility in mixtures of propyl and ethyl alcohol at 25°

P = % propyl alcohol in the solvent

G = g NH<sub>4</sub>Cl in 10 cc of the solution

S = Sp gr of the sat solution at 25°/4°

P	G	S
0	0 0533	0 7908
8 1	0 0505	0 7910
17 85	0 0455	0 7916
56 6	0 0312	0 7963
88 6	0 0210	0 7996
91 2	0 0203	0 8001
95 2	0 0190	0 8003
100	0 0177	0 8009

(Herz, Z anorg 1908, 60 160)

Insol in ether and CS<sub>2</sub> (Fordos and Gélis, A ch (3) 32 393)

Very sl sol in acetone (Krug and M'Elroy, J anal appl Ch 6 184)

Solubility of NH<sub>4</sub>Cl in acetone + Aq at 25°

A = cc acetone in 100 cc acetone + Aq

NH<sub>4</sub>Cl = millimols NH<sub>4</sub>Cl in 100 cc of the solution

A	NH <sub>4</sub> Cl	Sp gr
0	585 1	1 0793
10	534 1	1 0618
20	464 6	1 0451
30	396 7	1 0263
40	328 5	0 99984
46 5	283 7	0 97998
to		
85 7	18 9	0 8390
90	9 4	0 8274

(Herz, Z anorg 1905 45 263)

Solubility of NH<sub>4</sub>Cl in glycerine + Aq at 25°

G = g glycerine in 100 g glycerine + Aq

NH<sub>4</sub>Cl = millimols NH<sub>4</sub>Cl in 100 cc of the solution

G	NH <sub>4</sub> Cl	Sp gr
0	585 1	1 0793
15 28	544 6	1 0947
25 98	502 9	1 1127
45 36	434 4	1 1452
54 23	403 5	1 1606
83 84	291 4	1 2225
100	228 4	1 2617

(Herz, *loc*)

Insol in acetone (Naumann, B 1904, 37 4328), (Lindmann, C C 1899 II, 1014)

Insol in anhydrous pyridine Sol in 97% pyridine + Aq, 95% pyridine + Aq and in 93% pyridine + Aq (Kahlenberg, J Am Chem Soc 1908, 30 1107)

Insol in CS<sub>2</sub> (Arcowski, Z anorg 1894, 6 257)

Very sol in ethyl amine (Shinn, J phys Chem 1907, 11 538)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Sol in formic acid (Zanninovich-Tessarini, Z phys Ch 1896, 19 251)

**Ammonium antimony chloride**, SbCl<sub>5</sub>(NH<sub>4</sub>)<sub>2</sub>, SbCl<sub>5</sub>(NH<sub>4</sub>)<sub>3</sub>

Ppt Decomp by H<sub>2</sub>O (Weinland, B 1905, 38 1085)

SbCl<sub>5</sub>(NH<sub>4</sub>)<sub>2</sub>, SbCl<sub>5</sub>, NH<sub>4</sub>OH Very deliquescent, sl sol in H<sub>2</sub>O with decomp (Weinland, B 1901, 34 2635)

**Ammonium antimonous chloride**, NH<sub>4</sub>Cl, SbCl<sub>3</sub>

Deliquescent (Dehéran, C R 52 734)

2NH<sub>4</sub>Cl, SbCl<sub>3</sub> + 2H<sub>2</sub>O Permanent in dry air, decomp by much H<sub>2</sub>O (Poggiale)

3NH<sub>4</sub>Cl, SbCl<sub>3</sub> + 3H<sub>2</sub>O As above

**Ammonium antimonic chloride**, 3NH<sub>4</sub>Cl, SbCl<sub>5</sub>

Decomp by H<sub>2</sub>O (Dehéran, C R 52 734)

4NH<sub>4</sub>Cl, SbCl<sub>5</sub> Decomp by H<sub>2</sub>O (D)

See also Chlorantimonate, ammonium

**Ammonium antimony platinum chloride**, (Sb, Pt)Cl<sub>6</sub>(NH<sub>4</sub>)<sub>2</sub>

Ppt (Weinland, B 1905, 38 1084)

**Ammonium antimony tin chloride**,

(Sb, Sn)Cl<sub>6</sub>(NH<sub>4</sub>)<sub>2</sub>

Ppt (Weinland, B 1905, 38 1085)

**Ammonium arsenyl chloride**, 2NH<sub>4</sub>Cl, AsOCl + ½H<sub>2</sub>O

(Wallace, Phil Mag (4) 16 358)

**Ammonium bismuth chloride**, NH<sub>4</sub>Cl, 2BiCl<sub>3</sub>

Deliquescent (Dehéran, C R 54 724)

2NH<sub>4</sub>Cl, BiCl<sub>3</sub> Decomp by H<sub>2</sub>O (Arppe) Pogg 64 237)

+ 2½H<sub>2</sub>O (Rammelsberg)

3NH<sub>4</sub>Cl, BiCl<sub>3</sub> Decomp by H<sub>2</sub>O (Arppe)

5NH<sub>4</sub>Cl, 2BiCl<sub>3</sub> (Rammelsberg)

**Ammonium bismuth potassium chloride**, 2NH<sub>4</sub>Cl, BiCl<sub>3</sub>, KCl

(Dehéran, C R 54 724)

**Ammonium cadmium chloride**, NH<sub>4</sub>Cl CdCl

Solubility of NH<sub>4</sub>Cl (CdCl in H<sub>2</sub>O at t°

t	Pts by weight in 100 pts of solution			g in 100 g solution	Grams in 100 H <sub>2</sub> O	Mol H <sub>2</sub> O free salt dissolved by 100 mol H <sub>2</sub> O
	Cl	Cd	NH <sub>4</sub>			
2 4°	13 44	14 26	2 24	29 94	42 74	3 25
16 0	15 07	15 82	2 56	33 45	50 26	3 55
41 2	17 46	18 61	2 89	38 96	63 83	4 86
63 8	19 73	20 92	3 34	43 99	78 54	5 98
105 9	23 52	24 70	4 01	52 58	109 33	5 30

(Rimbach, B 1897, 30 3076)



+ $\frac{1}{2}$ H<sub>2</sub>O Sol in H<sub>2</sub>O, alcohol, and wood spirit (v Hauer, W A B 13 449)  
 4NH<sub>4</sub>Cl, CdCl<sub>2</sub> Sol in H<sub>2</sub>O (v Hauer)  
 Decomp by H<sub>2</sub>O to NH<sub>4</sub>Cl, CdCl<sub>2</sub> Decomp increases with decrease of temp At 39° approximately wholly decomp to NH<sub>4</sub>Cl, CdCl<sub>2</sub> At 113.9° very nearly all is 4NH<sub>4</sub>Cl, CdCl<sub>2</sub> (Rimbach, B 1897, 30 3077)

Solubility of 4NH<sub>4</sub>Cl, CdCl<sub>2</sub> in H<sub>2</sub>O at t°

t°	Pts dissolved in 100 pts by weight of solution		
	Cd	Cl	NH <sub>4</sub>
3 9	5 75	18 17	7 37
16 1	6 93	20 26	7 97
40 2	9 91	23 84	8 92
58 5	12 50	26 53	9 35
112 9	16 66	31 79	10 78
113 9	16 51	32 71	11 30

(Rimbach, B 1897, 30 3071)

Sol without decomp in 37.3% HCl(d=1.19) and 24.8% HCl(d=1.125) (Rimbach, B 1905, 38 1569)

Solubility of 4NH<sub>4</sub>Cl, CdCl<sub>2</sub>+NH<sub>4</sub>Cl in H<sub>2</sub>O at t°

t°	In 100 pts by wt of the solution			Composition of the solid phase	
	Pts by wt Cd	Pts by wt Cl	Pts by wt NH <sub>4</sub>	Mol % NH <sub>4</sub> Cl	Mol % Tetra salt
1 0	2 82	17 11	7 82	59 0	41 0
13 2	2 76	18 84	8 71	74 0	26 0
40 1	3 16	22 56	10 49	71 0	29 0
58 2	3 51	25 21	11 72	69 0	31 0

(Rimbach, B 1902, 35 1300)

Solubility of 4NH<sub>4</sub>Cl, CdCl<sub>2</sub>+NH<sub>4</sub>Cl, CdCl<sub>2</sub> in H<sub>2</sub>O at t°

t°	In 100 pts by wt of the solution			Composition of the solid phase	
	Pts by wt Cd	Pts by wt Cl	Pts by wt NH <sub>4</sub>	Mol % Mono salt	Mol % Tetra salt
1 1	5 34	17 62	7 27	49 6	50 4
14 0	7 12	19 86	7 84	47 0	53 0
40 7	10 24	23 82	8 85	77 0	23 0
58 5	12 50	26 53	9 35		

(Rimbach, B 1902, 35 1300)

Sol without decomp in 50% LiCl+Ag, 33.3% CaCl<sub>2</sub>+Ag and 50% MgCl<sub>2</sub>+Ag (Rimbach, B 1905, 38 1569)

**Ammonium chloromolybdenum chloride,** 2NH<sub>4</sub>Cl, Cl<sub>4</sub>Mo<sub>3</sub>Cl<sub>2</sub>+2H<sub>2</sub>O

Decomp by pure H<sub>2</sub>O, can be crystallized from HCl+Ag (Blomstrand)

**Ammonium chromium chloride,** 2NH<sub>4</sub>Cl, CrCl<sub>3</sub>+H<sub>2</sub>O

Sol in H<sub>2</sub>O with decomp (Neumann, A 244 229)

+6H<sub>2</sub>O=2NH<sub>4</sub>Cl, [Cl<sub>2</sub>Cl<sub>2</sub>4H<sub>2</sub>O]Cl+2H<sub>2</sub>O

Hygroscopic Decomp by H<sub>2</sub>O and b alcohol (Weinland, B 1907, 40 770)

**Ammonium cobaltous chloride,** NH<sub>4</sub>Cl, CoCl<sub>2</sub>+6H<sub>2</sub>O

Deliquescent in moist air Very easily so in H<sub>2</sub>O (Hautz, A 66 284)

**Ammonium cobaltous chloride ammonium** NH<sub>4</sub>Cl, CoCl<sub>2</sub>, NH<sub>3</sub> (F Roess)

**Ammonium cuprous chloride,** 4NH<sub>4</sub>Cl, Cu<sub>2</sub>Cl<sub>2</sub>

Decomp in the air 4NH<sub>4</sub>Cl, 3Cu<sub>2</sub>Cl<sub>2</sub> Decomp by H<sub>2</sub>O, not by alcohol (Ritthausen, J pr 56 369)

Fairly stable in air (Wells, Z anorg 1891 10 158)

**Ammonium cupric chloride,** NH<sub>4</sub>Cl, CuCl<sub>2</sub>

Solubility of NH<sub>4</sub>Cl, CuCl<sub>2</sub> in absolute alcohol at 25°

CuCl <sub>2</sub> %	Solid phase	CuCl <sub>2</sub> %	Solid phase
4 65	NH <sub>4</sub> Cl+NH <sub>4</sub> Cl, CuCl <sub>2</sub>	12 90	NH <sub>4</sub> Cl, CuCl <sub>2</sub>
4 74	NH <sub>4</sub> Cl+NH <sub>4</sub> Cl, CuCl <sub>2</sub>	34 92	NH <sub>4</sub> Cl, CuCl <sub>2</sub> +C <sub>2</sub> H <sub>5</sub> OH
6 45	NH <sub>4</sub> Cl, CuCl <sub>2</sub>	34 50	

(Foote and Walden, J Am Ch Soc 1911, 33 1032)

+2H<sub>2</sub>O Sol in 2 pts H<sub>2</sub>O (Hautz, A 66 280)

Does not exist, (Meerburg, C 1904 II 1362)

2NH<sub>4</sub>Cl, CuCl<sub>2</sub>+2H<sub>2</sub>O Easily soluble in H<sub>2</sub>O also in alcohol, even when absolute (Carr and Henry, J pr 13 184)

Solubility of 2NH<sub>4</sub>Cl, CuCl<sub>2</sub> in H<sub>2</sub>O at t°

g 2NH <sub>4</sub> Cl, CuCl <sub>2</sub> in 100 g of the solution	t°	Solid phase
3 87	-1 5°	
5 88	-2 48	
8 78	-3 95	
9 97	-4 60	
13 12	-6 40	
15 84	-5 04	
17 64	-7 24	
20 12	-10 80	
20 3	-11 0	
20 46	-10	
21 16	-5	
22 02	0	
24 26	+12	
25 95	20	
27 70	30	
30 47	40	
33 24	50	
36 13	60	
39 25	70	
43 36	80	

rec+2NH<sub>4</sub>Cl, CuCl<sub>2</sub> 2H<sub>2</sub>O  
 2NH<sub>4</sub>Cl, CuCl<sub>2</sub> 12H<sub>2</sub>O

(Meerburg, Z anorg 1905, 4 8)

Somewhat sol in liquid  $\text{NH}_3$  (Franklin and Kraus, Am Ch J 1898, 20 827)

Is the only hydrate of  $2\text{NH}_4\text{Cl}$ ,  $\text{CuCl}_2$  existing between  $-11^\circ$  and  $+80^\circ$  (Meerburg, C C 1904 II, 1362)

$+3\text{H}_2\text{O}$  (Bourgeois, Bull Soc 1898, (3) 19 786)

**Ammonium cupric chloride ammonia**,  $2\text{NH}_4\text{Cl}$ ,  $\text{CuCl}_2$ ,  $2\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$ , less easily by alcohol  
Decomp by acids (Rutthausen)

**Ammonium indium chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{InCl}_3$ ,  $+\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Meyer)

**Ammonium iodine chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{ICl}_3$

More sol in  $\text{H}_2\text{O}$  than  $\text{KCl}$ ,  $\text{ICl}_3$  (Fihlhol, J Pharm 25 441, Berz J B 20 (2) 110)

**Ammonium iridium trichloride**

See Chloriridate, ammonium

**Ammonium iridium tetrachloride**

See Chloriridate, ammonium

**Ammonium iron (ferrous) chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{FeCl}_2$

Easily sol in  $\text{H}_2\text{O}$ , insol in alcohol (Winkler)

**Ammonium iron (ferric) chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{FeCl}_3$ ,  $+\text{H}_2\text{O}$

Deliquescent Sol in  $\text{H}_2\text{O}$  without decomp (Fritzsch), sol in 3 pts  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abl)  
Sol in  $\text{H}_2\text{O}$  (Walden, Z anorg 1894, 1 332)

**Ammonium iron (ferric) potassium chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{FeCl}_3$ ,  $\text{KCl}$ ,  $+1\frac{1}{2}\text{H}_2\text{O}$

Min Kremerside Deliquescent

**Ammonium lead chloride**,  $\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2$ ,  $+3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  without decomp (?) (André, C R 96 1502)

$6\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2$ ,  $+\text{H}_2\text{O}$

$9\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2$ ,  $+1\frac{1}{2}\text{H}_2\text{O}$

$9\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2$ ,  $+2\frac{1}{2}\text{H}_2\text{O}$

$10\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2$ ,  $+\text{H}_2\text{O}$

$11\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2$ ,  $+3\frac{1}{2}\text{H}_2\text{O}$

$18\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2$ ,  $+4\frac{1}{2}\text{H}_2\text{O}$

All these salts are decomp by  $\text{H}_2\text{O}$  (André, A ch (6) 3 104)

Of the salts prepared by André, only one  $\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2$  exists (Wells, Sill Am J 146 25)

Solubility determinations show that  $\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2$  is the only double salt formed at  $25^\circ$  (Foote, Am Ch J 1907, 37 121)

$\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2$ ,  $+1\frac{1}{3}\text{H}_2\text{O}$  (Wells, l c)

**Ammonium lead tetrachloride**

See Chloroplumbate, ammonium

**Ammonium magnesium chloride**,  $\text{NH}_4\text{MgCl}_2$ ,  $+6\text{H}_2\text{O} = \text{NH}_4\text{Cl}$ ,  $\text{MgCl}_2$ ,  $+6\text{H}_2\text{O}$

Deliquescent Very sol in  $\text{H}_2\text{O}$

Sol in 6 pts cold  $\text{H}_2\text{O}$  (Fourcroy)

Solubility in  $\text{NH}_4\text{Cl}$  + Aq at  $t^\circ$

$t^\circ$	Per 1000 Mol $\text{H}_2\text{O}$	
	Mol $\text{NH}_4\text{Cl}$	Mol $\text{MgCl}_2$
3 5°	27 5	55 7
25 0	42 1	56 4
50 0	62 9	59 1

(Biltz, Z anorg 1911, 71 170)

$4\text{NH}_4\text{Cl}$ ,  $5\text{MgCl}_2$ ,  $+33\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Berthelot and André, A ch (6) 11 294)

**Ammonium manganous chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{MnCl}_2$ ,  $+\frac{1}{2}\text{H}_2\text{O}$

Sol in  $1\frac{1}{2}$  pts  $\text{H}_2\text{O}$  at ordinary temp (Hautz, A 66 280), does not exist (Saunders, Am Ch J 14 134)

$2\text{NH}_4\text{Cl}$ ,  $\text{MnCl}_2$ ,  $+\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Rammsberg), does not exist (Saunders)

$+2\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$ , but with decomp into  $\text{NH}_4\text{Cl}$  and  $\text{MnCl}_2$  (Saunders)

**Ammonium manganic chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{MnCl}_3$

Sol in  $\text{H}_2\text{O}$ , less sol in  $\text{NH}_4\text{Cl}$  + Aq Unstable (Neuman, M 1894, 15 490)

$+\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{HCl}$  apparently without decomp (Rice, Chem Soc 1898, 73 260)

**Ammonium mercuric chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{HgCl}_2$ ,  $+\text{H}_2\text{O}$  (sal alembroth)

Sol in 0.66 pt  $\text{H}_2\text{O}$  at  $10^\circ$ , and in nearly every proportion of hot  $\text{H}_2\text{O}$

$\text{NH}_4\text{Cl}$ ,  $\text{HgCl}_2$  Easily sol in  $\text{H}_2\text{O}$   
 $+1\frac{1}{2}\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Kane)

$2\text{NH}_4\text{Cl}$ ,  $3\text{HgCl}_2$ ,  $+4\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Holmes, C N 5 351)

$\text{NH}_4\text{Cl}$ ,  $2\text{HgCl}_2$  Very sol in  $\text{H}_2\text{O}$  (Rây, Chem Soc 1902, 81 648)

$\text{NH}_4\text{Cl}$ ,  $5\text{HgCl}_2$  (Stromholm, J pr 1902, (2) 66 441)

**Ammonium mercuric sodium chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{HgCl}_2$ ,  $4\text{NaCl}$  (?)

Sol in  $\text{H}_2\text{O}$  (Kossmann, A ch (3) 27 243)

**Ammonium molybdenum chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{MoCl}_3$ ,  $+\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Nearly insol in alcohol and ether (Chilesotti, C C 1903 II, 652)

See also Ammonium chloromolybdenum chloride

**Ammonium molybdenum chloride iodide**

See Ammonium chloromolybdenum iodide

**Ammonium molybdenyl chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{MoO}_2\text{Cl}_2 + 2\text{H}_2\text{O}$

(Weinland, Z anorg 1905, 44 98)

$2\text{NH}_4\text{Cl}$ ,  $\text{MoOCl}_3$  Sol in  $\text{H}_2\text{O}$ , insol in  $\text{H}_2\text{O}$  sat with  $\text{HCl}$  (Klason, B 1901, 34 149)

**Ammonium nickel chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{NiCl}_2 + 6\text{H}_2\text{O}$

Deliquescent in moist air Easily sol in  $\text{H}_2\text{O}$  (Hautz)

$4\text{NH}_4\text{Cl}$ ,  $\text{NiCl}_2 + 7\text{H}_2\text{O}$  (?)

**Ammonium osmium tetrachloride**

See Chlorosmate, ammonium

**Ammonium osmium sesquichloride**

See Chlorosmte, ammonium

**Ammonium osmyl chloride**,  $(\text{NH}_4)_2\text{OsO}_2\text{Cl}_4$

Sol in  $\text{H}_2\text{O}$  Decomp by  $\text{HCl}$  (Wintrebert, A ch 1903, (7) 28 92)

**Ammonium osmyl oxychloride**,

$(\text{NH}_4)_2\text{OsO}_3\text{Cl}_2$

Very sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{KOH} + \text{Ag}$  with decomp (Wintrebert, A ch 1903, (7) 28 116)

**Ammonium palladium chlorides**

See Chloropalladate, ammonium and chloroammonium

**Ammonium rhodium dichloride**,  $4\text{NH}_4\text{Cl}$ ,  $\text{RhCl}_3 + 3\frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , but decomp slowly (Willm B 16 3033)

Does not exist (Leidé, A ch (6) 17 277)

**Ammonium rhodium trichloride**

See Chlororhodite, ammonium

**Ammonium rhodium chloride ammonium nitrate**,  $\text{Rh}_2\text{Cl}_6$ ,  $6\text{NH}_4\text{Cl}$ ,  $2\text{NH}_4\text{NO}_3$

See Chlororhodite nitrate, ammonium

**Ammonium ruthenium trichloride**

See Chlororuthenite, ammonium

**Ammonium ruthenium tetrachloride**

See Chlororuthenate, ammonium

**Ammonium tellurium chloride**

See Chlorotellurate, ammonium

**Ammonium thallic chloride**,  $3\text{NH}_4\text{Cl}$ ,  $\text{HCl}_3$

Easily sol in  $\text{H}_2\text{O}$  (Willm)

$+2\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  and alcohol (Nickles, J Pharm (4) 1 28)

**Ammonium thorium chloride**,  $8\text{NH}_4\text{Cl}$ ,  $\text{ThCl}_4 + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Chydenius)

**Ammonium tin (stannous) chloride (ammonium chlorostannite)**,  $\text{NH}_4\text{Cl}$ ,  $\text{SnCl}_2 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  Resembles K salt (Richardson, Am Ch J 14 93)

$2\text{NH}_4\text{Cl}$ ,  $\text{SnCl}_2 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , it decomp by boiling (Rammelsberg)

Contains  $2\text{H}_2\text{O}$  (Richardson)

$4\text{NH}_4\text{Cl}$ ,  $\text{SnCl}_2 + 3\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Poggiale, C R 20 1182)

Does not exist (Richardson)

**Ammonium tin (stannic) chloride**

See Chlorostannate, ammonium

**Ammonium titanium chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{TiCl}_4 + 2\text{H}_2\text{O}$

Ppt, decomp in moist air, sol in fuming  $\text{HCl}$ , insol in ether (Rosenheim, Z anorg 1901, 26 242)

**Ammonium titanium chloride**,  $3\text{NH}_4\text{Cl}$ ,  $\text{TiCl}_4$

Sol in  $\text{H}_2\text{O}$

$6\text{NH}_4\text{Cl}$ ,  $\text{TiCl}_4$  Sol in  $\text{H}_2\text{O}$  (Rose)

**Ammonium tungsten chloride**,  $(\text{NH}_4)_3\text{W}_2\text{Cl}_7 = 3\text{NH}_4\text{Cl}$ ,  $2\text{WCl}_6$

Easily sol in  $\text{H}_2\text{O}$  Nearly insol in most organic solvents (Olsson, B 1913, 46 5 7)

**Ammonium uranyl chloride**

Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Lilgott)

$2\text{NH}_4\text{Cl}$ ,  $(\text{UO}_2)_2\text{Cl}_2 + 2\text{H}_2\text{O}$  Solution at  $5^\circ$  contains in 100 g 3.51 g,  $\text{NH}_4$ , 40.67 g  $\text{O}_2$  and 19.15 g  $\text{Cl}$ , hence there is considerable decomp (Rumbach, B 1904, 37 466)

**Ammonium vanadium chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{VCl}_3 + \text{H}_2\text{O}$

Difficulty sol in  $\text{H}_2\text{O}$  and alcohol (Staer, B 1904, 37 4412)

**Ammonium zinc chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2 + 2\text{H}_2\text{O}$

Deliquescent Very sol in  $\text{H}_2\text{O}$  (Hautz, A 66 287)

$2\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2$  Sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 94 507)

$+ \text{H}_2\text{O}$  Deliquescent in moist air Sol in  $\frac{1}{3}$  pt cold  $\text{H}_2\text{O}$  with absorption of heat Sol in 0.28 pt hot  $\text{H}_2\text{O}$  (Goltz-Bass, Z anorg 1901, 70 344), sol in  $\frac{1}{2}$  pt cold  $\text{H}_2\text{O}$  (Hautz, A 66 287)

$3\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2$  Sol in  $\text{H}_2\text{O}$  (Mangin, C)

$+ \text{H}_2\text{O}$  (Berthelot, A ch (6) 11 294)

$4\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2$  (Deherun)

$6\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2 + \frac{2}{3}\text{H}_2\text{O}$  (Berthelot, )

**Ammonium chloride zinc oxychloride**,  $2\text{ZnCl}_2$ ,  $8\text{NH}_4\text{Cl}$ ,  $\text{ZnO}$

Sol in a little  $\text{H}_2\text{O}$ , but decomp by excess (Andric)

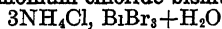
$3\text{ZnCl}_2$ ,  $10\text{NH}_4\text{Cl}$ ,  $\text{ZnO}$  As above (Andric, A ch (6) 3 88)

**Ammonium chloride antimony fluoc de**,  $\text{NH}_4\text{Cl}$ ,  $\text{SbF}_3$

Easily sol in  $\text{H}_2\text{O}$  (de Haen, B 21 90 R)

**Ammonium chloride arsenic trioxide**

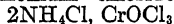
See Arsenite chloride, ammonium

**Ammonium chloride bismuth bromide,**

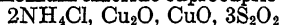
Deliquescent, decomp by  $\text{H}_2\text{O}$  (Murr, Chem Soc **31** 148)

$2\text{NH}_4\text{Cl}, \text{BiBr}_3 + 3\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Murr)

$5\text{NH}_4\text{Cl}, 2\text{BiBr}_3 + \text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Murr)

**Ammonium chloride chromic oxychloride,**

Decomp in the air Sol in conc  $\text{HCl}$  without decomp (Weinland, B 1906, **39** 4045)

**Ammonium chloride cuprocupric thiosulphate,**

See Thiosulphate ammonium chloride, cuprocupric

**Ammonium chloride lead iodide,  $3\text{NH}_4\text{Cl}, \text{PbI}_2$** 

Decomp with  $\text{H}_2\text{O}$  (Behrens, Pogg **62** 252)

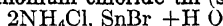
$4\text{NH}_4\text{Cl}, \text{PbI}_2 + 2\text{H}_2\text{O}$  Decomp with  $\text{H}_2\text{O}$  (Poggiale, C R **20** 1180)

**Ammonium chloride mercuric bromide,**

(Edhem-Bey, Dissert **1885**)

**Ammonium chloride platinum sulphite**

See Chloroplatosulphite, ammonium

**Ammonium chloride tin (stannous) bromide,**

Sol in  $\text{H}_2\text{O}$  (Rymann and Preis, A **223** 323)

**Ammonium dichloroiodide,  $\text{NH}_4\text{Cl I}$** 

Slowly decomp when exposed to dry air at ord temp. Vgry sol in  $\text{H}_2\text{O}$  (Chattaway, Chem Soc 1915 **107** 107)

**Ammonium tetrachloroiodide,  $\text{NH}_4\text{Cl}_4\text{I}$** 

Decomp in the air (Chattaway, Chem Soc 1915, **107** 107)

**Ammonium lead chloroiodide,  $\text{NH}_4\text{PbClI} + 2\text{H}_2\text{O}$  and  $(\text{NH}_4)_2\text{PbCl}_2 + 2\text{H}_2\text{O}$** 

Sol in  $\text{KOH} + \text{Aq}$  and in strong acids, decomp by  $\text{H}_2\text{O}$  (Ionizes Drwon, Bull Soc 1897, (5) **17** 318)

**Ammonium fluoride,  $\text{NH}_4\text{F}$** 

Abundantly sol in  $\text{H}_2\text{O}$ , sl sol in alcohol (Marignac, Ann Min (5) **15** 221)

Insol in liquid  $\text{NH}_3$  (Ruff und Giesel, B 1903, **36** 820)

Almost insol in liquid  $\text{NH}_3$  at  $50^\circ$  (Moissan, C R 1901, **133** 713)

Sol in methyl alcohol (Curara, Gazz ch 1896, **26** 119)

**Ammonium hydrogen fluoride,  $\text{NH}_4\text{F}, \text{HF}$** 

Deliquescent in moist air Sol in  $\text{H}_2\text{O}$

**Ammonium antimony fluoride,  $2\text{NH}_4\text{F}, \text{SbF}_3$** 

Deliquescent, sol in 0.9 pt cold  $\text{H}_2\text{O}$  Insol in alcohol or ether (Flückinger, A **84** 248)

$\text{NH}_4\text{F}, 4\text{SbF}_3$  3 pts sol in 2 pts  $\text{H}_2\text{O}$  (Raad and Hauser, B 1890, **23** R 125)

$\text{NH}_4\text{F}, \text{SbF}_3$  Easily sol in  $\text{H}_2\text{O}$  (Marignac, A **145** 239)

**Ammonium bismuth fluoride,  $2\text{NH}_4\text{F}, \text{BiF}_3$** 

Insol in  $\text{H}_2\text{O}$  Rather difficultly sol in acids (Helmholtz, Z anorg **3** 115)

**Ammonium cadmium fluoride,  $\text{NH}_4\text{F}, \text{CdF}_2$** 

Insol in  $\text{H}_2\text{O}$  Sol in acids on boiling (Helmholtz, Z anorg **3** 115)

**Ammonium chromium fluoride,  $3\text{NH}_4\text{F}, \text{CrF}_3$** 

Easily sol in  $\text{H}_2\text{O}$  Sl sol in  $\text{NH}_4\text{F} + \text{Aq}$  (Petersen, J pr (2) **40** 52)

$2\text{NH}_4\text{F}, \text{CrF}_3 + \text{H}_2\text{O}$  (Wagner, B **19** 896)

**Ammonium cobaltous fluoride,  $2\text{NH}_4\text{F}, \text{CoF}_2 + 2\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  (Wagner, B **19** 896)

Easily sol in  $\text{H}_2\text{O}$  (Helmholtz, Z anorg **3** 132)

**Ammonium columbyl fluoride**

See Fluoxycolumbate, ammonium

**Ammonium columbium fluoride oxyfluoride,  $3\text{NH}_4\text{F}, \text{CbF}_5, \text{CbOF}_3$** 

See Fluoxycolumbate columbium fluoride, ammonium

**Ammonium copper fluoride,  $2\text{NH}_4\text{F}, \text{CuF} + 2\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Helmholtz, Z anorg **3** 115)

Nearly insol in  $\text{H}_2\text{O}$  but decomp thereby (Haas, Ch Z 1908, **32** 8)

**Ammonium glucinum fluoride,  $2\text{NH}_4\text{F}, \text{GlF}$** 

Sol in  $\text{H}_2\text{O}$  (Marignac, A ch (4) **30** 51)

Vgry sol in  $\text{H}_2\text{O}$  (Helmholtz, Z anorg **3** 130)

**Ammonium iron (ferrous) fluoride,  $2\text{NH}_4\text{F}, \text{FeF}$** 

(Wagner, B **19** 896)

$\text{NH}_4\text{F}, \text{FeF} + 2\text{H}_2\text{O}$  (W)

**Ammonium iron (ferric) fluoride,  $2\text{NH}_4\text{F}, \text{FeF}_3$** 

More sol in  $\text{H}_2\text{O}$  than the corresponding K compound Decomp by boiling (Nickles, J Pharm (4) **7** 15)

$3\text{NH}_4\text{F}, \text{FeF}_3$  Sl sol in  $\text{H}_2\text{O}$  (Marignac, A ch (3) **60** 306)

Easily sol in acids (Helmholtz, Z anorg **3** 124)

**Ammonium manganic fluoride,  $2\text{NH}_4\text{F}, \text{MnF}_4$** 

More sol than the K salt (Nickles, C R **65** 107)

True composition is  $4\text{NH}_4\text{F}$ ,  $\text{Mn}_2\text{F}_6$  (Christensen, J pr (2) 34 41)

See also Fluomanganate, ammonium

**Ammonium manganyl fluoride**

See Fluoxymanganate, ammonium

**Ammonium molybdenum fluoride**

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  (Berzelius)

See also Fluomolybdate, ammonium

**Ammonium molybdenyl fluoride**

See Fluoxymolybdate, ammonium

**Ammonium nickel fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{NiF}_2 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Wagner, B 19 896)

Easily sol in  $\text{H}_2\text{O}$  (Helmholtz, Z anorg 3 143)

**Ammonium scandium fluoride**,  $(\text{NH}_4)_3\text{ScF}_6$

Easily sol in  $\text{H}_2\text{O}$  Aqueous solution is not decomp by boiling Decomp by acids (R I Meyer, Z anorg 1914, 86 275)

**Ammonium silicon fluoride**

See Fluosilicate, ammonium

**Ammonium silver fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{AgF} +$

scopie Sol in  $\text{H}_2\text{O}$ , sol in conc

Sol in alcohol (Grützner, in 1900, 238 3)

$\text{F}$ ,  $\text{AgF} + 4\text{H}_2\text{O}$  More deliquescent  $\text{H}_4\text{F}$  (Bohm, Dissert 1906)

**Ammonium tantalum fluoride**

See Fluotantalate, ammonium

**Ammonium tantaly fluoride**

See Fluoxytantalate, ammonium

**Ammonium tellurium fluoride**,  $\text{NH}_4\text{F}$ ,  $\text{TeF}_4$

Decomp by  $\text{H}_2\text{O}$  (Hogbom, Bull Soc (2) 35 60)

**Ammonium tin (stannous) fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{SnF}_2 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Wagner, B 19 896)

**Ammonium tin (stannic) fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{SnF}_4$

See Fluostannate, ammonium

**Ammonium titanium sesquifluoride**

See Fluotitanate, ammonium

**Ammonium titanyl fluoride**

See Fluoxypertitanate, ammonium

**Ammonium tungstyl fluoride**

See Fluoxytungstate, ammonium

**Ammonium uranyl fluoride**

See Fluoxyuranate, ammonium

**Ammonium vanadium sesquifluoride**

See Fluovanadate, ammonium

**Ammonium vanadyl fluoride**

See Fluoxylvanadate, ammonium

**Ammonium zinc fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{ZnF}_2$

Sol in  $\text{H}_2\text{O}$  (R Wagner)

+  $2\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  Easily s in dil acids (Helmholtz)

**Ammonium zirconium fluoride**

See Fluozirconate, ammonium

**Ammonium fluoride manganic oxyfluorid**

$2\text{NH}_4\text{F}$ ,  $\text{MnOF}_2$

Precipitate (Nicklès)

See also Fluoxymanganate, ammonium

**Ammonium fluoride molybdenum trioxid**

$2\text{NH}_4\text{F}$ ,  $\text{MoO}_3$

Decomp by  $\text{H}_2\text{O}$  (Mauro, Gazz ch 18 120)

**Ammonium fluoride tungsten oxyfluoride**

See Fluoxytungstate, ammonium

**Ammonium fluoride tungsten oxyfluorid**

ammonium tungstate,  $4\text{NH}_4\text{F}$ ,  $\text{WO}_2\text{F}_2$ ,  $(\text{NH}_4)_2\text{WO}_4$

See Fluoxytungstate tungstate, ammonium

**Ammonium fluoride vanadium oxyfluoride**

See Fluoxylvanadate, and fluoxyhypovanadate, ammonium

**Ammonium hydroselenide**,  $\text{NH}_4\text{HSe}$

Sol in  $\text{H}_2\text{O}$  with decomp (Bineau, A c (2) 67 229)

**Ammonium hydrosulphide**,  $\text{NH}_4\text{SH}$

Sol in  $\text{H}_2\text{O}$  and alcohol Solutions decomp on air

**Ammonium hydroxide**,  $\text{NH}_4\text{OH}$

See Ammonia,

**Ammonium imidosulphamide**,

$(\text{S O}_4\text{N}_3\text{H}_4)\text{NH}_4$

(Hantzsch, B 1905, 38 1033)

**Ammonium iodide**,  $\text{NH}_4\text{I}$

Very deliquescent Sol in 0.60 pt  $\text{H}_2\text{O}$  (Eder, Dingl 221 89)

Sp gr of aqueous solution of  $\text{NH}_4\text{I}$  at 1 containing—

10	20	30	40	50% $\text{NH}_4\text{I}$
1.0652	1.1397	1.2260	1.3260	1.4415

(Kohlrausch, W Ann 1879 1)

$\text{NH}_4\text{I} + \text{Aq}$  containing 12.51%  $\text{NH}_4\text{I}$  h sp gr  $20^\circ/20^\circ = 1.0846$

$\text{NH}_4\text{I} + \text{Aq}$  containing 19.19%  $\text{NH}_4\text{I}$  h sp gr  $20^\circ/20^\circ = 1.1359$

(Le Blanc and Rohland, Z phys Ch 189 19 279)

Very easily sol in liq  $\text{NH}_3$  (Frankl Am Ch J 1898, 20 826)

Very sol in liq  $\text{NH}_3$  at  $-50^\circ$  (Moissan C R 1901, 133 713)

Sol in  $\text{SOCl}_2$  (Walden, Z anorg 1900, 25 216)

Sol in liquid  $\text{SO}_2$  (Walden, Z anorg 1902, 30 160)

Sol in 40 pts abs alcohol (Eder, lc)

" 210 " ether (Eder, lc)

" 20 " alcohol-ether (1 1) (Eder, lc)

Sol in acetone (Eidmann, C C 1899, II 1014), (Naumann, B 1904, 37 4328)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Sl sol in benzonitrile (Naumann, B 1914, 47 1369)

#### Ammonium diiodide, $\text{NH}_4\text{I}_2$

Sol in alcohol, ether,  $\text{CS}_2$ , and  $\text{KI} + \text{Aq}$ , less sol in chloroform (Guthrie, Chem Soc (2) 1 239)

#### Ammonium triiodide, $\text{NH}_4\text{I}_3$

Sl deliquescent Sol in little  $\text{H}_2\text{O}$ , but decomp by much  $\text{H}_2\text{O}$  (Johnson, Chem Soc 33 397)

#### Ammonium antimony iodide, $\text{NH}_4\text{I}$ , $\text{SbI}_3 + 2\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Nickles, C R 51 1097)

$3\text{NH}_4\text{I}$ ,  $4\text{SbI}_3 + 9\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$ , with separation of  $\text{SbOI}$  Sol in  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{HCl}$ , and  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$  Decomp by  $\text{CS}_2$  (Schaffer, Pogg 109 611)

$3\text{NH}_4\text{I}$ ,  $\text{SbI}_3 + 3\text{H}_2\text{O}$  As above

$4\text{NH}_4\text{I}$ ,  $\text{SbI}_3 + 3\text{H}_2\text{O}$  As above

#### Ammonium bismuth iodide, $\text{NH}_4\text{I}$ , $\text{BiI}_3 + \text{H}_2\text{O}$

Deliquescent, decomp by  $\text{H}_2\text{O}$  (Nicklès, C R 51 1097)

$4\text{NH}_4\text{I}$ ,  $\text{BiI}_3 + 3\text{H}_2\text{O}$  As above (Linau, Pogg 111 240)

$2\text{NH}_4\text{I}$ ,  $\text{BiI}_3 + 2\frac{1}{2}\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$ , or  $\text{MCl}$ ,  $\text{MBr}$ , or  $\text{MI} + \text{Aq}$  (Nicklès, J pr (2) 39 116)

#### Ammonium cadmium iodide, $2\text{NH}_4\text{I}$ , $\text{CdI}_2 + 2\text{H}_2\text{O}$

Deliquescent (Croft)

Sol at  $15^\circ$  in 55 pt  $\text{H}_2\text{O}$ , 0.70 pt abs alcohol, 8.9 pts ether (sp gr 0.729), and 18 pts alcohol-ether (1 1) (Eder, Dingt 221 89)

100 pts of the solution in  $\text{H}_2\text{O}$  contain 85.97 pts of the salt at  $14.5^\circ$  (Rimbach, B 1905, 38 1563)

$\text{NH}_4\text{I}$ ,  $\text{CdI}_2 + \frac{1}{2}\text{H}_2\text{O}$  Sol at  $15^\circ$  in 0.90 pt  $\text{H}_2\text{O}$ , 0.88 pt abs alcohol, and 2.4 pts ether (sp gr 0.729) (Eder, lc)

$+ \text{H}_2\text{O}$  (Grossmann, Z anorg 1902, 33 154)

#### Ammonium chloromolybdenum iodide, $2\text{NH}_4\text{I}$ , $\text{Cl}_4\text{Mo}_3\text{I} + 2\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  Cryst from  $\text{HI} + \text{Aq}$  (Blomstrand)

#### Ammonium cuprous iodide, $2\text{NH}_4\text{I}$ , $\text{Cu}_2\text{I}_2 + \text{H}_2\text{O}$

Decomp on the air, or by  $\text{H}_2\text{O}$ , or alcohol (Saglier, C R 104 1440)

$+ \frac{1}{2}\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  with separation of  $\text{Cu}_2\text{I}_2$  (Gossner, Zeit Kryst 1903, 38 501)

#### Ammonium cupric iodide ammonia, $2\text{NH}_4\text{I}$ , $\text{CuI}_2$ , $2\text{NH}_3 + 2\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  or alcohol, sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$

$+ 6\text{H}_2\text{O}$  Unstable (Saglier, C R 104 1440)

$\text{NH}_4\text{I}$ ,  $2\text{CuI}$ ,  $3\text{NH}_3$  (Fleurent, C R 1891, 113 1047)

#### Ammonium iridium diiodide, $2\text{NH}_4\text{I}$ , $\text{IrI}_2$

Insol in cold or hot  $\text{H}_2\text{O}$ , and in alcohol Sol in warm dil acids (Oppler)

#### Ammonium iridium sesquiodide

See Iodiridite, ammonium

#### Ammonium iridium tetraiodide

See Iodiridate, ammonium

#### Ammonium lead iodide, $\text{NH}_4\text{I}$ , $\text{PbI}_2 + 2\text{H}_2\text{O}$

Decomp by much  $\text{H}_2\text{O}$  (Wells, Sil Am J 146 25)

$4\text{NH}_4\text{I}$ ,  $3\text{PbI}_2 + 6\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Mosnier, C R 1895, 120 444)

Sol in  $\text{H}_2\text{O}$  with decomp Sol in strong  $\text{KOH} + \text{Aq}$  and in strong acids (Fonze-Diacon, Bull Soc 1897, (3) 17 347)

#### Ammonium magnesium iodide, $\text{NH}_4\text{I}$ , $\text{MgI}_2 + 6\text{H}_2\text{O}$

Very deliquescent (Ierch, J pr (2) 28 338)

#### Ammonium mercuric iodide, $\text{NH}_4\text{I}$ , $\text{HgI}_2 + \text{H}_2\text{O}$

Decomp into its constituents by  $\text{H}_2\text{O}$  (Boullay, A ch (2) 34 345)

Sol without decomp in alcohol and ether  $\text{NH}_4\text{I}$ ,  $2\text{HgI}_2$  Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{KI} + \text{Aq}$  Very sol in alcohol, ether and nitrobenzol (Low, Zeit Kryst, 51 138)

#### Ammonium silver iodide, $2\text{NH}_4\text{I}$ , $\text{AgI}$

Deliquescent Decomp by  $\text{H}_2\text{O}$  (Poggiale)

#### Ammonium thallic iodide, $\text{NH}_4\text{I}$ , $\text{ThI}_3$

Sol in  $\text{H}_2\text{O}$  (Nickles, J Pharm (4) 1 32)

#### Ammonium tin (stannous) iodide, $\text{NH}_4\text{I}$ , $\text{SnI}_2$

Decomp by small amt  $\text{H}_2\text{O}$  but completely sol in a large amt (Boullay, A ch (2) 34 376)

$+ 1\frac{1}{2}\text{H}_2\text{O}$  (Personne)

#### Ammonium zinc iodide, $2\text{NH}_4\text{I}$ , $\text{ZnI}_2$

Extremely deliquescent, and sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 43 665)

$\text{NH}_4\text{I}$ ,  $\text{ZnI}_2 + 4\frac{1}{2}\text{H}_2\text{O}$  Hygroscopic  
(Ephraim, Z anorg 1910, 67 384)

**Ammonium iodide arsenic trioxide**  
See Arsenite iodide, ammonium

**Ammonium cobalt nitride**  
See Ammonium cobalt azonide

**Ammonium ruthenium dihydronitrosobromide**,  $\text{NO Ru}_2\text{H}_2(\text{NH}_3)_6\text{Br}_3 \cdot 2\text{HBr}$   
Ppt (Brizard, A ch 1900, (7) 21 363)

**Ammonium ruthenium nitroschloride**,  
 $3\text{NH}_4\text{Cl} \cdot 2\text{HCl} \cdot \text{NO Ru}_2\text{H}_2\text{Cl}_3$   
Ppt (Brizard, A ch 1900, (7) 21 354)

**Ammonium ruthenium dihydronitroschloride**,  $\text{NO Ru}_2\text{H}_2(\text{NH}_3)_6\text{Cl}_3 \cdot 2\text{HCl}$   
Ppt (Brizard, A ch 1900, (7) 21 358)

**Ammonium peroxide**,  $(\text{NH}_4)_2\text{O}_2$   
M-pt  $-2^\circ$  Sl sol in ether without  
decomp (D'Ans, B 1913, 46 3076)  
Sol in alcohol, insol in ether, decomp  
slowly in aq solution (Melikoff, B 1897, 30  
3145)

**Ammonium hydrogen peroxide**,  $(\text{NH}_4)_2\text{O}_2$ ,  
H O  
ordinary temp (Melikoff, B  
table, deliquesces at ordinary  
cohol, insol in light petroleum  
898, 31 152)

**Ammonium selenide**,  $(\text{NH}_4)_2\text{Se}$   
Sol in  $\text{H}_2\text{O}$  with decomp (Bineau, A ch  
(2) 67 229)  
Stable in the air Sol in  $\text{H}_2\text{O}$ , aq solution  
decomp slowly (Lenher and Smith, J Am  
Chem Soc 1898, 20 277)

**Ammonium hydrogen selenide**,  $\text{NH}_4\text{HSe}$   
Sol in H O (Fabre, C R 103 269)

**Ammonium monosulphide**,  $(\text{NH}_4)_2\text{S}$   
Decomp on air Sol in  $\text{H}_2\text{O}$ , but solution  
decomposes rapidly  
Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch  
J 1898, 20 826)

**Ammonium disulphide**,  $(\text{NH}_4)_2\text{S}_2$   
Sol in  $\text{H}_2\text{O}$  with decomp  
Does not exist (Bloxam, Chem Soc  
1895, 67 293)

**Ammonium tetrasulphide**,  $(\text{NH}_4)_2\text{S}_4$   
Easily sol in  $\text{H}_2\text{O}$  Conc solution is stable,  
dil solution decomp on air Easily sol in  
alcohol without decomp, but solution decomp  
on the air more rapidly than the  
aqueous solution (Fritzsch, J pr 32 313)  
 $+ \frac{1}{2}\text{H}_2\text{O}$  When dissolved in  $\text{H}_2\text{O}$ , it is at  
once dissociated with deposition of S (Blox-  
am, Chem Soc 1895, 67 303)

**Ammonium pentasulphide**,  $(\text{NH}_4)_2\text{S}_5$

Decomp on air Sol in  $\text{H}_2\text{O}$  with separa-  
tion of S Sol in alcohol without decomp,  
but solution decomposes quickly on standing  
(Fritzsch, J pr 32 313)

Rapidly decomp by  $\text{H}_2\text{O}$  with separation  
of S (Bloxam, Chem Soc 1895, 67 298)  
 $+ \text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  with separation  
of S (Bloxam, Chem Soc 1895, 67 298)

**Ammonium heptasulphide**,  $(\text{NH}_4)_2\text{S}_7$

More stable on air, and less easily decomp-  
posed by  $\text{H}_2\text{O}$  than  $(\text{NH}_4)_2\text{S}_5$   
 $+ 1\frac{1}{2}\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  with separa-  
tion of S Slowly attacked by dil  $\text{HCl} + \text{Aq}$   
(Bloxam, Chem Soc 1895, 67 307)

**Tetrammonium heptasulphide**,  $(\text{NH}_4)_2\text{S}_7 + 4\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Solution can be kept for a  
long time without depositing S (Bloxam,  
Chem Soc 1895, 67 298)

**Diammonium enneasulphide**,  $(\text{NH}_4)_2\text{S}_9 + \frac{1}{2}\text{H}_2\text{O}$

Decomposed by  $\text{H}_2\text{O}$  with separation of S  
Not attacked by boiling dil  $\text{HCl} + \text{Aq}$  on  
account of formation of a hard crust of S  
on the crystals (Bloxam, Chem Soc 1895,  
67 306)

**Tetrammonium enneasulphide**,  $(\text{NH}_4)_4\text{S}_9$

Solution in  $\text{H}_2\text{O}$  deposits crystals of  
 $(\text{NH}_4)_2\text{S}_5$  on standing (Bloxam, Chem Soc  
1895, 67 302)

$+ 3\frac{1}{2}\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  with separa-  
tion of S (Bloxam, Chem Soc 1895, 67  
299)

**Ammonium polysulphides**

Conc  $\text{NH}_3 + \text{Aq}$  dissolves  $\text{H}_2\text{S}$  to form  
 $(\text{NH}_4)_2\text{S}_2 \cdot 2\text{NH}_4\text{SH}$  On dilution more  $\text{H}_2\text{S}$  is  
absorbed to form  $(\text{NH}_4)_4\text{S}_4 \cdot \text{NH}_4\text{SH}$ , then  
 $(\text{NH}_4)_2\text{S}_8 \cdot 8\text{NH}_4\text{SH}$ , then  $(\text{NH}_4)_2\text{S}_{18} \cdot 18\text{NH}_4\text{SH}$   
and finally  $\text{NH}_4\text{SH}$  (Bloxam, Chem Soc  
1895, 67 234)

**Ammonium copper sulphide**,  $(\text{NH}_4)_2\text{S}_2$ ,  
 $2\text{CuS}_3 (?)$

Sol in warm H O, but decomp on standing  
Warm  $\text{KOH} + \text{Aq}$  acts similarly, sl sol in  
 $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{Na CO}_3 + \text{Aq}$ , or absolute al-  
cohol Insol in ether Decomp by dil acids  
(Priwoznik, B 6 1291)

Correct formula is  $\text{NH}_4\text{CuS}_4$  Sl sol in  
H O Decomp by conc and dil acids  
Easily sol in  $\text{NaOH}$  Sl sol in alcohol  
(Biltz, B 1907, 40 976)

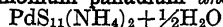
**Ammonium gold polysulphide**,  $\text{AuS}_3\text{NH}_4$

Ppt (Hofmann, B 1903, 36 3092, B  
1904, 37 245)

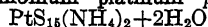
**Ammonium iridium pentadecasulphide**,

$\text{IrS}_{15}(\text{NH}_4)_3$

Ppt (Hofmann, B 1904, 37 247)

**Ammonium palladium undecasulphide,**

Ppt (Hofmann, B 1904, 37 248)

**Ammonium platinum pentadecasulphide,**

Can be washed with  $\text{CS}_2$  without decomp  
Sol in alcohol Insol in ether (Hofmann,  
B 1903, 36 3091)

**Ammonium stannic sulphide**

See Sulphostannate, ammonium

**Ammonium telluride,  $\text{NH}_4\text{HTe}$** 

Easily sol in  $\text{H}_2\text{O}$  (Bineau, A ch (2) 67  
229)

**Ammonium sulphide ammonia,  $(\text{NH}_4)_2\text{S}$ ,  
 $2\text{NH}_3$** 

Very unstable (Bloxam, Chem Soc 1895,  
67 294)

**Ammonium acisulphomelid,  $(\text{NSO ONH}_4)_2$   
(?)**

(Hantzsch and Stuer, B 1905, 38 1039)

**Ammonplatindramine comps**

See Platintriamine comps

**Ammondisulphonic acid,  $\text{NH}_2(\text{SO}_3\text{H})_2$** 

Known only in its salts (Claus, A 158  
52 and 194)

Contains 2 at H less, and is identical with  
midosulphonic acid  $\text{NH}(\text{SO}_3\text{H})_2$ , which see  
(Raschig, A 241 161)

**Ammontrisulphonic acid,  $\text{NH}_2(\text{SO}_3\text{H})_3$** 

Known only in its salts (Claus, A 158  
52 and 194)

Contains 2 at H less, and is nitrosulphonic  
acid  $\text{N}(\text{SO}_3\text{H})_3$ , which see (Raschig, A 241  
161)

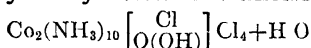
**Ammontetrasulphonic acid,  $\text{NH}(\text{SO}_3\text{H})_4$** 

Known only in its salts (Claus, A 158  
52 and 194)

Does not exist, but was impure nitrosul-  
phonic acid, which see (Raschig, A 241  
161)

**Anhydroarseniotungstic acid,  $\text{H}_3\text{AsW}_8\text{O}_{28}$** 

See under Arseniotungstic acid

**Anhydrooxycobaltamine chloride,**

Easily sol in  $\text{H}_2\text{O}$ , but decomposes after a  
few minutes, can be recrystallized from dil  
 $\text{HCl} + \text{Aq}$  Precipitated from sat  $\text{H}_2\text{O}$  solu-  
tion by conc  $\text{HCl} + \text{Aq}$ , or alcohol (Vort-  
mann, M Ch 6 404)

$\text{Co}_2(\text{NH}_3)_{10} \left( \begin{array}{c} \text{Cl} \\ \text{OH} \end{array} \right) \text{Cl}_4$  Sol in  $\text{H}_2\text{O}$  (Vort-  
mann)

**Anhydrooxycobaltamine chloride mercuric  
chloride,  $\text{Co}_2(\text{NH}_3)_{10}(\text{ClO}_2\text{H})\text{Cl}_4, 3\text{HgCl}_2$** 

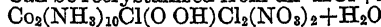
Can be recryst from very dil hot  $\text{HCl} + \text{Aq}$

**— chloroplatinate,  $\text{Co}_2(\text{NH}_3)_{10}(\text{ClO}_2\text{H})\text{Cl}_4$ ,  
 $2\text{PtCl}_4$** 

Can be recrystallized from  $\text{H}_2\text{O}$  containing  
 $\text{HCl}$

**— chloronitrate,  
 $\text{Co}_2(\text{NH}_3)_{10}\text{Cl}(\text{O OH})(\text{NO}_3)_4 + \text{H}_2\text{O}$** 

Can be recrystallized from dil  $\text{HCl} + \text{Aq}$



More easily sol in  $\text{H}_2\text{O}$  than the preceding  
comp

**— chlorosulphate,  
 $\text{Co}_2(\text{NH}_3)_{10}\text{Cl}(\text{O OH})(\text{SO}_4)_2$** **— dichromate,  $[\text{Co}_2(\text{NH}_3)_{10}\text{O OH}]_2(\text{Cr}_2\text{O}_7)_5$   
 $+ 8\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$

**— nitrate,  $\text{Co}_2(\text{NH}_3)_{10}(\text{NO}_3)(\text{O OH})(\text{NO}_3)_4$   
 $+ \text{H}_2\text{O}$** 

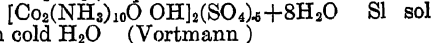
Sl sol in pure  $\text{H}_2\text{O}$  with immediate decomp  
Can be recrystallized from  $\text{H}_2\text{O}$  containing  
 $\text{HNO}_3$

**— sulphate,  $[\text{Co}_2(\text{NH}_3)_{10}\text{O OH}]_2(\text{SO}_4)_5$ ,  
 $2\text{H}_2\text{SO}_4 + 2\text{H}_2\text{O}$** 

Sl sol in cold  $\text{H}_2\text{O}$  When crystallized  
from dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ , is converted into—



which by further recrystallization from very  
dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  becomes—



Sl sol in cold  $\text{H}_2\text{O}$  (Vortmann)

**Anhydrophospholutedungstic acid,**

See under Phosphotungstic acid

**Antimonic Acid****Metantimonic acid,  $\text{HSbO}_3$** 

Very sl sol in  $\text{H}_2\text{O}$ , sol in conc  $\text{HCl} + \text{Aq}$ ,  
sl sol in dil  $\text{HNO}_3 + \text{Aq}$ , easily sol in tar-  
taric acid +  $\text{Aq}$ , easily sol in hot  $\text{KOH}$ , or  
 $\text{NaOH} + \text{Aq}$ , completely insol in  $\text{NH}_4\text{OH} +$   
 $\text{Aq}$  (Ficmy, A ch (3) 23 407)

Sl sol in  $\text{H}_2\text{O}$  Very sl sol in  $\text{KOH}$  and  
 $\text{K}_2\text{CO}_3 + \text{Aq}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  Insol  
in  $\text{HNO}_3 + \text{H}_2\text{SO}_4$  Slowly sol in cold, quickly  
in hot  $\text{HCl} + \text{Aq}$  Sl sol in tartaric and  
oxalic acid and in  $\text{KHC O}_4 + \text{Aq}$  (Senderens,  
Bull Soc 1899, (3) 21 48)

Insol in acetone (Nunemann, B 1904, 37  
4329)

**Pyroantimonic acid,  $\text{H}_4\text{Sb}_2\text{O}_7$** 

More sol in  $\text{H}_2\text{O}$  and acids than  $\text{H}_3\text{SbO}_4$   
Sol in cold  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$  (Ficmy)

Slowly sol in cold  $\text{H}_2\text{O}$

5.88 g  $\text{Sb}_2\text{O}_5$  in 1 l  $\text{H}_2\text{O}$  at 15°

8.55 " " " 1 l " " 25°

21.30 " " " 1 l " " 60°

(Delacroix, J Pharm 1897, 6 337-41)



Sl sol in  $\text{H}_2\text{O}$  Very sl sol in  $\text{KOH}$  and  $\text{K}_2\text{CO}_3 + \text{Aq}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$ , and in  $\text{HNO}_3 + \text{H}_2\text{SO}_4$  Slowly sol in cold, quickly in hot  $\text{HCl} + \text{Aq}$  Sl sol in tartaric acid, oxalic acid and  $\text{KHC}_2\text{O}_4 + \text{Aq}$  (Senderens, Bull Soc 1899, (3) 21 48)

#### Orthoantimonic acid, $\text{H}_3\text{SbO}_4$

Sl sol in  $\text{H}_2\text{O}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  Easily sol in  $\text{KOH} + \text{Aq}$  (Fremy)

Does not exist (Raschig, B 18 2745)

Has, however, been prepared by Daubrawa (A 186 110), Conrad (C N 40 198), and Beilstein and Blaese (Bull Ac St Petersburg 33 97)

Very sol in  $\text{H}_2\text{O}$  (Delacroix, Bull Soc 1899 (3) 21 1049)

Very sl sol in  $\text{H}_2\text{O}$ , in  $\text{KOH}$  and  $\text{K}_2\text{CO}_3 + \text{Aq}$  Slowly sol in cold, quickly in hot  $\text{HCl} + \text{Aq}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$ , and in  $\text{HNO}_3 + \text{H}_2\text{SO}_4$  Sl sol in tartaric acid, oxalic acid and  $\text{KHC}_2\text{O}_4 + \text{Aq}$  (Senderens, Bull Soc 1899, (3) 21 52)

$+ \frac{1}{2}\text{H}_2\text{O}$  (Beilstein and Blaese)

According to Beilstein and Blaese only one antimonic acid,  $\text{H}_3\text{SbO}_4$ , exists

#### Tetraantimonic acid, $\text{Sb}_2\text{O}_5 + 4\text{H}_2\text{O} = \text{H}_4\text{Sb}_2\text{O}_9$

Slowly sol in cold  $\text{H}_2\text{O}$

Solution sat at  $t^\circ$  contains g  $\text{Sb}_2\text{O}_5$  per litre—

$t^\circ$	15°	25°	60°	70°
	5.88	8.3-8.75	21.30	53.89

in solution by heating to  $100^\circ$  or long in the cold to  $\text{Sb}_2\text{O}_5 \cdot 3\text{H}_2\text{O}$  (Senderens, Bull Soc 1899, (3) 21 1049)

Insol in  $\text{H}_2\text{O}$  Very sl sol in  $\text{KOH}$  and  $\text{K}_2\text{CO}_3 + \text{Aq}$  Slowly sol in cold, quickly in hot  $\text{HCl} + \text{Aq}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  Insol in  $\text{HNO}_3 + \text{H}_2\text{SO}_4$  Sl sol in tartaric acid, oxalic acid and in  $\text{KHC}_2\text{O}_4 + \text{Aq}$  (Senderens, Bull Soc 1899, (3) 21 51)

#### Hexantimonic acid, $\text{Sb}_2\text{O}_5 + 6\text{H}_2\text{O} = \text{H}_{12}\text{Sb}_2\text{O}_{11}$

Sol in  $\text{H}_2\text{O}$  to the extent of 22 g  $\text{Sb}_2\text{O}_5$  per l but on standing becomes turbid and a white powder is pptd until finally only 3 g  $\text{Sb}_2\text{O}_5$  are dissolved per l (Senderens, Bull Soc 1899, (3) 21 48-49)

#### Antimonates

$\alpha$  Antimonates From  $\text{HSbO}_3$  Some of the K and  $\text{NH}_4$  salts are sol in  $\text{H}_2\text{O}$ , the others are slightly sol or insol

$\beta$  Pyroantimonates From  $\text{H}_2\text{Sb}_2\text{O}_7$  As a class, insol in  $\text{H}_2\text{O}$ , but decomp thereby except in presence of large excess of alkali (Fremy, A ch (3) 12 499)

Probably do not exist (Beilstein and Blaese)

#### Aluminum antimonate, $\text{Al}_2\text{O}_3 \cdot 3\text{Sb}_2\text{O}_5$ (?)

Ppt Somewhat sol in excess of Al salts + Aq Insol in  $\text{K}_2\text{Sb}_2\text{O}_7 + \text{Aq}$

$\text{Al}(\text{SbO}_3)_3 + 15\text{H}_2\text{O} = \text{AlH}_6(\text{SbO}_4)_3 + 12\text{H}_2\text{O}$

Ppt (Beilstein and Blaese, Bull Ac St Petersburg 33 101)

$\text{Al}(\text{SbO}_3)_3 + 7\text{H}_2\text{O} = \text{AlH}_6(\text{SbO}_4)_3 + 4\text{H}_2$

Ppt (B and B)

$\text{Al}_2\text{O}_3 \cdot \text{Sb}_2\text{O}_5 + 9\text{H}_2\text{O}$  Ppt (Ebel, B 2 3043)

#### Ammonium antimonate, $\text{NH}_4\text{SbO}_3 + 2\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$

$+ 2\frac{1}{2}\text{H}_2\text{C}$  Insol in  $\text{H}_2\text{O}$  (Senderens, Bull Soc 1899, (3) 21 56)

$+ 6\text{H}_2\text{O}$  See  $(\text{NH}_4)_2\text{H}_2\text{Sb}_2\text{O}_7 + 5\text{H}_2\text{O}$

#### Ammonium pyroantimonate, $(\text{NH}_4)_4\text{Sb}_2\text{O}_7$

Known only in solution

$(\text{NH}_4)_2\text{H}_2\text{Sb}_2\text{O}_7 + 5\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , but decomp by standing, boiling into insol salt Insol in alcohol (Fremy, J pr 45 215) Composition  $\text{NH}_4\text{SbO}_3 + 6\text{H}_2\text{O}$ , according to Raschig (J 18 2743)

#### Barium antimonate, $\text{Ba}(\text{SbO}_3)_2$

Ppt Scarcely sol in  $\text{H}_2\text{O}$  Slowly sol in  $\text{BaCl}_2 + \text{Aq}$

$+ 2\text{H}_2\text{O}$  Somewhat sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HCl} + \text{Aq}$  (Delacroix, Bull Soc 1899, (3) 21 1051)

$+ 5$ , or  $6\text{H}_2\text{O}$  Ppt

$\text{BaSb}_2\text{O}_7 + 5\text{H}_2\text{O}$  Sol in conc  $\text{HCl}$  (Delacroix, Bull Soc 1899, (3) 21 1051)

$\text{BaO} \cdot 3\text{Sb}_2\text{O}_5 + 5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Insol completely sol in  $\text{HCl}$  (Delacroix, l c)

$\text{BaO} \cdot 4\text{Sb}_2\text{O}_5 + 15\text{H}_2\text{O}$  (Delacroix, l c)

$9\text{BaO} \cdot 10\text{Sb}_2\text{O}_5 + 18\text{H}_2\text{O}$  Insol in  $\text{HCl}$  Aq (Delacroix, l c)

#### Bismuth antimonate, $\text{BiSbO}_4 + \text{H}_2\text{O}$

Ppt Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Ac}$  (Cavazzi, Gazz ch it 15 37)

$3\text{Bi}_2\text{O}_3 \cdot \text{Sb}_2\text{O}_5 + \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$  (Cavazzi)

$2\text{Bi}_2\text{O}_3 \cdot \text{Sb}_2\text{O}_5$  As above (Cavazzi)

#### Cadmium antimonate, $\text{Cd}(\text{SbO}_3)_2 + 2\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Senderens, Bull Soc 1899 (3) 21 56)

$+ 3\frac{1}{2}\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  (Ebel, Dissert 1890)

$+ 5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Senderens, l c)

$+ 6\text{H}_2\text{O}$  Ppt Insol in  $\text{H}_2\text{O}$  (Ebel, B 22 3043)

#### Calcium antimonate, $\text{Ca}(\text{SbO}_3)_2$

Ppt

$+ 5\text{H}_2\text{O}$  Ppt (Heffter, Pogg 86 418)

$+ 6\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Senderens, Bull Soc 1899, (3) 21 56)

$3\text{CaO} \cdot 2\text{Sb}_2\text{O}_5 + 6\text{H}_2\text{O}$  Min Ullmannite

#### Chromic antimonate, $\text{Cr}(\text{SbO}_3)_3 + 14\text{H}_2\text{O}$

Ppt (Beilstein and Blaese)

#### Cobaltous antimonate, $\text{Co}(\text{SbO}_3)_2 + 5\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Loses  $3\text{H}_2\text{O}$  in the presence of  $\text{H}_2\text{SO}_4$  and passes into  $\text{Co}(\text{SbO}_3)_2 + 2\text{H}_2\text{O}$

also insol in  $H_2O$  (Senderens, Bull Soc 1899, (3) 21 55)

+ $6H_2O$  Ppt (Ebel, B 22 3043)

+ $7H_2O$  Sl sol in  $H_2O$  Sl sol in boiling solutions of cobalt salts

+ $12H_2O$  Ppt (Heffter, Pogg 86 448)

**Cobaltous hydrogen antimonate**,  $CoH_4(SbO_4)_2 + H_2O$

(Gorgeul, Ann Phys Beibl 1897, 21 198)

**Cupric antimonate**,  $3CuO, 2Sb_2O_3$

Ppt (Beilstein and Blaesé)

$Cu(SbO_3)_2$  Insol in  $H_2O$ , acids, or alkalis (Berzelius)

+ $2H_2O$  Insol in  $H_2O$  (Senderens, Bull Soc 1899, (3) 21 55)

+ $5H_2O$  Ppt (Ebel, B 22 3043)

Insol in  $H_2O$  (Senderens, l c)

$CuO, 2Sb_2O_3 + 9H_2O$  Insol in  $H_2O$  Sol in  $Sb_2O_3, 4H_2O + Aq$  (Delacroix, Bull Soc 1899, (3) 21 1054)

$2CuO, 3Sb_2O_3 + 10H_2O$  Insol in  $H_2O$  Sol in  $NH_4OH$  and in triantimonic acid +  $Aq$  (Delacroix, l c)

$CuO, 6Sb_2O_3 + 16H_2O$  (Delacroix, l c)

**Cupric antimonate ammonia**,  $Cu(SbO_3)_2, 4NH_3 + 4H_2O$

Insol in  $H_2O$  and  $NH_4OH + Aq$  (Schiff, A 123 39)

$CuSb_2N_3H_{21}O_{12} = Cu(OH_4)OH,$

$2(NH_4SbO_3 + 2H_2O)$  (Raschig, B 18 2743)

$Cu(SbO_3)_2, 3NH_3 + 9H_2O$  (Delacroix, Bull Soc 1901, (3) 25 289)

**Glucinum antimonate**,  $Gl(SbO_3)_2 + 6H_2O$

Somewhat sol in hot  $H_2O$  Easily sol in warm  $HCl$  (Ebel, Dissert 1890)

**Iron (ferrous) antimonate**

Sl sol in  $H_2O$  (Berzelius)

**Iron (ferric) antimonate**

Insol in  $H_2O$  (B)

$Fe_2O_3, Sb_2O_3 + 7H_2O$  Ppt (Ebel, B 22 3043)

$Fe_2O_3, 2Sb_2O_3 + 11H_2O$  Ppt (Beilstein and Blaesé)

$Fe(SbO_3)_3 + 6H_2O$  Ppt (B and B)

**Lead antimonate, basic**,  $Pb_3(SbO_3)_4(OH)_4 + 2H_2O = Pb_3(SbO_4)_4 + 4H_2O$

Min *Bleinerite, Brindheimite*

$2Pb(SbO_3)_2, PbO + 11H_2O$  Ppt (B and B)

**Lead antimonate**,  $Pb(SbO_3)_2$

Insol in  $H_2O$  Incompletely decomp by acids (Berzelius)

*Naples Yellow* Insol in  $H_2O$

+ $2H_2O$  Insol in  $H_2O$  (Senderens, Bull Soc 1899, (3) 21 57)

+ $5H_2O$  Ppt (Ebel, B 22 3043)

+ $6H_2O$  Ppt (Beilstein and Blaesé)

+ $9H_2O$  Insol in  $H_2O$  (Senderens, l c)

**Lead antimonate chloride**,  $Pb(SbO_3)_2, PbCl_2$

Min *Nadorite* Sol in  $HCl, HNO_3$ , and tartaric acid +  $Aq$

**Lithium antimonate**,  $LiSbO_3$

Sl sol in cold, sol in hot  $H_2O$ , and crystallizes on cooling Much more sol than  $NaSbO_3$

+ $3H_2O$  Ppt Sl sol in  $H_2O$  (Beilstein and Blaesé)

**Magnesium antimonate**,  $Mg(SbO_3)_2 + 12H_2O$

Sol in hot, less sol in cold  $H_2O$  (Heffter)

Sol in  $MgSO_4 + Aq$ , insol in  $KSbO_3 + Aq$  (Berzelius)

**Manganous antimonate**,  $Mn(SbO_3)_2$

Difficultly sol in  $H_2O$

When heated, is sol only in strong acids

+ $2H_2O$  Insol in  $H_2O$  (Senderens, Bull Soc 1899, (3) 21 56)

+ $5H_2O$  Ppt (Ebel, B 22 3043)

+ $6H_2O$  Insol in  $H_2O$  (Senderens, l c)

+ $7H_2O$  Ppt (Beilstein and Blaesé)

**Mercurous antimonate**

Insol in  $H_2O$  (Berzelius)

**Mercuric antimonate**,  $Hg(SbO_3)_2$

Insol in  $H_2O$ , alkalis, and most acids

Sl attacked by boiling  $H_2SO_4$ , and  $HCl + Aq$

+ $2H_2O$  Insol in  $H_2O$  (Senderens, Bull Soc 1899, (3) 21 55)

+ $5H_2O$  Insol in  $H_2O$  (Senderens)

+ $6H_2O$  Ppt (Beilstein and Blaesé)

**Nickel antimonate**,  $Ni(SbO_3)_2 + 2H_2O$

Insol in  $H_2O$  (Senderens, Bull Soc 1899, (3) 21 54)

+ $5H_2O$  Insol in  $H_2O$  (Senderens)

+ $6H_2O$  Ppt Insol in  $H_2O$  (Heffter, Pogg 86 446)

+ $12H_2O$  Sl sol in  $H_2O$  (Heffter)

**Potassium antimonate**,  $KSbO_3$

Insol in  $H_2O$  Sol in warm  $KOH + Aq$ , but separates nearly completely on cooling By boiling with  $H_2O$ , or by standing for a long time with cold  $H_2O$ , it gradually dissolves as  $2KSbO_3 + 5H_2O$ , or  $K_2H_5SbO_7 + 4H_2O$  or  $2KH_2SbO_4 + 3H_2O$

Insol in  $CS_2$  (Arcowski, Z anorg 1894, 6 257)

+ $H_2O$  Insol in  $H_2O$  (Senderens, Bull Soc 1899, (3) 21 57)

+ $1\frac{1}{2}H_2O$  ( $= 2KSbO_4 + 5H_2O$  of Trömy)

Easily sol in  $H_2O$ , especially if warm Solution is pptd by  $NH_4Cl + Aq$  (Trömy, A ch (3) 12 499)

+ $2\frac{1}{2}H_2O$  100 pts  $H_2O$  at  $20^\circ$  dissolve 281 pts anhydrous salt, sp gr of solution sat at  $18^\circ = 1.0263$  Composition is given as  $K_2H_5Sb_2O_7 + 4H_2O$  (König and Olschewsky, B 20 3043)

+ $3\frac{1}{2}H_2O$  Insol in  $H_2O$  (Senderens, l c)

+4½H<sub>2</sub>O Sol in H<sub>2</sub>O (Delacroix, J Pharm 1897, (6) 6 533)  
 2K<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>5</sub>+10H<sub>2</sub>O Sl sol in H<sub>2</sub>O (Delacroix, J Pharm 1897, 6 337)  
 +10H<sub>2</sub>O (Delacroix, *l c*)

**Potassium pyroantimonate, K<sub>4</sub>Sb<sub>2</sub>O<sub>7</sub>**

Deliquescent, decomp by boiling with H<sub>2</sub>O into K<sub>2</sub>SbO<sub>3</sub>+5H<sub>2</sub>O, by cold H<sub>2</sub>O into K<sub>2</sub>H<sub>3</sub>Sb<sub>2</sub>O<sub>7</sub>+6H<sub>2</sub>O (Fremy)

Does not exist (Knorre and Olschewsky)  
 Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 829)

Insol in acetone (Naumann, B 1904, 37 4329)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in ethyl acetate (Naumann, B 1904, 37 3601)

**Potassium hydrogen pyroantimonate, K<sub>2</sub>H<sub>3</sub>Sb<sub>2</sub>O<sub>7</sub>**

Insol in acetone (Eidmann, C C 1899, II 1014)

+2½H<sub>2</sub>O (Senderens, Bull Soc 1899, (3) 21 57)

+3½H<sub>2</sub>O Very difficultly sol in hot or cold H<sub>2</sub>O (Knorre and Olschewsky, B 18 2358)

+6H<sub>2</sub>O Quite difficultly sol in cold H<sub>2</sub>O  
 Not precipitated by NH<sub>4</sub>Cl+Ag<sub>2</sub> Aqueous solution gradually decomposes (Fremy)  
 +4H<sub>2</sub>O See 2K<sub>2</sub>SbO<sub>3</sub>+5H<sub>2</sub>O

**Potassium antimonate sulphantimonate, K<sub>2</sub>SbO<sub>3</sub>, K<sub>2</sub>SbS<sub>4</sub>+5H<sub>2</sub>O**

Decomp on air, and with cold H<sub>2</sub>O Sol in hot H<sub>2</sub>O (Rammelsberg)

**Silver antimonate**

Insol in H<sub>2</sub>O (Berzelius)  
 AgSbO<sub>3</sub>+3H<sub>2</sub>O=AgH SbO<sub>4</sub>+2H<sub>2</sub>O 1 vol sol in NH<sub>4</sub>OH+Ag, when freshly pptd (Beilstein and Blaise)  
 +1½H<sub>2</sub>O Ppt (Ebel, B 22 3045)

**Silver antimonate ammonia, AgH SbO<sub>4</sub>, 2NH<sub>3</sub>+H<sub>2</sub>O**  
 (Beilstein and Blaise)

**Sodium antimonate, NaSbO<sub>3</sub>**

Sol in much H<sub>2</sub>O but soon becomes decomposed into Na<sub>2</sub>H SbO

+3½H<sub>2</sub>O composition of Na<sub>2</sub>H SbO +6H<sub>2</sub>O, according to Beilstein and Blaise  
 1000 pts H<sub>2</sub>O dissolve 0.31 pt NaSbO<sub>3</sub>+3½H<sub>2</sub>O at 12°

1000 pts alcohol of 15% dissolve 0.13 pt NaSbO<sub>3</sub>+3½H<sub>2</sub>O at 12°

1000 pts alcohol of 20% dissolve 0.07 pt NaSbO<sub>3</sub>+3½H<sub>2</sub>O at 12°

Somewhat more sol when freshly precipitated

Absolutely insol in glacial HC<sub>2</sub>H<sub>3</sub>O

Presence of NaOH or Na<sub>2</sub>S dissolves solubility while NH<sub>4</sub>OH or K salts increase it

slightly (Beilstein and Blaise, Bull Ac St Petersb 33 201)

+4½H<sub>2</sub>O Sol in H<sub>2</sub>O (Delacroix, Bull Soc 1899, (3) 21 1051)

2Na<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>5</sub>+10H<sub>2</sub>O (Delacroix, *l c*)  
 Na<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>5</sub>+11H<sub>2</sub>O (Delacroix, *l c*)

**Sodium pyroantimonate, Na<sub>2</sub>H<sub>2</sub>Sb<sub>2</sub>O<sub>7</sub>+6H<sub>2</sub>O**

Boiling H<sub>2</sub>O dissolves 1 pt of this salt (Fremy) 1000 pts H<sub>2</sub>O dissolve 2.5 pts salt (Ebel, B 22 3044) See also NaSbO<sub>3</sub>+3½H<sub>2</sub>O

+5H<sub>2</sub>O (Knorre and Olschewsky)

**Strontium antimonate, Sr(SbO<sub>3</sub>)<sub>2</sub>+6H<sub>2</sub>O**

Ppt Less sol in H<sub>2</sub>O than SrSO<sub>4</sub> (Heffter, Pogg 86 418)

**Thallous antimonate, TlSbO<sub>3</sub>+2H<sub>2</sub>O=TlH<sub>3</sub>SbO<sub>4</sub>+H<sub>2</sub>O**

Somewhat sol in H<sub>2</sub>O, when freshly precipitated, insol when dried (Beilstein and Blaise)

**Tin (stannous) antimonate, 2SnO, Sb<sub>2</sub>O<sub>5</sub>**

Ppt (Lenssen, A 114 113)  
 Sn(SbO<sub>3</sub>)<sub>2</sub>+2H<sub>2</sub>O Attacked with difficulty by acids or alkalis, most easily by hot conc H<sub>2</sub>SO<sub>4</sub> (Schiff, A 120 55)

2SnO, 3Sb<sub>2</sub>O<sub>5</sub>+4H<sub>2</sub>O  
 SnO, 2Sb<sub>2</sub>O<sub>5</sub>

**Tin (stannic) antimonate**

Insol in H<sub>2</sub>O (Levol, A ch (3) 1 504)

**Uranium antimonate, 5UO<sub>2</sub>, 3Sb<sub>2</sub>O<sub>5</sub>+15H<sub>2</sub>O**

Ppt Sol in hot conc HCl+Ag, and in UCl<sub>3</sub>+Ag (Rammelsberg)

**Zinc antimonate, Zn(SbO<sub>3</sub>)<sub>2</sub>**

Verv slightly sol in H<sub>2</sub>O (Berzelius) sol in solutions of Zn salts

+2H<sub>2</sub>O (Ebel, Dissert 1890)  
 Insol in H<sub>2</sub>O (Senderens, Bull Soc 1899 (3) 21 57)

+3H<sub>2</sub>O Not wholly insol in cold, moderately sol in hot H<sub>2</sub>O (Ebel, Dissert 1890)  
 +6H<sub>2</sub>O Insol in H<sub>2</sub>O (Senderens)

**Antimoniomolybdic acid**

**Ammonium antimoniomolybdate, 5(NH<sub>4</sub>)O 4SbO 7MoO<sub>4</sub>+12H<sub>2</sub>O**

Readily sol in hot H<sub>2</sub>O (Gibbs, Am Ch J 7 392)

**Antimoniotungstic acid, 3Sb<sub>2</sub>O<sub>5</sub>, 4WO<sub>3</sub>+11H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Hallopeau, C R 1896, 123 1068)

**Potassium antimoniotungstate, 3K<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>5</sub>, 4WO<sub>3</sub>+4H<sub>2</sub>O**

Much more sol in hot than in cold H<sub>2</sub>O  
 Decomp by HCl, H<sub>2</sub>SO<sub>4</sub> and HNO<sub>3</sub> (Hallopeau, C R 1896, 123 1066)

+16H<sub>2</sub>O Much more easily sol in hot than cold H<sub>2</sub>O Decomp by HCl, H<sub>2</sub>SO<sub>4</sub>, and HNO<sub>3</sub> (Hallepeau, *l c*)  
 6K<sub>2</sub>O, 4Sb<sub>2</sub>O<sub>3</sub>, 12WO<sub>3</sub>+25H<sub>2</sub>O  
 Sl sol in H<sub>2</sub>O (Gibbs, Am Ch J 7 392)

### Antimoniuretted hydrogen

See Antimony hydride

### Antimonosomolybdic acid

Ammonium antimonosomolybdate, 6(NH<sub>4</sub>)<sub>2</sub>O,  
 3Sb<sub>2</sub>O<sub>3</sub>, 17MoC<sub>3</sub>+21H<sub>2</sub>O

Insol in cold H<sub>2</sub>O (Gibbs, Am Ch J 7 313)

### Antimonosophosphotungstic acid

Potassium antimonosophosphotungstate,  
 12K<sub>2</sub>O, 5Sb<sub>2</sub>O<sub>3</sub>, 6P<sub>2</sub>O<sub>5</sub>, 22WO<sub>3</sub>+48H<sub>2</sub>O,

Nearly insol in cold or warm H<sub>2</sub>O (Gibbs, Am Ch J 7 392)

### Antimonosotungstic acid

Ammonium antimonosotungstate

Sol in H<sub>2</sub>O

Barium antimonosotungstate, 4BaO, 6Sb<sub>2</sub>O<sub>3</sub>,  
 22WO<sub>3</sub>+36H<sub>2</sub>O

Precipitate, very sl sol in hot H<sub>2</sub>O (Gibbs, Am Ch J 7 313)

### Antimonous acid, HSbO<sub>3</sub>

(Long, J Am Chem Soc 1895, 17 87)  
 +1½H<sub>2</sub>O Ppt (Schaffner, A 51 182)  
 H<sub>3</sub>SbO<sub>3</sub> Ppt (Clarke and Stallo, B 13 1793)

Does not exist (Guntz, C R 102 1472)

H<sub>4</sub>Sb<sub>2</sub>O<sub>5</sub> When freshly pptd, is sol in dil KOH, and NaOH+Aq Scarcely sol in NH<sub>4</sub>OH+Aq, or in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>, or KHCO<sub>3</sub>+Aq

Completely sol in K<sub>2</sub>CO<sub>3</sub>, and Na<sub>2</sub>CO<sub>3</sub>+Aq, especially if warm When recently pptd is sl sol in succinic acid+Aq

Calcium antimonite, (CaSb<sub>2</sub>O<sub>4</sub>) (?)

Min *Romelia* Insol in acids

Cobaltous antimonite (?)

Sl sol in H<sub>2</sub>O (Berzelius)

Cuprous antimonite, (Cu<sub>3</sub>(SbO<sub>2</sub>)<sub>2</sub>)

Insol in H<sub>2</sub>O Sol in acids, most easily in conc HCl+Aq (Husmann and Stromeyer, Schw J 19 241)

Cupric antimonite (?)

Insol in H<sub>2</sub>O (Berzelius)

CuSb<sub>2</sub>O<sub>5</sub> Min *Ammolite*

CuSb<sub>2</sub>O<sub>4</sub> Sol in HCl+Aq tutuic and citric acids (Harding, Z anorg 1899, 20 238)

Iron (ferrous) antimonite (?)

More sol in H<sub>2</sub>O than the antimonate (Dumas)

Potassium antimonite, K<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>

Easily decomp by cold H<sub>2</sub>O Not decomp by KOH+Aq containing over 20.9% K<sub>2</sub>O (Corimmbœuf, C R 115 1305)  
 +3H<sub>2</sub>O As above (C)

Potassium antimonite iodide, K<sub>2</sub>O, 8Sb<sub>2</sub>O<sub>3</sub>,  
 2KI

Insol and not decomp by cold or hot H<sub>2</sub>O Not decomp by acids or alkalies Aqua regia decomp slowly Tartaric acid dissolves gradually (Gruhl, Dissert 1897)

Sodium antimonite, NaSbO<sub>2</sub>+3H<sub>2</sub>O

Difficultly sol in H<sub>2</sub>O (Terreil, A ch (4) 7 380)

2Na<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>+H<sub>2</sub>O Decomp by H<sub>2</sub>O, but not by NaOH+Aq containing 94.3 g NaOH per l (Corimmbœuf)

Na<sub>2</sub>O, 2Sb<sub>2</sub>O<sub>3</sub> Decomp by H<sub>2</sub>O but not by NaOH+Aq containing 188.6 g NaOH per l (C)

Na<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub> Decomp by H<sub>2</sub>O, but not by NaOH+Aq containing 113.2 g NaOH per l (C)

+2H<sub>2</sub>O=NaH<sub>2</sub>(SbO)<sub>3</sub> (Terreil)

### Antimony, Sb

Does not decomp H<sub>2</sub>O Not attacked by HCl+Aq (Berzelius), slowly sol in conc HCl+Aq (Debray), slowly sol in conc warm HCl+Aq (Troost) Attacked by very conc HCl+Aq only when finely divided (Schutzenberger, Willm), very sl attacked by dil or conc acid (Guntz) Not attacked by boiling HCl+Aq (Gmelin) By careful experiments, pure Sb is absolutely insol in dil or conc, hot or cold HCl+Aq, except when in contact with oxygen (Ditte and Metzner, A ch (6) 29 889)

Insol in dil or cold conc, but sol in hot conc H<sub>2</sub>SO<sub>4</sub> Oxidized but not dissolved by HNO<sub>3</sub>+Aq Easily and completely sol in aqua regia

Very slowly attacked by pure HNO<sub>3</sub>+Aq of 1.51-1.42 sp gr weaker acid has no marked action whether it contains NO<sub>2</sub> or not HCl+HNO<sub>3</sub> has no action if dil or at low temp, but when even very dil and KNO<sub>3</sub> is added, the action will begin (Millon, A ch (3) 6 101)

Not attacked in 10 months by 2% HNO<sub>3</sub>+Aq Sb is not dissolved by HNO<sub>3</sub>+Aq of any concentration a white powder being always left, which is insol in HNO<sub>3</sub>+Aq or H<sub>2</sub>O (Montemurri Gazz ch it 22 384)

Insol in alkalis+Aq

Somewhat sol in distilled H<sub>2</sub>O More or less sol in solutions of acids, alkalis and salts and in alcohol and ether Only sl sol in a mixture of alcohol and ether (Ruff and Albert, B 1905 38 54)

Alkaline H<sub>2</sub>O<sub>2</sub> converts Sb into antimonite acid, but neutral H<sub>2</sub>O is without action (Clark, Chm Soc 1893, 63 886)

Insol in liquid NH<sub>3</sub> (Gore, Am Ch J 1898, 20 826)

# ANTIMONY ARSENIDE

Easily attacked by pyrosulphurvl chloride (Feumann and Kochlin, B 16 479)  
Sb is sol in a mixture of HNO<sub>3</sub> and tartaric acid or other polybasic acids (Czerwek, Z anal 1906, 45 507)

Not attacked by a mixture of alcohol and ether (Cohen, Z phys Ch 1904, 47 12)  
½ cc oleic acid dissolves 0.0007 g Sb in 10 days (Gates, J phys Ch 1911, 15 143)

There are three modifications  
1 Ordinary gray metallic  
2 Black amorphous Unstable at ord temp By boiling with H<sub>2</sub>O is changed to metallic Sb

3 Yellow Very unstable At -50° goes over rapidly into the ordinary black modification Sol in CS<sub>2</sub> at a little above -90° (Stock, B 1903, 37 898)

Unstable above -90° (Stock, B 1905, 38 337)

**Antimony arsenide, Sb<sub>2</sub>As**  
(Descamps, C R 86 1065)

**Antimony tribromide, SbBr<sub>3</sub>**

Deliquescent, decomps by H<sub>2</sub>O  
Very sol in liquid NH<sub>3</sub> (Gore, Am Ch 1898, 20 826)  
Very sol in warm liquid AsBr<sub>3</sub>, forming a solution with sp gr = 3.685 at 47° (Retgers, Z anorg Ch 1903, 11 339)

Walden, Z anorg 1900, 25

1B1<sub>3</sub> (Isbekow, Z anorg 1913,

very sol in PCl<sub>3</sub> and PBr<sub>3</sub> (Walden, Z 1900, 25 211)

Sol in alcohol and CS

Sol in ether forming two liquids (Hynes, J chem Soc 1902, 24 360)

Sol in acetone (Nannum, B 1904, 37 328)

**Solubility of SbBr<sub>3</sub> in organic liquids**  
Data in parentheses indicate liquid equilibrium

Solvent	t°	Mols per 100	t°	Mols per 100	t°	Mols per 100
Benzene	-28°	0	-17°	17.1	-91°	7.3
	-30°	4.0	-15°	24.9	-90°	7.3
	-32°	8.7	-10°	30.7	-80°	84.1
	-13°	13.5	-5°	38.4	-70°	11.4
	-17°	17.5	0°	48.2	-62°	14.5
	0°	21.7	5°	58.1	-50°	100
Chlor benzene	-17°	0	0°	7.2	-60°	37.4
	-30°	1.7	10°	12	-70°	30.0
	-40°	2.2	20°	11.5	-80°	66.6
	-20°	3.2	30°	11.4	-90°	89.6
Brom benzene	-10°	4.3	40°	20.5	-94°	100
	-10°	5.6	50°	28.1		
	-12°	9.2	60°	36.6		

**Solubility of SbBr<sub>3</sub> in organic liquids—Co**

Solvent	t°	Mols per 100	t°	Mols per 100	t°	Mols
Iod benzene	-28°	0	10°	26.3	70°	6.1
	-30°	4.0	20°	31.5	80°	7.8
	-32°	8.7	30°	37.3	90°	9.1
	-13°	13.5	40°	43.7	94°	100
	-17°	17.5	50°	50.7		
	0°	21.7	60°	58.5		
Paradi-chlor-benzene	54°	0	65°	29.5	85°	6.8
	51°	6.3	70°	37.0	90°	8.0
	48°	12.8	75°	45.6	94°	100
	55°	18.7	80°	56.2		
Paradi-brom-benzene	88°	0	65°	52.0	90°	9.3
	80°	6.8	70°	59.1	92°	9.1
	80°	18.0	75°	66.5	94°	100
	75°	29.5	80°	74.4		
	70°	41.5	85°	83.0		
Nitro benzene	6°	0	-5°	32.3	55°	5.1
	1°	8.6	5°	35.3	65°	6.4
	-4°	17.0	15°	38.8	75°	7.3
	-9°	24.0	25°	42.8	85°	8.0
	-15°	29.7	35°	47.4	90°	9.1
	(-17°)	(31.9)	45°	52.8	94°	100
Metadi-nitro-benzene	90°	0	55°	49.1	70°	7.3
	85°	8.1	50°	53.0	75°	7.7
	80°	16.2	47°	54.4	80°	8.7
	75°	24.2	50°	56.1	85°	8.3
	70°	31.8	55°	58.8	90°	9.2
	65°	38.5	60°	62.2	94°	100
	60°	44.3	65°	66.2		
Toluene	-93°	0	10°	28.8	70°	6.4
	-93°	0.3	20°	36.7	80°	7.4
	-70°	1.2	30°	47.3	85°	8.2
	-50°	2.6	(34)	(54.0)	90°	9.6
	-30°	5.2	40°	51.5	94°	100
	-10°	13.3	50°	56.3		
Ethyl benzene	-93°	0	10°	9.8	60°	5.8
	-60°	0.4	20°	19.5	70°	6.4
	-40°	1.0	25°	28.6	80°	7.4
	-20°	2.3	29°	37.8	85°	8.0
	-10°	3.9	40°	44.6	90°	9.6
	0°	6.4	50°	51.6	94°	100
Propyl benzene	-80°	0.4	(-15°)	(33.3)	50°	4.3
	-60°	1.2	(-20°)	(23.3)	60°	5.5
	-40°	3.4	0°	25.8	70°	6.5
	-30°	5.3	10°	27.8	80°	7.5
	-20°	9.5	20°	30	90°	9
	-10°	17.2	30°	44.1	94°	100
	-5°	24.3	40°	38.6		
Isomyl benzene	-70°	1.9	(-13°)	(21.9)	60°	4.8
	-50°	3.6	-10°	17	70°	4.3
	-30°	1.1	0°	18.2	80°	5.0
	-20°	7.1	10°	19.9	90°	6.0
	-10°	13.4	20°	22	94°	100
	-17°	16.4	30°	25.9		
	(-15°)	(19.4)	40°	30.3		

(Menschutkin, Ann Inst Pol P le Ch 13)

**Antimony bromide with MBr**

See Bromantimonate, M

Also below

**Antimony hydrogen bromide, SbH<sub>3</sub>, HBr + 3H<sub>2</sub>O**

Very hygroscopic Decomps by H<sub>2</sub>  
(Weinland and Feige, B 1903, 36 256)

See Metabromantimonic acid

**Antimony caesium bromide**,  $2\text{SbBr}_3, 3\text{CsBr} + 2\text{H}_2\text{O}$   
Loses  $\text{Br}_2$  in the air (Weinland, B 1903, 16 257)

**Antimony calcium bromide**,  $\text{SbBr}_3, \text{CaBr}_2 + 8\text{H}_2\text{O}$

Easily decomp (Benedict, Proc Am Acad 1895, 30 9)

**Antimony glucinum bromide**,  $3\text{SbBr}_3, 2\text{GlBr}_2 + 18\text{H}_2\text{O}$

Hydroscopic Easily decomp (Weinland, 3 1903, 36 258)

**Antimony magnesium bromide**,  $\text{SbBr}_3, \text{MgBr}_2 + 8\text{H}_2\text{O}$

As Ca salt (Benedict, Proc Am Acad 1895, 30 9)

**Antimony potassium bromide**,  $10\text{SbBr}_3, 23\text{KBr} + 27\text{H}_2\text{O}$

(Herty, Am Ch J 1894, 16 496)

**Antimony rubidium bromide**,  $2\text{SbBr}_3, 3\text{RbBr}$

Decomp by  $\text{H}_2\text{O}$ , can be recryst from dil  $\text{HBr} + \text{Aq}$  (Wheeler, Z anorg 5 258)

$\text{SbRb}_2\text{Br}_6$  Slowly loses  $\text{Br}_2$  in the air  
Decomp by  $\text{H}_2\text{O}$  (Weinland, B 1903, 36 259)

$10\text{SbBr}_3, 23\text{RbBr}$  (?) Cryst from conc  $\text{HBr} + \text{Aq}$  (Wheeler)

The composition assigned to this salt by Wheeler (Z anorg 5 253) is incorrect  
Ephraim, B 1903, 36 1817)

**Antimony vanadium bromide**,  $\text{SbBr}_3, \text{VBr}_4 + 7\text{H}_2\text{O}$

Hydroscopic Decomp by  $\text{H}_2\text{O}$  Sol in dil  $\text{HCl}$  and in tartaric acid (Weinland, B 1903, 36 260)

**Antimony bromide potassium chloride**,  $\text{SbBr}_3, 3\text{KCl} + 1\frac{1}{2}\text{H}_2\text{O}$

Slowly deliquescent Very sol in  $\text{H}_2\text{O}$   
Sat solution contains 120.5 g to 100 cc  $\text{H}_2\text{O}$ , and has sp gr = 1.9

Decomp by much  $\text{H}_2\text{O}$  (Atkinson, Chem Soc 43 290)

Does not exist (Herty, Am Ch J 1894, 16 497)

See also Antimony chloride potassium bromide

**Antimony bromofluoride**,  $\text{SbF}_3\text{Br}$

Decomp by  $\text{H}_2\text{O}$  (Ruff, B 1906, 39 4319)

**Antimony trichloride**,  $\text{SbCl}_3$

Deliquescent Decomp by  $\text{H}_2\text{O}$  with precipitation of  $\text{SbOCl}$  This precipitation is prevented by tartaric, citric, or hydrochloric acid, or by conc solutions of chlorides of alkalis and alkaline earths

Solubility in  $\text{H}_2\text{O}$   
100 pts  $\text{SbCl}_3$  sol in pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{H}_2\text{O}$
0°	16 6
15°	12 3
20°	10 9
25°	10 1
30°	9 4
35°	8 7
40°	7 3
50°	5 2
60°	2 2

(Meerburg, Z anorg 1903, 33 299)

Solubility in  $\text{HCl} + \text{Aq}$   
100 mol  $\text{H}_2\text{O}$  dissolve mol  $\text{SbCl}_3$  in presence of mol  $\text{HCl}$  at 20°

Mol $\text{HCl}$	Mol $\text{SbCl}_3$
0	72 1-72 8
2 4	73 0
6 5	67 5
8 4	67 6
8 6	66 5
9 8	65 0
12 2	65 3
29 6	54 5

(Meerburg, Z anorg 1903, 33 304)

Solubility in  $\text{HCl} + \text{Aq}$

Solid phase	100 mol $\text{H}_2\text{O}$ dissolve at 20°			
	1	2	3	4
	Mol $\text{SbCl}_3$	Mol $\text{HCl}$	Mol $\text{SbOCl}$	Mol $\text{HCl}$
$\text{SbOCl}$	8 7	7 2	9 8	6 9
	8 6	7 5	16 1	7 9
	19 6	8 0	21 7	7 4
	19 8	8 9	25 0	8 8
			28 0	8 6
$(\text{SbOCl})_x, (\text{SbCl}_3)_y$	37 5	8 7	32 0	7 9
	44 0	6 8	35 8	7 9
	63 7	6 2	59 5	6 4
	69 1	5 6	61 0	6 5
	66 1	4 6	62 7	4 4
	69 8	5 3		
$\text{SbCl}_3$ and $(\text{SbOCl})_x, (\text{SbCl}_3)_y$	69 3	4 3		
	68 3	3 6		

1 & 2 (Meerburg, Z anorg 1903, 33 302)  
3 & 4 (Noodt, Z anorg 1903, 33 302)

Somewhat sol in liquid  $(\text{CN})$  (Centnerszwer, Bull Soc 1901, (3) 28 405)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 826)

Easily sol in  $\text{PCl}_3$  and  $\text{PBr}_3$  (Walden, Z anorg 1900, 25 211)

Sol in  $\text{S Cl}_2$  (Walden, Z anorg 1900, 25 217)

Easily sol in  $\text{AsBr}_3$  (Walden, Z anorg 1902, 29 374)

Sol in alcohol without decomp Very sol in hot  $\text{CS}_2$ , but solubility diminishes rapidly on cooling (Cooke, Proc Am Acad 13 72)

1 g  $\text{SbCl}_3$  is sol in 0.186 g acetone at  $18^\circ$  Sp gr of sat solution  $18^\circ/4^\circ = 2.216$  (Naumann, B 1904, 37 4332)

Sol in ethyl acetate (Naumann B 1904, 37 3601)

1 pt sol in 16.97 pts of ethyl acetate at  $18^\circ$  Sp gr of sat solution  $18^\circ/4^\circ = 1.7968$  (Naumann, B 1910, 43 320)

Sol in benzonitrile (Naumann, B 1914, 47 1369)

Sol in methylal (Eidmann, C C 1899, II 1014)

Solubility of  $\text{SbCl}_3$  in organic liquids  
Data in parentheses indicate labile equilibrium

Solvent	$t^\circ$	Mols per 100	$t^\circ$	Mols per 100	$t^\circ$	Mols per 100
Benzene	$5.6^\circ$	0	50	27.2	$75^\circ$	78.5
	4	2.6	60	34.7	70	83.3
	1	7.1	70	45.2	62	89.3
	10	10.1	75	53.1	67.5	94.2
	20	13.1	77.5	58.7	73	100
	30	16.8	79	66.6		
	40	21.4	77.5	73.4		
Chlor benzene	$-45.2^\circ$	0	$-10$	14.4	30	47.1
	$-47$	2.2	$-5$	19.4	40	56.2
	$-40$	3.6	0	28.1	50	66.6
	$-30$	6.0	(4)	(41.1)	60	78.7
	$-20$	9.0	10	32.5	70	94.3
	$-15$	11.6	20	38.7	73	100
Brom benzene	$-31^\circ$	0	$-5^\circ$	21.7	40	59.2
	$-32.5$	3.4	0	26.6	50	68.5
	( $-30$ )	(6.4)	3	31.8	60	80.6
	$-30$	4.8	(6)	(41.9)	65	87.2
	$-25$	7.6	(7)	(50.0)	70	95.0
	$-20$	10.7	10	36.4	73	100
	$-15$	14.1	20	43.2		
	$-10$	17.8	30	50.8		
Iod benzene	$-28.6$	0	( $-5$ )	(10.7)	25	53.4
	$-30$	2.4	$-34$	10.7	35	60.4
	( $-30$ )	(11.7)	$-2$	16.4	45	67.5
	( $-40$ )	(20.8)	$-15$	24.7	55	76.2
	( $-45$ )	(27.2)	$-5$	39.1	65	87.4
	( $-35$ )	(30.9)	( $-3$ )	(47.2)	70	95.0
	( $-25$ )	(33.9)		44.5	75	100
	( $-15$ )	(35.5)	15	48.7		
Parachlor benzene	$54$	0	95	29.5	60	66.5
	50	6.3	45	37.5	65	78.1
	45	15.5	30	46.4	70	91.1
	40	28.0		56.0	75	100
Methylnitro benzene	$55^\circ$	0	$65^\circ$	45.1	$65^\circ$	87.1
	50	9.9	60	53.9	70	95.2
	40	15.8	55	64.9	75	100
	30	25.7		72.5		
	20	35.7	40	79.8		
Nitro benzene	$5^\circ$	0	$-13$	27.3	15	59.2
	2	7.0	$-10$	29.8	25	63.0
	$-2$	12.1	$-7$	35.2	35	67.6
	$-4$	16.5	$-6$	40.7	45	72.8
	$-10$	20.3	$-4$	50.0	55	79.0
	$-14$	23.5	6	52.8	65	87.2
	( $-18$ )	(26.2)	$-5$	63.0	70	92.7
	$-15$	28.2		65.5	75	100

Solvent	$t^\circ$	Mols per 100	$t^\circ$	Mols per 100	$t^\circ$	Mols per 100
Metadinitro benzene	$90^\circ$	0	( $-10^\circ$ )	(57.7)	( $0^\circ$ )	(73.1)
	80	14.3	(10)	(62.4)	20	65.2
	70	25.3	(27.5)	(44.5)	30	68.8
	60	33.8	(28.5)	(50.0)	40	73.2
	40	45.6	27.5	55.0	50	78.5
	(20)	(53.6)	25	60.2	60	85.8
	(1)	(59.9)	(20)	(66.2)	70	95.2
	( $-11$ )	(62.2)	(10)	(73.5)	73	100
Toluene	$-93^\circ$	0	$-10^\circ$	14.4	$40^\circ$	59.3
	$-94$	0.5	0	22.1	$42^\circ$	66.6
	$-70$	1.4	6	28.6	40	71.1
	$-50$	3.3	11	35.7	50	77.1
	$-40$	5.1	( $-8$ )	(27.0)	60	83.8
	$-30$	7.2	20	40.5	70	94.7
	$-20$	10	30	47.6	73	100
Ethylbenzene	$-93^\circ$	0	$35^\circ$	36.4	(36.8)	(68.1)
	$-50$	0.6	39	50	(33)	(65.7)
	$-30$	1.1	37	57.7	40	70.3
	$-10$	3.6	35	61.8	50	77.3
	0	5.6	(33)	(65.7)	60	85.5
	10	9.4	(15)	(37.8)	65	90.3
	20	16.8	(25)	(47.5)	70	95.6
	30	27.2	37	66.6	73	100
Propyl benzene	( $-70^\circ$ )	(0.6)	$-70^\circ$	0.2	8	53.2
	( $-50$ )	(2.8)	$-50$	1.5	10	53.6
	( $-40$ )	(5.2)	$-40$	3.0	20	58.9
	( $-30$ )	(8.8)	$-30$	5.5	30	60.6
	( $-20$ )	(14.8)	$-20$	9.7	40	65.5
	( $-10$ )	(25.1)	$-10$	16.2	50	72
	( $-5$ )	(32.4)	$-5$	20.5	60	81
Isoamyl benzene	(0)	(43.3)	0	26.2	65	86.8
	(1.5)	(50.1)	5	35.6	70	95.1
	(1)	(51)	7	41.6	73	100
	$-80$	3	( $-45^\circ$ )	(17.1)	$0^\circ$	46.3
	$-70$	5.4	( $-35$ )	(22.8)	10	48.8
	$-60$	8.4	$-25$	29.3	20	52.5
	$-50$	12.4	$-15$	36.6	30	57.3
Isobutyl benzene	$-40$	17.9		46.6	40	63.4
	( $-30$ )	(27.3)	(0)	(52.3)	50	71.4
	( $-25$ )	(34.4)	( $-5$ )	(60.3)	60	81.7
	( $-22$ )	(40.7)	(7.5)	(66.6)	65	88
	( $-20.5$ )	(50)	( $-21$ )	(44.2)	70	95.5
	( $-22$ )	(54)	( $-10$ )	(44.9)	73	100

(Menschutkin, Ann Inst Pol P-le Gr 13 1)

### Antimony hydrogen trichloride, $2\text{SbCl}_3 + 2\text{HCl}$

Deliquescent Decomps by  $\text{H}_2\text{O}$

Melts in crystal  $\text{H}_2\text{O}$  at  $16^\circ$  (Engel C R 106 1797)

### Antimony pentachloride, $\text{SbCl}_5$

Deliquesces to  $\text{SbCl}_3 + \text{HCl}$  which can be crystallized out of a little  $\text{H}_2\text{O}$ . Decomps by more  $\text{H}_2\text{O}$  into  $\text{SbOCl}$ . Sol in a large amount of  $\text{H}_2\text{O}$ , if it is added all at one time. Capitation by  $\text{H}_2\text{O}$  is also hindered by presence of tartaric, or hydrochloric acid.

+  $\text{HCl}$  Deliquescent Sol in chloroform (Anschutz and Evans, A 239 285)

+  $\text{H}_2\text{O}$  Insol in chloroform (Anschutz and Evans)

### Antimony pentachloride with $\text{MCl}$

See Chlorantimonate, M

See also below

**Antimony hydrogen pentachloride**,  $\text{SbCl}_5$ ,  $\text{HCl} + 4\frac{1}{2}\text{H}_2\text{O}$

"Metachlorantimonic acid" according to Weinland and Schmid, (Z anorg 1905, 44 43)

Very easily sol in  $\text{H}_2\text{O}$ , alcohol, acetone and glacial acetic acid. Aqueous solution decomposes on standing with separation of  $\text{Sb}_2\text{O}_3$  but remains clear in presence of 10%  $\text{HCl}$  (Weinland and Schmid, Z anorg 1905, 44 43)

$\text{SbCl}_5$ ,  $5\text{HCl} + 10\text{H}_2\text{O}$  Not deliquescent. Decomposes by  $\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  at about  $55^\circ$  (Engel, C R 106 1797)

**Antimony antimonyl chloride**,  $\text{SbCl}_3$ ,  $\text{SbOCl}$

More easily attacked by  $\text{H}_2\text{O}$  than  $\text{SbOCl}$  (Bemmelen, Z anorg 1903, 33 293)

**Antimony antimonyl potassium chloride**,  $\text{SbCl}_3$ ,  $\text{SbOCl}$ ,  $2\text{KCl}$

Not deliquescent. Immediately decomposes by hot or cold  $\text{H}_2\text{O}$ , sol in hot glacial  $\text{HC}_2\text{H}_3\text{O}_2$ , or in  $\text{HCl}$ , or tartaric acid +  $\text{Aq}$ . Insol in  $\text{KCl} + \text{Aq}$ , hot or cold alcohol,  $\text{CS}_2$ , or ligroine (Benedikt, Proc Am Acad 29 217)

**Antimony antimonyl rubidium chloride**,  $\text{SbCl}_3$ ,  $\text{SbOCl}$ ,  $2\text{RbCl}$

Sol in very dil  $\text{HCl} + \text{Aq}$  (Wells, Am J Sci 1897, (4) 3 463)

**Antimony barium chloride**,  $\text{SbCl}_3$ ,  $\text{BaCl}_2 + \frac{3}{2}\text{H}_2\text{O}$

Decomposes by  $\text{H}_2\text{O}$

**Antimony caesium chloride**,  $\text{SbCl}_3$ ,  $6\text{CsCl}$

Decomposes by  $\text{H}_2\text{O}$ . Cryst from dil  $\text{HCl} + \text{Aq}$  (Godefroy, Arch Pharm (3) 12 47)

$2\text{SbCl}_3$ ,  $3\text{CsCl}$  Decomposes by  $\text{H}_2\text{O}$ , sl sol in cold, easily in hot dil  $\text{HCl} + \text{Aq}$ . This is identical with the above salt (Saunders, Am Ch J 14 152)

$\text{SbCl}_3$ ,  $2\text{CsCl}$  Sol in boiling conc  $\text{HCl} + \text{Aq}$  without decomposition (Setterberg, Oef Vet Akad 1882, 6 23)

$\text{SbCl}_3$ ,  $\text{CsCl}$  Cryst from  $\text{HCl} + \text{Aq}$  without decomposition. Decomposes by  $\text{H}_2\text{O}$  (Setterberg, Oef Vet Akad 1882, 6 27)

**Antimony calcium chloride**,  $\text{SbCl}_3$ ,  $\text{CaCl}_2 + 8\text{H}_2\text{O}$

Easily decomposes (Benedikt, Proc Am Acad 1895, 30 9)

$\text{SbCl}_3$ ,  $\text{CaSbCl}_6$ ,  $\text{OH} + 9\text{H}_2\text{O}$  Deliquescent, sl sol in  $\text{H}_2\text{O}$  (Weinland, B 1901, 34 2635)

**Antimony chromium chloride**,

$\text{CrCl}_3$ ,  $3\text{SbCl}_3 + 13\text{H}_2\text{O}$  (Weinland) should be

$[\text{SbCl}_2]_3[\text{Cr}(\text{OH})_2]_3 + 7\text{H}_2\text{O}$ , and  $\text{CrCl}_3$ ,  $\text{SbCl}_3 + 10\text{H}_2\text{O}$  should be

$[\text{SbCl}_2]_3[\text{Cr}(\text{OH})_2]_3 + 6\text{H}_2\text{O}$  (Pfeiffer, Z anorg 1903, 36 349)

**Antimony glucinum chloride**,  $\text{SbCl}_3$ ,  $\text{GlCl}_2 + 3\text{H}_2\text{O}$

Very hygroscopic. Decomposes by  $\text{H}_2\text{O}$ . Very easily sol in  $\text{HCl}$  (Ephraim, B 1903, 36 1822)

$+4\text{H}_2\text{O}$  Ppt. Decomposes by  $\text{H}_2\text{O}$ . Sol in  $\text{HCl}$  (Ephraim, B 1903, 36 1822)

**Antimony hydrazine chloride**,  $\text{SbCl}_3$ ,  $3\text{N}_2\text{H}_4\text{Cl}$

Sol in conc  $\text{HCl} + \text{Aq}$ , decomposes by  $\text{H}_2\text{O}$  (Ferrattini, C A 1912, 1613)

**Antimony lithium chloride**,  $\text{SbCl}_3$ ,  $2\text{LiCl} + 5\text{H}_2\text{O}$

Hygroscopic. Decomposes by  $\text{H}_2\text{O}$ . Very easily sol in  $\text{HCl}$  (Ephraim, B 1903, 36 1821)

$+6\text{H}_2\text{O}$  Decomposes by  $\text{H}_2\text{O}$ , easily sol in  $\text{HCl}$  (Ephraim, B 1903, 36 1822)

**Antimony magnesium chloride**,  $\text{SbCl}_3$ ,  $\text{MgCl}_2 + 5\text{H}_2\text{O}$

Hygroscopic. Decomposes by  $\text{H}_2\text{O}$ . Can be cryst from  $\text{HCl}$  without decomposition (Ephraim, B 1903, 36 1823)

$2\text{SbCl}_3$ ,  $\text{MgCl}_2$  Hygroscopic. Decomposes by  $\text{H}_2\text{O}$ . Very sol in  $\text{HCl}$  (Ephraim)

$\text{SbCl}_3$ ,  $\text{MgSbCl}_6$ ,  $\text{MgOH} + 17\text{H}_2\text{O}$  Hygroscopic. Sol in  $\text{H}_2\text{O}$  with decomposition (Weinland, B 1901, 34 2635)

**Antimony nitrosyl chloride**,  $\text{SbCl}_3$ ,  $\text{NOCl}$

Very deliquescent, decomposes by pure  $\text{H}_2\text{O}$  sol in  $\text{H}_2\text{O}$  containing tartaric acid (Weber, Pogg 123 347)

$2\text{SbCl}_3$ ,  $5\text{NOCl}$  Decomposes by  $\text{H}_2\text{O}$  (Sudborough, Chem Soc 59 661)

**Antimony phosphorus chloride**,  $\text{SbCl}_3$ ,  $\text{PCl}_3$

Deliquescent (Weber, Pogg 125 78)

**Antimony phosphoryl chloride**,  $\text{SbCl}_3$ ,  $\text{POCl}_3$

Deliquescent (Weber)

**Antimony platinum potassium chloride**,

$(\text{Sb}, \text{Pt})\text{Cl}_6\text{K}$

Ppt (Weinland, B 1903, 38 1056)

**Antimony potassium chloride**,  $\text{SbCl}_3$ ,  $2\text{KCl}$

Sol in  $\text{H}_2\text{O}$  without decomposition (Jacquelin, A ch (2) 66 125)

Not deliquescent. Immediately decomposes by hot or cold  $\text{H}_2\text{O}$ . Sol in  $\text{HCl}$ , or tartaric acid +  $\text{Aq}$  (Benedikt, Proc Am Acad 29 219)

$+2\text{H}_2\text{O}$  Very efflorescent

$\text{SbCl}_3$ ,  $3\text{KCl}$  Deliquescent. Decomposes by hot  $\text{H}_2\text{O}$  (Poggiale)

$+2\text{H}_2\text{O}$  (Romanis, C N 49 273)

Not obtained by Benedikt (l c)

$10\text{SbCl}_3$ ,  $23\text{KCl}$  True composition of above salts. Sol in  $\text{H}_2\text{O}$  (Herty Am Ch J 1894, 16 495)

$\text{SbCl}_3$ ,  $2\text{KCl}$  is the only true compound, all



others being isomorphous mixtures (Jordis, B 1903, **36** 2539)

$2\text{SbCl}_3, 3\text{KCl}$  Deliquescent Decomp by  $\text{H}_2\text{O}$  (Bosek, Chem Soc 1895, **67** 516)

$\text{SbCl}_3\text{KSbCl}_3\text{KOH}$  Hygroscopic Sol in  $\text{H}_2\text{O}$  with decomp (Weinland, B 1901, **34** 2635)

See also Antimony antimonyl potassium chloride

**Antimony rubidium chloride**,  $\text{SbCl}_3, \text{RbCl}$

Decomp on air or with  $\text{H}_2\text{O}$  (Saunders, Am Ch J **14** 162)

$2\text{SbCl}_3, \text{RbCl} + \text{H}_2\text{O}$  Decomp on air (Wheeler, Z anorg **5** 253)

$\text{SbCl}_3, 6\text{RbCl}$  Decomp by  $\text{H}_2\text{O}$  (Godefroy, Arch Pharm (3) **9** 343)

Formula is  $10\text{SbCl}_3, 23\text{RbCl}$  (?) (Saunders Am Ch J **14** 159)

$10\text{SbCl}_3, 23\text{RbCl}$  (?) Decomp by  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$  (Saunders)

Formula is  $3\text{SbCl}_3, 7\text{RbCl}$  (Wells and Foote, Am J Sci 1897, (4) **3** 461)

Composition assigned to this salt by Saunders (Am Ch J **14** 155) is incorrect (Ephraim, B 1903, **36** 1817)

$3\text{SbCl}_3, 5\text{RbCl}$  As above (Saunders)

Formula is  $2\text{SbCl}_3, 3\text{RbCl}$  (Wheeler)

$\text{Rb}_2\text{SbCl}_6$  Ppt Decomp by  $\text{H}_2\text{O}$  (Weinland, B 1905, **38** 1083)

$\text{Rb}_2\text{SbCl}_6, 2\text{Rb}_2\text{SbCl}_6$  Ppt Decomp by  $\text{H}_2\text{O}$  (Weinland, B, 1901, **34** 2635)

**Antimony selenium chloride**,  $\text{SbCl}_3, \text{SeCl}_4$

Deliquescent (Weber)

**Antimony selenyl chloride**,  $\text{SbCl}_3, \text{SeOCl}_2$

Very deliquescent (Weber, Pogg **125** 325)

**Antimony sodium chloride**,  $\text{SbCl}_3, 3\text{NaCl}$  (?)

Decomp by much  $\text{H}_2\text{O}$  (Poggiale)

**Antimony sulphur chloride**,  $2\text{SbCl}_3, 3\text{SbCl}_2$

Decomp by  $\text{H}_2\text{O}$

$\text{SbCl}_3, \text{SbCl}_4$  Sol in dil  $\text{HNO}_3 + \text{Aq}$   
Mpt  $125-126^\circ$  in an atmos of chlorine  
Violently decomp by  $\text{H}_2\text{O}$  (Ruff, B 1904, **37** 4515)

**Antimony thallium chloride**,  $\text{SbCl}_3, 3\text{TlCl}$

Ppt (Ephraim, Z anorg 1909, **61** 249)

$\text{SbCl}_4, \text{TlCl}$  (Ephraim and Barteczko, Z anorg 1909, **61** 251)

$2\text{SbCl}_4, 2\text{TlCl}, \text{TlCl}_3$  Slowly decomp by cold  $\text{H}_2\text{O}$  (Ephraim and Barteczko, Z anorg 1909, **61** 253)

**Antimony trichloride ammonia**,  $\text{SbCl}_3, \text{NH}_3$

Not very deliquescent Decomp by  $\text{H}_2\text{O}$

**Antimony pentachloride ammonia**,  $\text{SbCl}_5, 6\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  (Persoz)

**Antimony pentachloride cyanhydric acid**,  $\text{SbCl}_5, 3\text{HCN}$

Deliquescent, decomp by  $\text{H}_2\text{O}$  (K n, A **74** 85)

**Antimony pentachloride nitric oxide**,  $\text{SbCl}_5, \text{NO}$

Decomp by  $\text{H}_2\text{O}$  (Besson, C F **108** 1012)

**Antimony pentachloride nitrogen peroxide**,  $3\text{SbCl}_5, 2\text{NO}_2$

Decomp by  $\text{H}_2\text{O}$  (Besson)

**Antimony pentachloride nitrogen sulphide**,  $\text{SbCl}_5, \text{N}_4\text{S}_4$

Easily decomp (Davis, Chem Soc 1906, **89** 1577)

Decomp by cold  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and warm alcohol, also by boiling with  $\text{KOH} + \text{Aq}$   
Almost insol in organic solvents (Wells, Z anorg 1908, **57** 283)

**Antimony chloride potassium bromide**,  $\text{SbCl}_3, 3\text{KBr} + 1\frac{1}{2}\text{H}_2\text{O}$

Very deliquescent Decomp by much  $\text{H}_2\text{O}$  (Atkinson, Chem Soc **43** 289)

$2\text{SbCl}_3, 3\text{KBr} + 2\text{H}_2\text{O}$  (Atkinson)

$\text{SbCl}_3, \text{KBr} + \text{H}_2\text{O}$  (Atkinson)

Above are mixtures (Herty, Am Ch J **1894**, **16** 497)

See Antimony bromide potassium chloride

**Antimony chlorofluoride**,  $\text{SbCl}_3\text{F}_2$

(Swarts, Z anorg 1896, **12** 71)

**Antimony fluoriodide**,  $\text{SbF}_3\text{I}$

Slowly decomp by  $\text{H}_2\text{O}$  (Ruff, B 1906, **39** 4321)

$(\text{SbF}_3)_2\text{I}$  Sol in  $\text{H}_2\text{O}$  with pptn of  $\text{I}_2$  (Ruff, B 1906, **39** 4321)

**Antimony trifluoride**,  $\text{SbF}_3$

Deliquescent Sol in  $\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	100 g of the solution contain g $\text{SbF}_3$	100 g $\text{H}_2\text{O}$ contain g $\text{SbF}_3$
$0^\circ$	79.37	38.47
20	81.64	44.47
22.5	81.91	45.28
25	83.12	49.24
30	84.93	56.66

(Rosenheim, Z anorg 1909, **61** 18)

Solubility in  $\text{HI} + \text{Aq}$  at  $0^\circ$

Normality of $\text{HI} + \text{Aq}$	100 g $\text{H}_2\text{O}$ of the solution dissolve g $\text{SbF}_3$	solubility
2	474.9	
1	432.5	
0.5	404.0	

(Rosenheim, Z anorg 1909, **61** 19)

Solubility of  $\text{SbF}_3$  in salts + Aq at  $0^\circ$ 

Salt	Normality of salt solution	100 g $\text{H}_2\text{O}$ of the salt solution dissolve g $\text{SbF}_3$
KCl	1	461.8
	0.5	448.3
	0.25	431.9
	0.125	407.3
KBr	1	448.7
	0.5	450.0
	0.25	455.6
	0.125	417.2
$\text{KNO}_3$	1	458.2
	0.5	451.9
	0.25	418.3
	0.125	401.4
$\frac{1}{2}\text{K}_2\text{SO}_4$	1	419.9
	0.5	408.5
	0.25	406.6
$\frac{1}{2}\text{K}_2\text{C}_2\text{O}_4$	1	465.7
	0.5	481.2
	0.25	451.3
	0.125	405.2
$\frac{1}{2}(\text{NH}_4)_2\text{C}_2\text{O}_4$	0.5	431.9
	0.25	442.3
	0.125	433.3
$\frac{1}{2}\text{K}_2\text{C}_4\text{H}_4\text{O}_6$	1	461.4
	0.5	430.5
	0.25	430.8
	0.125	435.2

(Rosenheim, Z anorg 1909, 61 192)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 826)

**Antimony pentafluoride,  $\text{SbF}_5$** 

Sol in  $\text{H}_2\text{O}$  (Maignac, A 145 239)  
 Very hygroscopic, bpt  $155^\circ$  Sol in  $\text{H}_2\text{O}$  with hissing (Ruff, B 1904, 37 678)  
 $+2\text{H}_2\text{O}$  (Ruff, B 1904, 37 679)

**Antimony pentafluoride diantimony trifluoride,  $\text{Sb}_3\text{F}_{11} = 2\text{SbF}_3 \cdot \text{SbF}_5$** 

Hygroscopic, bpt  $390^\circ$  Easily sol in  $\text{H}_2\text{O}$  (Ruff, B 1904, 37 680)

**Antimony pentafluoride pentantimony trifluoride,  $\text{SbF}_5 \cdot 5\text{SbF}_3$** 

Bpt  $384^\circ$  (corr) (Ruff, B 1904, 37 681)

**Antimony caesium fluoride,**

$\text{CsF} \cdot 2\text{SbF}_3$   
 $\text{CsF} \cdot 3\text{SbF}_3$   
 $4\text{CsF} \cdot 7\text{SbF}_3$   
 $\text{CsF} \cdot \text{SbF}_3$   
 $2\text{CsF} \cdot \text{SbF}_3$   
 (Wells, Am J Sci 1901, (4) 11 451)

**Antimony lithium fluoride,  $\text{SbF}_3 \cdot 2\text{LiF}$** 

Sol in more than 20 pts  $\text{H}_2\text{O}$  (Flückinger, Pogg 87 245)

$\text{SbF}_3 \cdot \text{LiF}$  Easily sol in  $\text{H}_2\text{O}$  (Stein, Chem Z 13 357)

**Antimony potassium fluoride,  $\text{SbF}_3 \cdot 2\text{KF}$** 

Sol in less than 2 pts boiling, and in 9 pts cold  $\text{H}_2\text{O}$  Insol in alcohol or ether

$\text{SbF}_3 \cdot \text{KF}$  More sol than  $\text{SbF}_3 \cdot 2\text{KF}$  Sol in 2.8 pts  $\text{H}_2\text{O}$  (Flückinger, Pogg 87 245)

$\text{SbF}_3 \cdot \text{KF}$  Easily sol in  $\text{H}_2\text{O}$

$\text{SbF}_3 \cdot 2\text{KF} + 2\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Maignac, A 145 239)

**Antimony sodium fluoride,  $\text{SbF}_3 \cdot 3\text{NaF}$** 

Sol in 14 pts cold, and 4 pts boiling  $\text{H}_2\text{O}$  Sol in  $\text{HF}$  (Flückinger, Pogg 87 245)

$\text{SbF}_3 \cdot \text{NaF}$  100 pts cold  $\text{H}_2\text{O}$  dissolve 93 pts 100 pts hot  $\text{H}_2\text{O}$  dissolve 166 pts (Stein, Wagners' J B 1887 1160)

$4\text{SbF}_3 \cdot \text{NaF}$  As  $\text{NH}_4$  salt (Raad and Hauser, B 1890, 23 R 125)

$\text{SbF}_3 \cdot 2\text{NaF}$  Easily sol in  $\text{H}_2\text{O}$  (Maignac, A 145 329)

**Antimony thallium fluoride,  $\text{TlF} \cdot \text{SbF}_3$** 

Sol in  $\text{H}_2\text{O}$  without decomp (Ephraim, B 1909, 42 4458)

$\text{TlF} \cdot 2\text{SbF}_3$  Sol in  $\text{H}_2\text{O}$  without decomp (Ephraim)

$\text{TlF} \cdot 3\text{SbF}_3$  Sol in  $\text{H}_2\text{O}$  without decomp

**Antimony trifluoride ammonia,  $\text{SbF}_3$** 

Sl sol in liquid  $\text{NH}_3$  (Ruff, B 1904, 4326)

**Antimony trifluoride ammonium chloride  $\text{SbF}_3 \cdot \text{NH}_4\text{Cl}$** 

Easily sol in  $\text{H}_2\text{O}$  (de Haen, B 21 901 R)

**Antimony trifluoride ammonium sulphate,  $\text{SbF}_3 \cdot (\text{NH}_4)_2\text{SO}_4$** 

More sol than K or Na salt 1 pt  $\text{H}_2\text{O}$  dissolves 1.4 pts at  $24^\circ$  and 15 pts at  $100^\circ$  (de Haen, B 21 902 R)

**Antimony fluoride lithium chloride,  $\text{SbF}_3 \cdot \text{LiCl}$** 

Sol in  $\text{H}_2\text{O}$  (Stein, Chem Z 13 357)

**Antimony pentafluoride nitrosyl fluoride,  $\text{SbF}_5 \cdot \text{NOF}$** 

Hygroscopic Decomp by  $\text{H}_2\text{O}$  Sol in liquid  $\text{NH}_3$  with decomp Sl sol in  $\text{NOCl}$ ,  $\text{SiCl}_4$ ,  $\text{PCl}_3$ ,  $\text{AsCl}_3$ ,  $\text{SO}_2\text{Cl}_2$  and  $\text{SOCl}_2$  (Ruff, Z anorg 1908, 58 434)

**Antimony trifluoride potassium chloride,  $\text{SbF}_3 \cdot \text{KCl}$** 

100 pts  $\text{H}_2\text{O}$  dissolve 51 pts at  $24^\circ$ , and 300 pts at  $100^\circ$  (de Haen, B 21 901 R)

- Antimony trifluoride potassium sulphate**,  $\text{SbF}_3, \text{K}_2\text{SO}_4$   
Sol in  $\text{H}_2\text{O}$  (de Haen)  
2SbF<sub>3</sub>, K<sub>2</sub>SO<sub>4</sub> Very sol in  $\text{H}_2\text{O}$  (Mayer, B 1894, 27 R 922)
- Antimony trifluoride sodium chloride**,  $\text{SbF}_3, \text{NaCl}$   
Easily sol in  $\text{H}_2\text{O}$  (de Haen, B 21 901 R)
- Antimony trifluoride sodium sulphate**,  $\text{SbF}_3, \text{Na}_2\text{SO}_4$   
Sol in  $\text{H}_2\text{O}$  (de Haen)
- Antimony fluoiodide**,  $\text{SbF}_2\text{I}$   
Mpt 80°, slowly decomp by  $\text{H}_2\text{O}$  (Ruff, B 1906, 39 4321)  
(SbF<sub>2</sub>)<sub>2</sub>I Mpt 110–115°, decomp by  $\text{H}_2\text{O}$  (Ruff)
- Antimony fluosulphide**,  $\text{SbF}_2\text{S}$   
Very hygroscopic. Decomp by  $\text{H}_2\text{O}$ . Sol with decomp in alcohol. Sol in  $\text{CCl}_4$  (Ruff, B 1906, 39 4322)
- Antimony gold**,  $\text{AuSb}$   
Insol in equal pts of  $\text{HNO}_3$  and tartaric acids (Roessler, Z anorg 1895, 9 72)
- Antimony hydride**,  $\text{SbH}_3$   
Scarcely sol in  $\text{H}_2\text{O}$ . 1000 ccm  $\text{H}_2\text{O}$  absorb 4.12 cc  $\text{SbH}_3$  at 10.5°. Decomp by long contact with  $\text{H}_2\text{O}$ , also by conc  $\text{H}_2\text{SO}_4$  or  $\text{KOH} + \text{Aq}$  (Jones, Chem Soc 29 641)
- Antimony trihydroxide**,  $\text{Sb}_2\text{O}_3, 2\text{H}_2\text{O} = \text{Sb}_2\text{O}_3(\text{OH})_4$   
(Schaffner, A 51 182)  
 $\text{Sb}(\text{OH})_3$  Ppt (Clarke and Stolla, B 13 1787)  
Does not exist (Guntz, C R 102 1472)  
See Antimonous acid and antimony trioxide
- Antimony triiodide**,  $\text{SbI}_3$   
Decomp by  $\text{H}_2\text{O}$  or 50% alcohol. Sol in  $\text{HI} + \text{Aq}$ , sol in boiling  $\text{CS}_2$  and in boiling benzene, but separates out on cooling. Almost insol in  $\text{CHCl}_3$  (Cooke, Proc Am Acad (2) 5 72)  
Easily sol in  $\text{AsI}_3$  (Walden, Z anorg 1902, 29 574)  
Sol in warm  $\text{AsI}_3$ . Sp gr of a solution sat. at 40° which solidifies at 37°, = 3.720. This dissolves further  $\text{AsI}_3$ , whereby the mpt sinks to 31° and sp gr rises to 3.801. By mixing the latter solution with a solution of  $\text{AsI}_3$  in  $\text{CH}_2\text{I}_2$ , a liquid can be obtained with a sp gr of 3.702 at 20° (Retgers, Z phys Ch 1893, 11 340)  
Sol in  $\text{PCl}_3$  (Buckmann, Z anorg 1906, 51 110)  
Sol in  $\text{SOCl}_2$  (Walden, Z anorg 1900, 25 215)
- Sol in  $\text{SOCl}_2$  and  $\text{S}_2\text{Cl}_2$  (Walden, Z anorg 1900, 25 216)  
Sol in  $\text{AsCl}_3$  (Walden, Z anorg 1901, 25 214)  
Sol in  $\text{SnCl}_4$  (Walden, Z anorg 1901, 25 218)  
Sol in  $\text{POCl}_3$  (Walden, Z anorg 1901, 25 212)  
Easily sol in  $\text{PCl}_3$  and  $\text{PBr}_3$  (Walden, Z anorg 1900, 25 211)  
Partly sol in, and partly decomp by alcohol or ether (M'Ivor, Chem Soc (2) 4 328)  
Insol in oil of turpentine and  $\text{CCl}_4$   
100 pts methylene iodide dissolve 11.3 ts  $\text{SbI}_3$  at 12°, sp gr of solution = 3.453 (Retgers, Z anorg 3 343)  
Sol in  $\text{C}_6\text{H}_6$  (Retgers, Z phys Ch 1 18, 11 334)  
Sol in acetone (Naumann, B 1904 17 4328)
- Antimony pentaoxide**,  $\text{SbI}_5$   
Very unstable (Pendleton, C N 48 7)
- Antimony barium iodide**,  $\text{SbI}_3, \text{BaI}_2 + 9\text{H}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$ . Sol in  $\text{HCl}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$ .  $\text{CS}_2$  dissolves out  $\text{I}_3$  (Schaffer, Pogg 109 611)
- Antimony caesium iodide**,  $2\text{SbI}_3, 3\text{CsI}$   
Sl sol in  $\text{HI} + \text{Aq}$ . Exists in two distinct forms (Wells, Am J Sci 1901, (4) 11 5)
- Antimony potassium iodide**,  $2\text{SbI}_3, 3\text{KI} + 3\text{H}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$ . Sol in  $\text{HCl}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$ .  $\text{CS}_2$  dissolves out  $\text{I}_3$  (Schaffer, Pogg 109 611)  
 $\text{SbI}_3, 2\text{KI} + 2\frac{1}{2}\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Nickles, J Pharm (3) 39 116)
- Antimony rubidium iodide**,  $2\text{SbI}_3, 3\text{RbI}$   
Decomp by  $\text{H}_2\text{O}$  (Wheeler, Z anorg 5 259)
- Antimony sodium iodide**,  $2\text{SbI}_3, 3\text{NaI} + 12\text{H}_2\text{O}$   
 $\text{As}_2\text{SbI}_3, 3\text{KI}$  (Schaffer, Pogg 109 1)
- Antimony thallos iodide**,  $2\text{SbI}_3, 3\text{HI}$   
Decomp by  $\text{H}_2\text{O}$  and by  $\text{HCl} + \text{Aq}$ , al by alcohol (F phram, Z anorg 1908, 58 14)
- Antimony nitride**,  $\text{SbN}$   
Decomp by heat (Frimmischer, B 10, 43 1471)
- Antimony trioxide**,  $\text{Sb}_2\text{O}_3$   
Very sl sol in  $\text{H}_2\text{O}$ . Sol in 8900–10000 pts  $\text{H}_2\text{O}$  at 100°, 55,000–61,100 pts at 15° (Schulze, J pr (2) 27 320)  
Sol in  $\text{HCl} + \text{Aq}$ . Insol in  $\text{HNO}_3 + \text{Aq}$  but not as insol as metastannic acid. Sol in old fuming  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . Insol in dil but sol in conc alkalis, or alkali carbon s+

Aq Sol in cold  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3$  + Aq  
Sol in 15 pts boiling  $\text{SbCl}_3$  (Schneider, Pogg 108 407)

Sol in  $\text{HC}_2\text{H}_3\text{O}_2$  or  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$  + Aq, and not pptd from these solutions by  $\text{H}_2\text{O}$ . Easily sol in benzoic acid. Insol in pyrotartaric acid. Very sol in  $\text{KHC}_4\text{H}_4\text{O}_6$  + Aq. Sol in glycerine.

Somewhat sol in  $\text{H}_3\text{PO}_4$  + Aq (Köhler, Dingl 1885, 258 520)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 826)

Sol in lactic acid (Kretzschmar, Ch Z 1888, 12 943)

Sol in grape sugar solution to which  $\text{Ca}(\text{OH})_2$  has been added (Vogel, B 1885, 18, R 38)

Insol in acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

Sol in glycerine in presence of alkalis (Köhler, Dingl 1885, 258 520)

Exists in a sol colloidal modification (Spring, B 16 1142)

Min *Valentinite*, *Senarmontite* +  $\text{H}_2\text{O}$  See Antimonous acid

#### Antimony tetroxide, $\text{Sb}_2\text{O}_4$

Insol in  $\text{H}_2\text{O}$ . Slightly attacked by acids, hot conc  $\text{HCl}$  + Aq acts only slightly (Fresenius)

Min *Cervantite*. Sl sol in  $\text{HCl}$  + Aq

#### Antimony pentoxide, $\text{Sb}_2\text{O}_5$

Insol in  $\text{H}_2\text{O}$ . Easily sol in  $\text{HCl}$  + Aq. Sl sol in conc  $\text{KOH}$  + Aq.

"Antimonoxvd" is sol in glycerine in presence of alkalis.

100 g glycerine, to which have been added 10 g  $\text{NaOH}$  + Aq (1 l), dissolve 20.6 g at b-pt, 20 g  $\text{NaOH}$  + Aq (1 l), dissolve 36.0 g at b-pt, 40 g  $\text{NaOH}$  + Aq (1 l), dissolve 68.5 g at b-pt, 80 g  $\text{NaOH}$  + Aq (1 l), dissolve 93.0 g at b-pt, 120 g  $\text{NaOH}$  + Aq (1 l), dissolve 119.2 g at b-pt (Köhler, Dingl 258 520)

See also Antimonic acid

#### Antimony nitrogen pentoxide, $2\text{Sb}_2\text{O}_5 \cdot \text{N}_2\text{O}_5$

Not decomp by  $\text{H}_2\text{O}$  (Thomas, C R 1895, 120 1116)

#### Antimony oxybromide

See Antimonyl bromide

#### Antimony oxychloride

See Antimonyl chloride

#### Antimony oxyfluoride

See Antimonyl fluoride

#### Antimony oxysulphide, $\text{Sb}_2\text{O}_3\text{S}$

Min *Antimony blends* (*kermesite*)

Insol in  $\text{H}_2\text{O}$  or dil acids, except  $\text{HCl}$  + Aq (Schneider, Pogg 110 147)

#### Antimony palladium, $\text{Sb}_2\text{Pd}$

Sl sol in equal pts of  $\text{HNO}_3$  and tartaric acids (Roessler, Z anorg 1895, 9 69)

#### Antimony platinum, $\text{Sb Pt}$

Insol in equal pts of  $\text{HNO}_3$  and tartaric acids (Roessler, Z anorg 1895, 9 67)

#### Antimony phosphide, $\text{SbP}$

Insol in benzene, ether, or  $\text{CS}_2$  (M'Ivor, B 6 1362)

#### Antimony selenide, $\text{SbSe}$

(Chrétien, C R 1906, 142 1341)

$\text{Sb}_2\text{Se}_4$  (Chrétien, l c)

$\text{Sb}_2\text{Se}_3$  (Chrétien, l c)

$\text{Sb}_2\text{Se}_3$  Sol in  $\text{KOH}$  + Aq (Hofacker, A 107 6)

$\text{Sb}_2\text{Se}_3$  (Hofacker)

#### Antimony selenide, with M selenide

See Selenoantimonates, M

#### Antimony trisulphide, $\text{Sb}_2\text{S}_3$ (*Kermes*)

Insol in  $\text{H}_2\text{O}$  and dil acids

1 l  $\text{H}_2\text{O}$  dissolves  $5.2 \times 10^{-6}$  mols pptd  $\text{Sb}_2\text{S}_3$  at  $18^\circ$  (Weigel, Z phys Ch 1907, 58 294)

Decomp by conc  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . Sol in conc  $\text{HCl}$  + Aq. Easily sol in dil  $\text{KOH}$ ,  $\text{NaOH}$ ,  $(\text{NH}_4)_2\text{S}$ , and  $\text{K}_2\text{S}$  + Aq. Sl sol in  $\text{NH}_4\text{OH}$  + Aq, very sl sol in  $(\text{NH}_4)_2\text{CO}_3$  + Aq, insol in  $\text{KSH}$  + Aq (Fresenius)

Sol in a mixture of 50 pts  $\text{H}_2\text{O}$  and 18 pts  $\text{HCl}$  (sp gr 1.16) even when completely sat with  $\text{H}_2\text{S}$  (Lung and Carson, J Soc Chem Ind 1902, 21 1018)

Sl sol in  $\text{H}_2\text{SO}_4$  + Aq (Guierout, C R 1872, 75 1276)

Cryst  $\text{Sb}_2\text{S}_3$  is only sl sol in  $\text{NH}_4\text{OH}$  + Aq (1 pt in about 2000 pts  $\text{NH}_4\text{OH}$ )

Pptd amorphous  $\text{Sb}_2\text{S}_3$  is appreciably more sol (1 pt in 600 pts  $\text{NH}_4\text{OH}$ ) (Guot, J pr 1843, 29 83)

Sl sol in hot  $2^\circ\text{Na}_2\text{B}_2\text{O}_7$  + Aq still less sol in cold (Matrone, C C 1906, II 557)

Insol in  $\text{NH}_4\text{Cl}$  + Aq

Sol in 14-15 pts pure  $\text{SbCl}_3$  (Schneider, Pogg 108 407)

Slowly sol in  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$  + Aq

Sol in boiling  $\text{Na}_2\text{SbS}_4$  + Aq

Sol in hot citric, tartaric and oxalic acids. Sl sol in milder, benzoic, picric and pyrogallic acids. Insol in formic and acetic acids. Especially easily sol in citric and oxalic acids with addition of  $\text{KNO}_3$ ,  $\text{KNO}$  or  $\text{KClO}_3$  (Bolton, C N 1878, 37 Sb and 99)

Sol in ethylamine sulphhydrate + Aq

Min *Stibnite*. Sol in cold citric acid + Aq (Bolton, C N 37 11)

*Soluble modification*.  $\text{Sb}_2\text{S}_3$  may be obtained in a colloidal state in aqueous solution containing 1 pt  $\text{Sb}_2\text{S}_3$  to 200 pts  $\text{H}_2\text{O}$ . This can be boiled without decomp but  $\text{Sb}_2\text{S}_3$  is pptd by acids and salts.

- Antimony trifluoride potassium sulphate**,  $\text{SbF}_3, \text{K}_2\text{SO}_4$   
Sol in  $\text{H}_2\text{O}$  (de Haen)  
 $2\text{SbF}_3, \text{K}_2\text{SO}_4$  Very sol in  $\text{H}_2\text{O}$  (Mayer, B 1894, 27 R 922)
- Antimony trifluoride sodium chloride**,  $\text{SbF}_3, \text{NaCl}$   
Easily sol in  $\text{H}_2\text{O}$  (de Haen, B 21 901 R)
- Antimony trifluoride sodium sulphate**,  $\text{SbF}_3, \text{Na}_2\text{SO}_4$   
Sol in  $\text{H}_2\text{O}$  (de Haen)
- Antimony fluoiodide**,  $\text{SbF}_2\text{I}$   
Mpt  $80^\circ$ , slowly decomp by  $\text{H}_2\text{O}$  (Ruff, B 1906, 39 4321)  
 $(\text{SbF}_2)_2\text{I}$  Mpt  $110-115^\circ$ , decomp by  $\text{H}_2\text{O}$  (Ruff)
- Antimony fluosulphide**,  $\text{SbF}_2\text{S}$   
Very hygroscopic. Decomp by  $\text{H}_2\text{O}$ . Sol with decomp in alcohol. Sol in  $\text{CCl}_4$  (Ruff, B 1906, 39 4372)
- Antimony gold**,  $\text{Au}_3\text{Sb}$   
Insol in equal pts of  $\text{HNO}_3$  and tartaric acids (Roessler, Z anorg 1895, 9 72)
- Antimony hydride**,  $\text{SbH}_3$   
Scarcely sol in  $\text{H}_2\text{O}$ . 1000 ccm  $\text{H}_2\text{O}$  absorb 4.12 cc  $\text{SbH}_3$  at  $10.5^\circ$ . Decomp by long contact with  $\text{H}_2\text{O}$ , also by conc  $\text{H}_2\text{SO}_4$  or  $\text{KOH} + \text{Aq}$  (Jones, Chem Soc 29 641)
- Antimony trihydroxide**,  $\text{Sb(OH)}_3$   
 $\text{Sb(OH)}_3$  (Schaffner, A 51 182)  
 $\text{Sb(OH)}_3$  Ppt (Clarke and Stolla, B 13 1787)  
Does not exist (Gauntz, C R 102 1472)  
*See Antimonious acid and antimony trioxide*
- Antimony triiodide**,  $\text{SbI}_3$   
Decomp by  $\text{H}_2\text{O}$  or  $\text{SO}_2$ ; alcohol. Sol in  $\text{HI} + \text{Aq}$  sol in boiling  $\text{CS}_2$  and in boiling benzene but separates out on cooling. Almost insol in  $\text{CHCl}_3$  (Coolidge, Proc Am Acad (2) 5 72)  
Easily sol in  $\text{AsI}_3$  (Walden, Z anorg 1902 29 574)  
Sol in warm  $\text{AsI}_3$ . Sp gr of a solution sat at  $40^\circ$  which solidifies at  $37-37.20^\circ$ . This dissolves further  $\text{AsI}_3$  whereby the mpt sinks to  $34^\circ$  and sp gr rises to 3.801. By mixing the latter solution with a solution of  $\text{AsI}_3$  in  $\text{CHCl}_3$  a liquid can be obtained with a sp gr of 3.702 at  $20^\circ$  (Retgers, Z phys Ch 189, 11 40)  
Sol in  $\text{PCl}_5$  (Pechmann, Z anorg 1906 51 110)  
Sol in  $\text{SOCl}_2$  (Walden, Z anorg 1900
- Sol in  $\text{SOCl}_2$  and  $\text{S}_2\text{Cl}_2$  (Walden, Z anorg 1900, 25 216)  
Sol in  $\text{AsCl}_3$  (Walden, Z anorg 900, 25 214)  
Sol in  $\text{SnCl}_4$  (Walden, Z anorg 1900, 25 218)  
Sol in  $\text{POCl}_3$  (Walden, Z anorg 1900, 25 212)  
Easily sol in  $\text{PCl}_5$  and  $\text{PBr}_5$  (Walden, Z anorg 1900, 25 211)  
Partly sol in, and partly decomp by alcohol or ether (M'IVOR, Chem Soc 1911 14 328)  
Insol in oil of turpentine and  $\text{CCl}_4$ . 100 pts methylene iodide dissolve 1 pt  $\text{SbI}_3$  at  $12^\circ$ , sp gr of solution = 3.453 (Retgers, Z anorg 3 343)  
Sol in  $\text{C}_6\text{H}_6$  (Retgers, Z phys Ch 1893, 11 334)  
Sol in acetone (Naumann, B 1904, 37 4328)
- Antimony pentaoxide**,  $\text{Sb}_2\text{O}_5$   
Very unstable (Pendleton, C N 1917 97)
- Antimony barium iodide**,  $\text{SbI}_3, \text{BaI}_2 + \text{H}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$ . Sol in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$ .  $\text{CS}_2$  dissolves only  $\text{SbI}_3$  (Schaffer, Pogg 109 611)
- Antimony caesium iodide**,  $2\text{SbI}_3, 3\text{CsI}$   
Sl sol in  $\text{HI} + \text{Aq}$ . Exists in two distinct forms (Wells, Am J Sci 1901, (4) 455)
- Antimony potassium iodide**,  $2\text{SbI}_3, 3\text{KI} + 3\text{H}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$ . Sol in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$ .  $\text{CS}_2$  dissolves only  $\text{SbI}_3$  (Schaffer, Pogg 109 611)  
 $\text{SbI}_3, 2\text{KI} + 2\frac{1}{2}\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Nickles, J Pharm (3) 39 116)
- Antimony rubidium iodide**,  $2\text{SbI}_3, 3\text{RbI}$   
Decomp by  $\text{H}_2\text{O}$  (Whacker, Z anorg 5 259)
- Antimony sodium iodide**,  $2\text{SbI}_3, 3\text{NaI} + 12\text{H}_2\text{O}$   
 $\text{As}_2\text{SbI}_6, 3\text{KI}$  (Schaffer, Pogg 109 611)
- Antimony thallos iodide**,  $2\text{SbI}_3, 3\text{I}$   
Decomp by  $\text{H}_2\text{O}$  and by  $\text{HCl} + \text{Ac}$  also by alcohol (Lippman, Z anorg 1908, 8 354)
- Antimony nitride**,  $\text{SbN}$   
Decomp by heat (Franz Fischer, B 1910, 43 1471)
- Antimony trioxide**,  $\text{Sb}_2\text{O}_3$   
Very sl sol in  $\text{H}_2\text{O}$ . Sol in 89-10,000 pts  $\text{H}_2\text{O}$  at  $100^\circ$ , 55,000-61,100 p at  $15^\circ$  (Schulze, J pr (2) 27 320)  
Sol in  $\text{HCl} + \text{Aq}$ . Insol in  $\text{HNO}_3$ . Aq, but not as insol as metastannic acid. Sl in cold fuming  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . Insol in dil, but sol in conc alkalis, or alkali carbonates +

Aq Sol in cold  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$   
Sol in 15 pts boiling  $\text{SbCl}_3$  (Schneider, Pogg 108 407)

Sol in  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$ , and not pptd from these solutions by  $\text{H}_2\text{O}$  Easily sol in benzoic acid Insol in pyrotartaric acid Very sol in  $\text{KHC}_4\text{H}_4\text{O}_6 + \text{Aq}$  Sol in glycerine

Somewhat sol in  $\text{H}_3\text{PO}_4 + \text{Aq}$  (Kohler, Dngl 1885, 258 520)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 826)

Sol in lactic acid (Kretschmar, Ch Z 1888, 12 943)

Sol in grape sugar solution to which  $\text{Ca}(\text{OH})_2$  has been added (Vogel, B 1885, 18, R 38)

Insol in acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

Sol in glycerine in presence of alkalis (Kohler, Dngl 1885, 258 520)

Exists in a sol colloidal modification (Spring, B 16 1142)

Min *Valentinite*, *Senarmontite*  
+  $\text{H}_2\text{O}$  See *Antimonous acid*

#### Antimony tetroxide, $\text{Sb}_2\text{O}_4$

Insol in  $\text{H}_2\text{O}$  Slightly attacked by acids, hot conc  $\text{HCl} + \text{Aq}$  acts only slightly (Fresenius)

Min *Cervantite* Sl sol in  $\text{HCl} + \text{Aq}$

#### Antimony pentoxide, $\text{Sb}_2\text{O}_5$

Insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HCl} + \text{Aq}$  Sl sol in conc  $\text{KOH} + \text{Aq}$

"Antimonoxyd" is sol in glycerine in presence of alkalis

100 g glycerine, to which have been added 10 g  $\text{NaOH} + \text{Aq}$  (1 1), dissolve 20.6 g at b-pt, 20 g  $\text{NaOH} + \text{Aq}$  (1 1), dissolve 36.0 g at b-pt, 40 g  $\text{NaOH} + \text{Aq}$  (1 1), dissolve 68.5 g at b-pt 80 g  $\text{NaOH} + \text{Aq}$  (1 1), dissolve 93.0 g at b-pt, 120 g  $\text{NaOH} + \text{Aq}$  (1 1), dissolve 119.2 g at b-pt (Kohler, Dngl 258 520)

See also *Antimonic acid*

#### Antimony nitrogen pentoxide, $2\text{Sb}_2\text{O}_5, \text{N}_2\text{O}_5$

Not decomp by  $\text{H}_2\text{O}$  (Thomas, C R 1895, 120 1116)

#### Antimony oxybromide

See *Antimonyl bromide*

#### Antimony oxychloride

See *Antimonyl chloride*

#### Antimony oxyfluoride

See *Antimonyl fluoride*

#### Antimony oxysulphide, $\text{Sb}_2\text{OS}_2$

Min *Antimony blende* (*kermesite*)

Insol in  $\text{H}_2\text{O}$  or dil acids, except  $\text{HCl} + \text{Aq}$  (Schneider, Pogg 110 147)

#### Antimony palladium, $\text{Sb}_2\text{Pd}$

Sl sol in equal pts of  $\text{HNO}_3$  and tartaric acids (Roessler, Z anorg 1895, 9 69)

#### Antimony platinum, $\text{Sb}_2\text{Pt}$

Insol in equal pts of  $\text{HNO}_3$  and tartaric acids (Roessler, Z anorg 1895, 9 67)

#### Antimony phosphide, $\text{SbP}$

Insol in benzene, ether, or  $\text{CS}_2$  (M'Ivor, B 6 1362)

#### Antimony selenide, $\text{SbSe}$

(Chrétien, C R 1906, 142 1341)

$\text{Sb}_3\text{Se}_4$  (Chrétien, l c)

$\text{Sb}_4\text{Se}_5$  (Chrétien, l c)

$\text{Sb}_2\text{Se}_3$  Sol in  $\text{KOH} + \text{Aq}$  (Hofacker, A 107 6)

$\text{Sb}_2\text{Se}_3$  (Hofacker)

#### Antimony selenide, with M selenide

See *Selenoantimonates*, M

#### Antimony trisulphide, $\text{Sb}_2\text{S}_3$ (*Kermes*)

Insol in  $\text{H}_2\text{O}$  and dil acids

1 l  $\text{H}_2\text{O}$  dissolves  $5.2 \times 10^{-6}$  mols pptd  $\text{Sb}_2\text{S}_3$  at  $18^\circ$  (Weigel, Z phys Ch 1907, 58 294)

Decomp by conc  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$  Sol in conc  $\text{HCl} + \text{Aq}$  Easily sol in dil  $\text{KOH}$ ,  $\text{NaOH}$ ,  $(\text{NH}_4)_2\text{S}$ , and  $\text{K}_2\text{S} + \text{Aq}$  Sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  very sl sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , insol in  $\text{KSH} + \text{Aq}$  (Fresenius)

Sol in a mixture of 50 pts  $\text{H}_2\text{O}$  and 18 pts  $\text{HCl}$  (sp gr 1.16) even when completely sat with  $\text{H}_2\text{S}$  (Lang and Carson, J Soc Chem Ind 1902, 21 1013)

Sl sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  (Guerout, C R 1872, 75 1276)

Cryst  $\text{Sb}_2\text{S}_3$  is only sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (1 pt in about 2000 pts  $\text{NH}_3$ )

Pptd amorphous  $\text{Sb}_2\text{S}_3$  is appreciably more sol (1 pt in 600 pts  $\text{NH}_3$ ) (Garot, J pr 1843, 29 83)

Sl sol in hot 2%  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  still less sol in cold (Materne, C C 1906, II 557)

Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$

Sol in 14-15 pts pure  $\text{SbCl}_3$  (Schneider, Pogg 108 407)

Slowly sol in  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$

Sol in boiling  $\text{Na}_2\text{SbS}_4 + \text{Aq}$

Sol in hot citric, tartaric and oxalic acids Sl sol in malic, benzoic, picric and pyrogallic acids Insol in formic and acetic acids Especially easily sol in citric and oxalic acids with addition of  $\text{KNO}_3$ ,  $\text{KNO}$  or  $\text{KClO}_3$  (Bolton, C N 1878, 37 86 and 99)

Sol in ethylamine sulphhydrate +  $\text{Aq}$

Min *Stibnite* Sol in cold citric acid +  $\text{Aq}$  (Bolton, C N 37 14)

*Soluble modification*  $\text{Sb}_2\text{S}_3$  may be obtained in a colloidal state in aqueous solution containing 1 pt  $\text{Sb}_2\text{S}_3$  to 200 pts  $\text{H}_2\text{O}$  This can be boiled without decomp, but  $\text{Sb}_2\text{S}_3$  is pptd by acids and salts

Table of maximum dilution of solutions of acids and salts which cause pptn of  $\text{Sb}_2\text{S}_3$

HCl	1	270
$\text{H}_2\text{SO}_4$	1	140
$\text{H}_2\text{C}_2\text{O}_4$	1	45
$\text{K}_2\text{SO}_4$	1	65
$(\text{NH}_4)_2\text{SO}_4$	1	130
$\text{MgSO}_4$	1	1720
$\text{MnSO}_4$	1	2060
NaCl	1	135
$\text{BaCl}_2$	1	2050
$\text{MgCl}_2$	1	5800
$\text{CoCl}_2$	1	2500
$\text{KNO}_3$	1	75
$\text{Fe}_2\text{Cl}_6$	1	2500
$\text{Ba}(\text{NO}_3)_2$	1	1250
$\text{K}_2\text{Al}(\text{SO}_4)_4$	1	35,000
$(\text{NH}_4)_2\text{Fe}_2(\text{SO}_4)_4$	1	800
$\text{K}_2\text{Cr}_2(\text{SO}_4)_4$	1	40,000
$\text{KSB}(\text{OC}_2\text{H}_4)_6$	1	18

(Schulze, J pr (2) 27 320)

### Antimony trisulphide with M.S

See Sulphantimonites, M

### Antimony pentasulphide, $\text{Sb}_2\text{S}_5$

Insol in  $\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$  containing  $\text{H}_2\text{S}$  Sol in conc  $\text{HCl} + \text{Aq}$  Completely sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , traces dissolve in  $(\text{NH}_4)_2\text{CO}_3 + \text{dil sol in KOH}$ , or  $\text{NaOH} + \text{Aq}$ , or sulphides +  $\text{Aq}$  Sol in 50 pts cold  $\text{OH} + \text{Aq}$  (Geiger) in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  in cold, but sol in hot alkali carbonates +  $\text{Aq}$  (Berzelius)

Insol in  $\text{Na}_2\text{SbS}_4 + \text{Aq}$  When boiled with alcohol, ether,  $\text{CS}_2$ , oil of turpentine, etc, portion of the S is dissolved out (Berzelius)

$\text{CS}_2$  dissolves about 5% of the sulphur (Rammelsberg)

### Antimony pentasulphide with M S

See Sulphantimonates, M

### Antimony sulphochloride, $\text{SbSCl}_3$

Decomp by moist air in  $\text{H}_2\text{O}$  (Clotz, A ch (3) 30 374)

$\text{SbSCl}_3$  Easily attacked by acids insol in  $\text{CS}_2$  (Ouvrard, C R 116 1516)

$\text{SbSCl}_3$  (Ouvrard)  $2\text{SbSCl}_3, 3\text{SbSCl}_3$  Decomp by dil  $\text{HCl} + \text{Aq}$  (Schneider)

$\text{SbSCl}_3$   $7\text{SbSCl}_3$  Deliquescent decomp by  $\text{H}_2\text{O}$  (Schneider Pogg 108 407)

### Antimony sulphofluoride, $\text{SbSI}_3$

See Antimony fluosulphide

### Antimony sulphiodide, $\text{SbSI}$

Not attacked by  $\text{H}_2\text{O}$  and decomp only by conc acids Insol in  $\text{CS}_2$  (Schneider, Pogg 110 147)

$\text{SbSI}_3$  (Henry and Garot)  $\text{SbSI}_3$  Sol in dry  $\text{CS}_2$  Very easily decomp (Ouvrard, C R 117 108)

### Antimony sulphur dioxide, $\text{SbSO}_2$

Ppt (Faktor, C C 1900, I 1211)

### Antimony telluride, $\text{SbTe}$

Insol in  $\text{H}_2\text{O}$

$\text{Sb}_2\text{Te}_3$  Insol in  $\text{H}_2\text{O}$  (Oppenheim, J pr 71 277)

### Antimony bromide, $\text{SbOBr}$

Insol in  $\text{CS}_2$  (Cooke, Proc Am Acad 1 104)

Sl sol in liquid  $\text{NH}_3$  (Gore, Am Ch 1898, 20 826)

$\text{Sb}_4\text{O}_5\text{Br}_2$  (M'Ivor, C N 29 179)  $10\text{Sb}_4\text{O}_5\text{Br}_2, \text{SbBr}_3$

### Antimonyl chloride

From  $\text{SbCl}_3$   $\text{SbOCl}$  Insol in  $\text{H}_2\text{O}$  D comp by boiling with  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{A}$  or  $\text{C}_6\text{H}_6$  (Sabanajew, Zeit Ch 1871 204)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch 1898, 20 826)

Insol in acetone (Naumann B 1904, 3 4329)

$\text{Sb}_4\text{O}_5\text{Cl}_2$  *Algaroth powder* Decomp in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  (Cooke, Proc Am Acad 13 1), tartaric acid +  $\text{Aq}$  (Schaff A 152 135)

$\text{Sb}_5\text{O}_{11}\text{Cl}_2$  (Cooke)

$\text{Sb}_5\text{OCl}_{12}$

$\text{Sb}_{41}\text{O}_{60}\text{Cl}_{23}$

From  $\text{SbCl}_5$   $\text{SbOCl}_3$  Deliquescent I composed by  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Daubray A 184 118)

Does not exist (Anschutz and Evans, 239 285)

$\text{Sb}_3\text{OCl}_{13}$  Deliquescent Insol in  $\text{C}_6\text{H}_6$ , easily sol in tartaric acid +  $\text{Aq}$  (Willhar, C N 24 224)

$\text{Sb}_3\text{O}_4\text{Cl}_7$  (Williams)

$\text{Sb}_2\text{OCl}_2$  Decomp by hot  $\text{H}_2\text{O}$  into  $\text{HSbOCl}_2$

### Antimonyl fluoride

From  $\text{SbF}_3$   $\text{Sb}_4\text{O}_5\text{F}_6$  Not deliquescent (Fluckiger, Pogg 87 249)

### Antimonyl caesium fluoride, $\text{SbF}_4\text{OH}$ , $\text{CsF}$

(Wells, Am J Sci 1901, (4) 11 456)

### Antimonyl sodium fluoride, $\text{SbOF}_3$ , $\text{NaF}$

$\text{H}_2\text{O}$  Deliquescent Easily sol in  $\text{H}_2\text{O}$  (Mann, A 145 239)

### Antimonyl iodide, $\text{Sb}_4\text{O}_5\text{I}_2$

Difficultly sol in solution of tartaric acid or tartarates Decomp by  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  Easily sol in alkalis, or  $(\text{NH}_4)_2\text{S} + \text{Aq}$

$\text{SbOI}$  Insol in  $\text{CS}_2$  (Cooke, Proc Am Acad (2) 5 72)

### Antimonyl sulphide

See Antimony oxysulphide

**Argon, A**

100 cc H<sub>2</sub>O dissolve 4.05 cc argon at 13.9°  
 Critical t — 121.6° under 50.6 atmos Bpt —  
 186.9° Sp gr 19.9 (Rayleigh, C N 1895,  
 71 51-62, 299-302, C C 1895 467)

Coefficient of absorption in H<sub>2</sub>O at 12° =  
 0.0394, at 13.9° = 0.0405 (Ramsay, Phil  
 Trans 1895, 186 A 225)

## Absorption by H O at t°

t°	Coefficient of absorption
0°	0.0561
10	0.0438
20	0.0379
30	0.0348
40	0.0338
50	0.0343

(Antropoff, Roy Soc Proc 1910, 83 A 480)

Absorption of argon by H<sub>2</sub>O at t° and 760 mm pressure

t°	Coefficient of absorption
0°	0.05780
1	0.05612
5	0.05080
10	0.04525
15	0.04099
20	0.03790
25	0.03470
30	0.03256
35	0.03053
40	0.02865
45	0.02731
50	0.02567

(Estreicher, Z phys Ch 1899, 31 184)

1 l H<sub>2</sub>O at 35° absorbs 25.7 cc A  
 1 l blood absorbs 25.3 cc A (Regnard  
 and Schloesing, C R 1897, 124 303)

Not absorbed by members of the fatty  
 series of organic compounds, with members  
 of the aromatic series absorption was ob-  
 served varying from 8% of the volume em-  
 ployed for benzene to 1% for aniline (Berthelot,  
 C R 1899, 129 71)

**Arsenamides, As(NH<sub>2</sub>)<sub>3</sub>**

Insol in liquid NH<sub>3</sub> Decomp by H<sub>2</sub>O  
 (Hugot, C R 1904, 139 55)

**Arsenic, As**

Unaltered by pure H<sub>2</sub>O Insol in HCl +  
 Aq if air is excluded, but sl sol in presence of  
 air Not attacked by dil H<sub>2</sub>SO<sub>4</sub> + Aq Oxidized  
 by conc H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, or aqua regia  
 Not attacked at 20° by HNO<sub>3</sub>, conc or dil,  
 or containing NO<sub>2</sub>, nor by HNO<sub>3</sub> + HCl, as  
 long as they do not act on each other, but if  
 treated with the above mixture in extremely  
 dilute state, and a few drops of KNO<sub>2</sub> + Aq

are added, the As is attacked at once (Milton,  
 A ch (3) 6 101)

Sol in sea water, 0.009 mg per liter off  
 Brittany, 0.01 to 0.09 mg per liter near  
 Azores (Gautier, C R 1903, 137 232)

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch  
 J 1898, 20 827)

Insol in liquid NH<sub>3</sub> (Hugot, A ch 1900,  
 (7) 21 31)

Insol in NaOH, KOH, or NH<sub>4</sub>OH + Aq  
 Sol in S<sub>2</sub>Br<sub>2</sub> (Hannay, Chem Soc (2) 11  
 823)

Insol in alcohol and ether

Sol in certain fatty oils

Insol in methylene iodide (Retgers, Z  
 anorg 3 343)

½ ccm oleic acid dissolves 0.0032 g As in  
 6 days (Gates, J phys Ch 1911, 15 143)

Yellow modification Very unstable (Mc-  
 Leod, C N 1894, 70 139)

Fairly stable in liquid air (Thomson,  
 Chem Soc 1906, 90 (2) 745)

100 ccm CS<sub>2</sub> dissolve at

46° 20° 12° 0° -15° -60°  
 11 8 6 4 2 0-2 5 1 0 g As

Less sol in benzene and ethyl acetate  
 (Erdmann, Z anorg 1902, 32 448)

**Arsenic acid** See page 59

**Arsenic bromide AsBr<sub>3</sub>**

Decomp by

about 3 pts boil

presence of HBr

17 261)

Sol in CS

Sol in AlBr<sub>3</sub> (Isbekow, Z anorg 1913,  
 84 26)

Easily sol in PCl<sub>3</sub> and PB<sub>3</sub> (Walden,  
 Z anorg 1900, 25 211)

Sol in S<sub>2</sub>Cl<sub>2</sub> (Walden, Z anorg 1900,  
 25 217)

**Arsenic caesium bromide, 2AsBr<sub>3</sub>, 3CsBr**

Decomp by H<sub>2</sub>O, can be recryst from  
 conc HBr + Aq (Wheeler, Z anorg 4 451)

**Arsenic rubidium bromide, 2AsBr<sub>3</sub>, 3RbCl**

As the corresponding Cs comp

**Arsenic bromide ammonia, AsBr<sub>3</sub>, 3NH<sub>3</sub>**

Decomp by H<sub>2</sub>O (Besson, C R 110  
 1258)

**Arsenic bromide copper, 2AsBr<sub>3</sub>, 7Cu**

Stable toward hot H<sub>2</sub>O Decomp by KOH  
 (Hilpert and Herrman, B 1913, 46 2224)

**Arsenic bromide silver, AsBr<sub>3</sub>, 3Ag**

Scarcely decomp by cold H<sub>2</sub>O (Hilpert  
 and Herrmann)

**Arsenic chloride, AsCl<sub>3</sub>**

Miscible with little H<sub>2</sub>O, and with alcohol,  
 ether, and volatile oils Decomp by much  
 H<sub>2</sub>O, or by boiling (Gmelin)



Miscible with oil of turpentine, and with olive oil. Somewhat sol in  $\text{HCl} + \text{Aq}$ .

Easily sol in  $\text{PCl}_5$  and  $\text{PBr}_5$  (Walden, Z anorg 1900, 25 211).

Sol in liquid  $\text{CN}$  (Centnerszwer, J russ phys Ges 1901, 33 545).

Sol in  $\text{S}_2\text{Cl}_2$  (Walden, Z anorg 1900, 25 217).

#### Arsenic pentachloride, $\text{AsCl}_5$

Fumes in the air with evolution of hydrogen chloride. Readily sol in  $\text{CS}_2$ , and absolute ether cooled to  $-30^\circ$  (Baskerville, J Am Chem Soc 1902, 24 1070).

#### Arsenic caesium chloride, $2\text{AsCl}_3, 3\text{CsCl}$

Decomp by  $\text{H}_2\text{O}$ . 100 pts  $\text{HCl} + \text{Aq}$  (12 sp gr) dissolve 0.429 pt salt (Wheeler, Z anorg 4 451).

#### Arsenic iridium phosphorus chloride

See Iridium phosphorus chloride arsenic chloride.

#### Arsenic rubidium chloride, $2\text{AsCl}_3, 3\text{RbCl}$

Decomp by  $\text{H}_2\text{O}$ . 100 pts  $\text{HCl} + \text{Aq}$  (sp gr 1.2) dissolve 2.935 pts salt (Wheeler, Z anorg 4 451).

#### Arsenic chloride, $2\text{AsCl}_3, 3\text{SCl}_2$

by  $\text{H}_2\text{O}$  (Rose).  
Compound is a mixture (Nilson, 1).

#### Arsenic chloride ammonia, $2\text{AsCl}_3, 7\text{NH}_3$

Decomp by cold  $\text{H}_2\text{O}$ , with evolution of  $\text{NH}_3$ . From the solution crystallizes  $\text{As}_4\text{Cl}_6 \cdot \text{N}_2\text{H}_{10}\text{O}_8$ .

Sol in alcohol without decomp (Rose, Pogg 52 62).

Composition is  $\text{AsCl}_3, 4\text{NH}_3$  (Besson, C R 110 1258).

#### Arsenic chloride copper, $2\text{AsCl}_3, 7\text{Cu}$

Somewhat decomp by  $\text{H}_2\text{O}$ . Decomp by  $\text{KOH}$ , or hot  $\text{HCl}$  (Hilpert and Herrmann, B 1913, 46 2224).

#### Arsenic chloride silver, $2\text{AsCl}_3, 7\text{Ag}$

$\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$  and  $\text{KOH}$  split off  $\text{Ag}$  (Hilpert and Herrmann).

#### Arsenic trifluoride, $\text{AsF}_3$

Sol in  $\text{H}_2\text{O}$  with evolution of heat and decomposition (Berzelius).

Easily sol in benzene (Moissan, C R 99 574).

Miscible with alcohol and ether (Meyer, C N 30 169).

#### Arsenic pentafluoride, $\text{AsF}_5$

Sol in  $\text{H}_2\text{O}$ , alkalis +  $\text{Aq}$  and liquid  $\text{AsF}_5$  with evolution of heat. Absorbed by ether, alcohol and benzene with evolution of heat (Ruff, B 1906, 39 67).

#### Arsenic potassium fluoride, $\text{AsF}_5, \text{KF}$ $\frac{1}{2}\text{H}_2\text{O}$

$\text{AsF}_5, 2\text{KF} + \text{H}_2\text{O}$

$\text{AsF}_5, \text{AsOF}_3, 4\text{KF} + 3\text{H}_2\text{O}$  (Maignac, 145 237).

#### Arsenic fluoride ammonia, $2\text{AsF}_3, 5\text{NH}_3$

Easily decomp by  $\text{H}_2\text{O}$  (Besson, C R 110 1258).

#### Arsenic pentafluoride nitrosyl fluoride, $\text{AsF}_5, \text{NOF}$

Decomp by  $\text{H}_2\text{O}$ , fuming  $\text{HCl}$ ,  $\text{NaOH} + \text{A}$ , dry ether and dry alcohol with evolution. NO. Sol in conc  $\text{HNO}_3$ , hot conc  $\text{H}_2\text{SC}$ , boiling  $\text{NOCl}$  and  $\text{AsF}_3$ . Insol in  $\text{CCl}_4$  and  $\text{CS}_2$  (Ruff, Z anorg 1908, 58 327).

#### Arsenic trifluoride sulphur tetrachloride, $2\text{AsF}_3, \text{SCl}_4$

Very hygroscopic. Decomp by  $\text{H}_2\text{O}$  and  $\text{NaOH}$ . Decomp by thionyl chloride,  $\text{CCl}_4$ ,  $\text{CS}_2$ , abs alcohol and ether. Decomp by ligron, benzene and toluene (Ruff, B 1907, 37 4520).

#### Arsenic hydride, $\text{AsH}_3$

Sl sol in  $\text{H}_2\text{O}$  and alkali hydrates +  $\text{A}$ , with subsequent decomposition.  $\text{H}_2\text{O}$  absorbs  $\frac{1}{5}$  vol  $\text{AsH}_3$ . Decomp by conc acid. Absorbed rapidly by oil of turpentine, slightly by fixed oils, and not at all by alcohol, ether or  $\text{KOH} + \text{Aq}$  (Gmelin).

Insol in  $\text{KOH} + \text{Alcohol}$  (Meissner). Not more sol in alkaline solutions than pure  $\text{H}_2\text{O}$  (Berzelius).

$\text{AsH}_3$  Solid. Insol in  $\text{H}_2\text{O}$ , alcohol, ether, and  $\text{CS}_2$  (Wiederhold, Pogg 118 615).

Insol in  $\text{H}_2\text{O}$ , sol in methylene iodide, xylene, or in conc  $\text{KOH} + \text{Aq}$  (Retgers, Z anorg 4 403).

#### Arsenic hydride boron bromide, $\text{AsH}_3, \text{BI}_3$

Easily decomp. Decomp by  $\text{H}_2\text{O}$  and probably sol in  $\text{AsH}_3$  or  $\text{BBr}_3$ . Insol in  $\text{C}$  (Stock, B 1901, 34 949).

#### Arsenic diiodide, $\text{AsI}_3$

Decomp by  $\text{H}_2\text{O}$  or alkalis, easily sol in alcohol, ether, chloroform or carbon disulphide (Bunbriger and Phillip, B 14 261).

Not attacked by cold conc  $\text{H}_2\text{SO}_4$  or by cold fuming  $\text{HNO}_3$ . The latter oxidizes on warming. Decomp by pyridine. Sol in boiling acetic anhydride (Hewitt and Warrall, Chem Soc 1907, 91 962).

#### Arsenic triiodide, $\text{AsI}_3$

Sol in 5-2 pts boiling  $\text{H}_2\text{O}$ , and solution if boiled down deposits pure  $\text{AsI}_3$ , but if left to cool slowly, deposits crystals of  $\text{As}_2\text{O}_3$  and  $\text{AsOI}$ .

Sl sol in  $\text{HCl} + \text{Aq}$ .

Sol in  $\text{POCl}_3$ ,  $\text{PCl}_5$  and  $\text{PBr}_3$  (Walden, Z anorg 1900, 25 212).

Sol in  $\text{PCl}_3$  (Beckmann, Z anorg 1906, 51 110)

Sol in  $\text{SOCl}_2$ ,  $\text{S}_2\text{Cl}_2$  and  $\text{SO}_2\text{Cl}_2$  (Walden, Z anorg 1900, 25 216)

Sol in  $\text{SnCl}_4$  (Walden, l c)

Easily sol in  $\text{AsBr}_3$  (Walden, Z anorg 1902, 29 374)

Sol in  $\text{AsCl}_3$  (Walden, Z anorg 1900, 25 214)

Sol in alcohol without decomp

Sol in ether, benzene, chloroform, and  $\text{CS}_2$   
100 pts methylene iodide dissolve 17 4 pts  $\text{AsI}_3$  at  $12^\circ$  (Retgers, Z anorg 3 343)

#### Arsenic pentaoxide, $\text{As}_2\text{O}_5$

More or less sol in  $\text{H}_2\text{O}$ , alcohol,  $\text{CHCl}_3$ , ether and  $\text{CS}_2$  (Sloan, C N 1882, 46 194)

#### Arsenic caesium iodide, $2\text{AsI}_3$ , $3\text{CsI}$

Decomp by  $\text{H}_2\text{O}$ , sol in conc  $\text{HI} + \text{Aq}$  (Wheeler, Z anorg 4 451)

#### Arsenic rubidium iodide, $2\text{AsI}_3$ , $3\text{RbI}$

As the corresponding Cs comp

#### Arsenic sulphur iodide

See Arsenic sulphohydride

#### Arsenic trioxide ammonia, $2\text{AsI}_3$ , $9\text{NH}_3$

Insol in benzene (Bamberger and Phillip, B 14 2643)

$\text{AsI}_3$ ,  $4\text{NH}_3$  (Besson, C R 110 1258)

#### Arsenic nitride, $\text{AsN}$

Easily decomp into As and N (Hugot, C R 1904, 139 56)

Decomp by heat (Franz Fischer, B 1910, 43 1471)

#### Arsenic suboxide, $\text{As}_2\text{O}$ (?)

Insol in  $\text{H}_2\text{O}$ , decomp by dil acids or  $\text{NH}_4\text{OH} + \text{Aq}$

Does not exist (Geuther, A 240 208)

#### Arsenic trioxide, $\text{As}_2\text{O}_3$

"White arsenic" exists in two modifications  $\alpha\text{As}_2\text{O}_3$ —crystalline, octahedral, opaque, porcelainous, etc.,  $\beta\text{As}_2\text{O}_3$ —amorphous, vitreous, "arsenic glass"

The difference in the solubility of  $\text{As}_2\text{O}_3$  are very small, the reasons being that (1) the solubility of the two modifications is different, (2) that the length of time necessary to effect solution differs in the two modifications, and (3) that there is a tendency of the amorphous  $\text{As}_2\text{O}_3$  to go over into the crystalline state during the process of solution  $\alpha\text{As}_2\text{O}_3$  is also not easily moistened, especially when in a pulverulent condition, which is not the case with the  $\beta$  modification (Winkler, J pr (2) 31 247)

The older data are very unreliable, but possess a certain historical interest

1 pt  $\text{As}_2\text{O}_3$  is sol in 10.5 pts (Wenzel) 11.34 pts (Fischer) 11.86 pts in  $\frac{1}{2}$  hour (Klaproth) 12.2 pts (Bucholz) 15.0 pts (Brandt Bergman) 16.0 pts (Vogel) 24 pts (Lametherie) 40 pts (Porner) 64 pts

(Baumé) 80 pts (Navier) 200 pts (Aschof and Nasse 1812) 640 pts (Hagen 1796) boiling  $\text{H}_2\text{O}$

1 pt  $\text{As}_2\text{O}_3$  is sol in 7.72 pts  $\text{H}_2\text{O}$  if  $\alpha$  or 9.33 pts if  $\beta$  (Gumbort) in 24 pts  $\text{H}_2\text{O}$  if  $\alpha$  or 21 pts if  $\beta$  (Taylor)

Sol in 53.3 pts  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abl)

Sol in 30 pts  $\text{H}_2\text{O}$  (Nussebrook)

After the solution in  $\text{H}_2\text{O}$  at  $100^\circ$  has been left standing at ordinary temperatures—

1 pt  $\text{As}_2\text{O}_3$  remains dissolved in 16 pts  $\text{H}_2\text{O}$  at  $16^\circ$  and 20 pts  $\text{H}_2\text{O}$  at  $7^\circ$  (Bucholz) in 33 pts  $\text{H}_2\text{O}$  at  $7^\circ$  (Klaproth) in 38 45 pts  $\text{H}_2\text{O}$  after 3 days 55 pts  $\text{H}_2\text{O}$  after 8 days 64 50 pts  $\text{H}_2\text{O}$  after 2 3 weeks at  $10^\circ$  (Fischer) in 33 52 pts if  $\alpha\text{As}_2\text{O}_3$  was used 55 06 pts if  $\beta\text{As}_2\text{O}_3$  was used (Gumbort) in 38 pts if  $\alpha\text{As}_2\text{O}_3$  after 6 months 53 71 pts if  $\beta\text{As}_2\text{O}_3$  after 48 hours (Taylor)

When an excess of pulverized  $\text{As}_2\text{O}_3$  is left to digest for several days with cold  $\text{H}_2\text{O}$ —

1 pt dissolves in 50 pts (Bucholz) in 66 pts (Fischer) in 80 pts at  $15^\circ$  (Bergman) in 80 pts if  $\alpha$ , and 103 pts if  $\beta$  (Gumbort) 96 pts at  $10^\circ$  (Speiman) 96 pts at  $35.5^\circ$  (Hahemann) 320 pts  $\text{H}_2\text{O}$  at  $20^\circ$  (Aschof and Nasse 1812)

$\text{H}_2\text{O}$  at  $15.6^\circ$  or below dissolves less than  $\frac{1}{4}\%$   $\text{As}_2\text{O}_3$  (Dalton)

To dissolve 1 pt  $\text{As}_2\text{O}_3$  in 12 pts  $\text{H}_2\text{O}$  it is necessary to boil an excess of  $\text{As}_2\text{O}_3$  with  $\text{H}_2\text{O}$  if 1 pt  $\text{As}_2\text{O}_3$  is boiled with 12 pts  $\text{H}_2\text{O}$  considerable remains undissolved and even with 1 pt  $\text{As}_2\text{O}_3$  to 50–60 pts  $\text{H}_2\text{O}$  long continued boiling is necessary to effect solution If a clear solution saturated by long boiling with an excess of  $\text{As}_2\text{O}_3$  is poured off and evaporated continuously to  $\frac{1}{2}$  its original bulk no  $\text{As}_2\text{O}_3$  separates out and the solution contains 1 pt  $\text{As}_2\text{O}_3$  to 6 pts  $\text{H}_2\text{O}$  (Fischer)

100 pts aqueous solution of  $\beta\text{As}_2\text{O}_3$  sat at  $15^\circ$  contain 0.96 pt  $\text{As}_2\text{O}_3$  and 9.68 pts when sat at  $100^\circ$  (Gumbort)

If 1 pt pulverized  $\text{As}_2\text{O}_3$  be digested 10 days at  $19$ – $25^\circ$  in 5–10 pts  $\text{H}_2\text{O}$  the solution contains 1 pt  $\text{As}_2\text{O}_3$  to 50 pts  $\text{H}_2\text{O}$  A solution of same strength is obtained in 25 days by digesting 1 pt  $\text{As}_2\text{O}_3$  in 40 pts  $\text{H}_2\text{O}$  If 1 pt  $\text{As}_2\text{O}_3$  be immersed in 80 pts  $\text{H}_2\text{O}$  the resulting solution contains 1 pt  $\text{As}_2\text{O}_3$  to 90 pts  $\text{H}_2\text{O}$

160 pts  $\text{H}_2\text{O}$  1 pt  $\text{As}_2\text{O}_3$  to 180 pts  $\text{H}_2\text{O}$  180 pts  $\text{H}_2\text{O}$  1 pt  $\text{As}_2\text{O}_3$  to 280 pts  $\text{H}_2\text{O}$  if  $\text{H}_2\text{O}$  1 pt  $\text{As}_2\text{O}_3$  to 1200 pts  $\text{H}_2\text{O}$  and ev pt  $\text{As}_2\text{O}_3$  is digested at ordinary temperature several days with 16 000–100 000 pts  $\text{H}_2\text{O}$  a portion remains undissolved Pulverized  $\alpha\text{As}_2\text{O}_3$  was set aside with  $\text{H}_2\text{O}$  in closed bottles for 18 years when 1 pt  $\text{As}_2\text{O}_3$  was present in 1000 pts  $\text{H}_2\text{O}$  a perfect solution was obtained when 1 pt  $\text{As}_2\text{O}_3$  in 100 pts  $\text{H}_2\text{O}$   $\alpha\text{As}_2\text{O}_3$  was undissolved when 1 pt  $\text{As}_2\text{O}_3$  in 55 pts  $\text{H}_2\text{O}$  0.35%  $\alpha\text{As}_2\text{O}_3$  was undissolved so that the solution contained 1 pt  $\text{As}_2\text{O}_3$  to 54 pts  $\text{H}_2\text{O}$  (Gmelin)

Porcelainous modification ( $\alpha\text{As}_2\text{O}_3$ ) is much more sol in  $\text{H}_2\text{O}$  than the vitreous ( $\beta\text{As}_2\text{O}_3$ ) 100 pts  $\text{H}_2\text{O}$  at ordinary temperature dissolve 0.96 pt  $\beta\text{As}_2\text{O}_3$  and 1.25 pts  $\alpha\text{As}_2\text{O}_3$  100 pts boiling  $\text{H}_2\text{O}$  dissolve 9.68 pts  $\beta\text{As}_2\text{O}_3$  and 11.47 pts  $\alpha\text{As}_2\text{O}_3$  and when the temperature of this solution has fallen to  $15^\circ$  the solution from  $\beta\text{As}_2\text{O}_3$  retains 1.78 pts and that from  $\alpha\text{As}_2\text{O}_3$  retains 2.9 pts (Berzelius [citing Gumbort])

$\beta\text{As}_2\text{O}_3$  dissolves more quickly and abundantly than  $\alpha\text{As}_2\text{O}_3$  The same amount  $\text{H}_2\text{O}$  which will take up 36–38 pts  $\beta\text{As}_2\text{O}_3$  at  $12$ – $13^\circ$  will dissolve only 12–14 pts  $\alpha\text{As}_2\text{O}_3$ , or 100 pts  $\text{H}_2\text{O}$  dissolve 4 pts  $\beta\text{As}_2\text{O}_3$  and 12–13 pts  $\alpha\text{As}_2\text{O}_3$  By long boiling with  $\text{H}_2\text{O}$ ,  $\alpha\text{As}_2\text{O}_3$  is converted into  $\beta\text{As}_2\text{O}_3$ , and thus requires the solubility of the latter, so that 100 pts boiling  $\text{H}_2\text{O}$  can take up 11 pts  $\alpha\text{As}_2\text{O}_3$  But at low temperature  $\beta\text{As}_2\text{O}_3$  is converted into  $\alpha\text{As}_2\text{O}_3$  when in contact with  $\text{H}_2\text{O}$ , so that the solution becomes weaker after a while, and retains only the proportion of  $\text{As}_2\text{O}_3$  corresponding to the solubility of  $\alpha\text{As}_2\text{O}_3$  Communion which hastens the rate of solubility of  $\alpha\text{As}_2\text{O}_3$ , without increasing the amount dissolved diminishes the solubility of  $\beta\text{As}_2\text{O}_3$ , as this is converted into  $\alpha\text{As}_2\text{O}_3$

by the friction or contact with  $\text{H}_2\text{O}$   $\beta\text{As}_2\text{O}_3$ , which has been rendered opaque by  $\text{NH}_4\text{OH}$ , and that which has been crystallized from an aqueous solution, are equally sol in  $\text{H}_2\text{O}$  (Bussy, C R **24** 774, A **64** 286)

100 pts  $\text{H}_2\text{O}$  dissolve 1 707 pts  $\beta\text{As}_2\text{O}_3$  in  $2\frac{1}{2}$  years, 100 pts boiling  $\text{H}_2\text{O}$  dissolve 11 46 pts  $\beta\text{As}_2\text{O}_3$  in 3 hours, and 11 86 pts in 12 hours, 10 14 pts  $\alpha\text{As}_2\text{O}_3$  in 3 hours, and 10 18 pts in 12 hours (Rose, Ann Phys (1) **36** 494)

A cold sat solution which stood over excess of  $\text{As}_2\text{O}_3$  for 10 months at  $10-20^\circ$  contains 1 2%  $\text{As}_2\text{O}_3$ , hot sat solution a few days after saturation contains 2 25-2 50%  $\text{As}_2\text{O}_3$ . If trace of  $\text{HCl}$  is present, the solution contains 3 8%  $\text{As}_2\text{O}_3$ . Hot sat solution of porcelain mod of  $\text{As}_2\text{O}_3$  contains 4 days after saturation 2 4%  $\text{As}_2\text{O}_3$  at  $24^\circ$ , after 82 days at  $14^\circ$ , 1 5%, after 4 months at  $12^\circ$ , 1 3%  $\text{As}_2\text{O}_3$  (Bacaloglo, J pr **83** 111)

According to later experiments, 1 pt  $\alpha\text{As}_2\text{O}_3$  dissolves in 355 pts  $\text{H}_2\text{O}$  in 1 day at  $15^\circ$ , while 1 pt  $\beta\text{As}_2\text{O}_3$  dissolves in 108 pts  $\text{H}_2\text{O}$  under the same conditions. 1 pt  $\alpha\text{As}_2\text{O}_3$  dissolves in 46 pts  $\text{H}_2\text{O}$ , if solution is prepared at  $100^\circ$ , and allowed to stand 24 hours at  $15^\circ$ , while 1 pt  $\beta\text{As}_2\text{O}_3$  dissolves in 30 pts  $\text{H}_2\text{O}$  under the same conditions (Buchner, N Rep Pharm **22** 265)

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\alpha\text{As}_2\text{O}_3$  and  $\beta\text{As}_2\text{O}_3$  at ordinary temperature

Time	$\alpha\text{As}_2\text{O}_3$	$\beta\text{As}_2\text{O}_3$
1 hour	0 023	1 589
3 hours	0 088	2 356
6 hours	0 353	3 666
12 hours	0 364	3 361
24 hours	0 956	5 306
2 days	1 627	2 629
4 days	1 814	2 429
1 week	1 673	1 763
3 weeks	1 776	1 713
$2\frac{1}{4}$ years	1 712	1 707

In the solution of  $\beta\text{As}_2\text{O}_3$ , octahedral crystals were deposited on the sides of the vessel after 12 hours, which continued to increase. There was no such deposit in the case of  $\alpha\text{As}_2\text{O}_3$ .

From the maxima in the above table, 100 pts  $\text{H}_2\text{O}$  can dissolve 3 7 pts  $\beta\text{As}_2\text{O}_3$  and 1 7 pts  $\alpha\text{As}_2\text{O}_3$  at ordinary temperature

100 pts boiling  $\text{H}_2\text{O}$  dissolve 11 46 pts  $\beta\text{As}_2\text{O}_3$  and 10 140 pts  $\alpha\text{As}_2\text{O}_3$  in 3 hours, 11 86 pts  $\beta\text{As}_2\text{O}_3$  and 10 176 pts  $\alpha\text{As}_2\text{O}_3$  in 12 hours (Cl Winkler, J pr (2) **31** 247)

100 pts  $\text{H}_2\text{O}$  dissolve 1 75 pts of a third modification (hexagonal crystalline) at ordinary temperature, and 2 75 pts at  $100^\circ$  (Claudet, Chem Soc (2) **6** 179)

$\beta\text{As}_2\text{O}_3$  dissolves more rapidly in  $\text{HCl} + \text{Aq}$  than  $\alpha\text{As}_2\text{O}_3$  (Schultz-Sellac, B **4** 109)

While 100 ccm  $\text{H}_2\text{O}$  dissolve 0 8507  $\beta\text{As}_2\text{O}_3$  at  $18 5^\circ$ , 100 ccm  $\text{H}_2\text{O}$  contain 1 3195 g  $\text{HCl}$  dissolve 1 1513 g  $\beta\text{As}_2\text{O}_3$ , containing 6 09 g  $\text{HCl}$ , 1 2724 g  $\beta\text{As}_2\text{O}_3$  (Chodounsky, Listy Chemické, **13** 114)

100 ccm  $\text{H}_2\text{O}$  dissolve 1 495 g  $\text{As}_2\text{O}_3$  at  $15^\circ$  (Wood, Chem Soc 1908, **93** 412)

Solubility of crystalline  $\text{As}_2\text{O}_3$  in  $\text{H}_2\text{O}$

1 l of the sat solution contains at  
 $2^\circ$      $15^\circ$      $25^\circ$      $39 8^\circ$     bpt  
 12 006 16 566 20 384 29 302 60 + g  $\text{As}_2\text{O}_3$  (Bruner, Z anorg 1903, **37** 456)

Much more easily sol in many acids than in  $\text{H}_2\text{O}$ . Easily sol in fuming  $\text{H}_2\text{SO}_4$  (Schultz-Sellac)

100 pts dilute  $\text{H}_2\text{SO}_4 + \text{Aq}$  of various strengths dissolve at  $t^\circ$

$t^\circ$	Pts $\beta\text{As}_2\text{O}_3$	$t^\circ$	Pts $\beta\text{As}_2\text{O}_3$	Ratios amts dissolved $80^\circ$ is
$80^\circ$	1 0195	$18 5^\circ$	0 5422	1 88
	1 3664		0 7203	1 89
	1 1933		0 6522	1 84

(Chodounsky, l c)

Decomp by  $\text{HNO}_3$  or aqua regia into  $\text{As}$  Sol in  $\text{H}_3\text{PO}_4 + \text{Aq}$  (Bergman)

More sol in  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{SO}_4 + \text{HNO}_3 + \text{Aq}$ , and still less in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$

Solubility in  $\text{HCl} + \text{Aq}$

Conc of $\text{HCl} + \text{Aq}$	Grams of $\text{As}_2\text{O}_3$ per 100 of solution
0 46N	1 52
0 98N	1 41
2 03N	1 17
3 13N	1 11
3 81N	1 15
5 32N	2 20
6 50N	5 11
7 85N	12 28
9 17N	18 16

As the concentration of the acid increases, the solubility of the oxide decreases, a minimum being reached when the concentration of the solvent is about 3 2N. Beyond this point, an increase in the concentration of the solvent leads to a corresponding increase in the solubility (Wood, Chem Soc 1908, **93** 415)

Insol in liquid  $\text{CO}$  (Buchner, Z ph **5** Ch 1906, **54** 674)

Easily sol in cold  $\text{HClO}_4 + \text{Aq}$  (Bergman)

When pulverized, it dissolves in hot  $\text{HCl} + \text{Aq}$ , but separates out on cooling

Easily sol in hot benzoic acid +  $\text{Aq}$

Sol in tartaric acid +  $\text{Aq}$

Easily sol in alkali hydrates, or carbonates +  $\text{Aq}$

Easily sol in  $\text{NH}_4$  arsenite + Aq at  $70-80^\circ$ , crystallizing out on cooling (Berzelius)

Sol in hot  $\text{K}_2\text{C}_2\text{O}_4$  + Aq

Sol in  $\text{AsCl}_3$  (Penney and Wallace)

More sol in  $\text{Na}_2\text{B}_4\text{O}_7$  + Aq than in  $\text{H}_2\text{O}$

Very sl sol in absolute alcohol (Vogel)

Sol in 80 pts highly rectified spirit (Wenzel)

When 1 pt powdered  $\text{As}_2\text{O}_3$  is digested 30 days in 10-40 pts alcohol a solution is formed containing 1 pt  $\text{As}_2\text{O}_3$  to 60 pts alcohol when 1 pt  $\text{As}_2\text{O}_3$  is digested with 60-150 pts alcohol a solution is formed containing 1 pt  $\text{As}_2\text{O}_3$  to 124-140 pts alcohol (Fischer)

Sol in 70-80 pts alcohol (Thompson.)

Alcohol dissolves 0.446 pt  $\beta\text{As}_2\text{O}_3$  (Rose, A. Phys. (1) 52 455)

100 pts alcohol dissolve pts,  $\text{As}_2\text{O}_3$

Vol % of alcohol	$\alpha\text{As}_2\text{O}_3$ at $15^\circ$	$\alpha\text{As}_2\text{O}_3$ at b pt of alcohol	$\beta\text{As}_2\text{O}_3$ at $15^\circ$
56	1 680	4 895	0 504
79	1 430	4 551	0 540
84			0 565
86	0 715	3 197	
88			0 717
100	0 025	3 402	1 060

(Girardin, J. Pharm. (3) 46 269)

100 pts absolute alcohol dissolve 0.446 pt  $\beta\text{As}_2\text{O}_3$  in  $2\frac{1}{4}$  years (Winkler, J. pr. (2) 31 347)

Nearly insol in ether

100 pts ether dissolve 0.454 pt  $\beta\text{As}_2\text{O}_3$  (Winkler)

Ether extracts 1 mg  $\text{As}_2\text{O}_3$  from sat  $\text{As}_2\text{O}_3$  + Aq for every 15 cc ether used, less is extracted when the solution is acidified with  $\text{HCl}$ , and almost none if acidified with  $\text{H}_2\text{SO}_4$  or  $\text{H}_2\text{C}_2\text{O}_4$  (Selmi, B. 13 206)

$\alpha\text{As}_2\text{O}_3$  is sol in 50 pts boiling nitrobenzol  $\beta\text{As}_2\text{O}_3$  is insol in boiling nitrobenzol (Auerbach, Z. 1903, 37 353)

$\beta\text{As}_2\text{O}_3$  is insol in oil of turpentine, but  $\alpha\text{As}_2\text{O}_3$  is insol therein  $\alpha\text{As}_2\text{O}_3$  is very sl sol in benzene or petroleum ether, but more sol in methyl alcohol, (thyl alcohol, ether, or chloroform (Selmi))

100 pts  $\text{C}_2\text{H}_5$  dissolve 0.001 pt  $\beta\text{As}_2\text{O}_3$  in  $2\frac{1}{4}$  years (Winkler)

Sl sol in the fatty oils

1000 pts castor-oil dissolve 1.33 pts  $\text{As}_2\text{O}_3$  at ordinary temperature, and 9 pts at boiling temperature 1000 pts other oils dissolve 0.6-0.8 pt  $\text{As}_2\text{O}_3$  in the cold, and about 1.7 pts on boiling (Berzelius)

Insol in chinoline or milme (Hoffmann, A. ch. (3) 9 113, 169)

Modestly sol in chinolin (Beckmann and Gubel, Z. anorg. 1906, 51 236)

Insol in acetone (Naumann, B. 1904, 37 4329), (Edimann, C. C. 1899, II 1014)

Sol in amyl alcohol and is divided between it and  $\text{H}_2\text{O}$  in the constant ratio of 1 : 5.47 at  $25^\circ$  (Auerbach, Z. anorg. 1903, 37 376)

Min. *Arsenolite*

**Arsenic trioxide pentoxide**,  $3\text{As}_2\text{O}_3$ ,  $2\text{As}_2\text{O}_5$  +  $3\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Joly, C. R. 100 1221)  $2\text{As}_2\text{O}_3$ ,  $\text{As}_2\text{O}_5$  +  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Joly)

$\text{As}_2\text{O}_3$ ,  $\text{As}_2\text{O}_5$  +  $\text{H}_2\text{O}$  (Joly)

**Arsenic tetroxide**,  $\text{As}_2\text{O}_4$

Sl sol in  $\text{H}_2\text{O}$  from which it is partially pptd by alcohol. More easily sol in alkali carbonates or  $\text{HCl}$  + Aq. Most easily sol in  $\text{NaOH}$  or  $\text{KOH}$  + Aq (Heibst, Dissert 1894)

**Arsenic pentoxide**,  $\text{As}_2\text{O}_5$

Deliquescent in moist air, slowly sol in  $\text{H}_2\text{O}$ , forming  $\text{H}_3\text{AsO}_4$ , which see. Easily sol in alcohol, much more sol in alcohol than  $\text{As}_2\text{O}_3$ . Very sl sol in the fatty oils, 100 pts of oil dissolving 0.2 pt  $\text{As}_2\text{O}_5$  in the cold, and 1 pt with partial decomp on boiling (Berzelius)

1000 pts boiling poppy-oil dissolve 27 pts  $\text{As}_2\text{O}_5$ , 1000 pts boiling castor-oil dissolve 34 pts  $\text{As}_2\text{O}_5$  (Hempel and Grundner)

+  $4\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{H}_2\text{AsO}_4$ in 100 pts solution	$t^\circ$	Pts $\text{H}_2\text{AsO}_4$ in 100 pts solution
$-55^\circ$	69 9	$-5^\circ$	80 0
$-50$	70 9	0	81 0
$-45$	71 9	+5	82 1
$-40$	72 9	10	83 3
$-35$	73 9	15	84 7
$-30$	74 9	20	86 3
$-25$	75 9	25	88 0
$-20$	76 9	30	90 1
$-15$	77 9	35	92 8
$-10$	78 9		

(Menzies and Potter, J. Am. Chem. Soc. 1912, 34 1464)

+  $\frac{5}{3}\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{H}_2\text{AsO}_4$ in 100 pts of solution
+ $10^\circ$	88 1
20	89 1
30	89 8
40	90 5
50	91 2
60	91 9
70	92 6
80	93 2
90	93 8
100	94 1
110	95 0
120	95 6
130	96 2
140	96 8

(Menzies and Potter, J. Am. Chem. Soc. 1912, 34 1464)

$\text{As}_2\text{O}_3 + 4\text{H}_2\text{O}$  and  $3\text{As}_2\text{O}_3 + 5\text{H}_2\text{O}$  are the only hydrates that can be isolated (Menzies and Potter)

See also Arsenic Acid

**Arsenic trioxide, with alkali haloid**

See Arsenite, alkali haloid

**Arsenic sulphur trioxide,  $\text{As}_2\text{O}_3, \text{SO}_3$**

Deliquescent, decomp by  $\text{H}_2\text{O}$  (Adie, Chem Soc 55 157)

$\text{As}_2\text{O}_3, 2\text{SO}_3$  As above (Adie)  
 $\text{As}_2\text{O}_3, 3\text{SO}_3$  (Weber, B 19 3186)  
 $\text{As}_2\text{O}_3, 4\text{SO}_3$  As above (Adie)  
 $\text{As}_2\text{O}_3, 6\text{SO}_3$  (Weber)  
 $\text{As}_2\text{O}_3, 8\text{SO}_3$  As above (Adie)

**Arsenic oxychloride, etc**

See Arsenyl chloride, etc

**Arsenic phosphide,  $\text{AsP}$**

Decomp by  $\text{H}_2\text{O}$  Not attacked by cold  $\text{H}_2\text{SO}_4$  or  $\text{HCl}$ , and only sl sol therein on warming Easily decomp by  $\text{HNO}_3, \text{KOH}, \text{NaOH}, \text{BaO}_2\text{H}_2 + \text{Aq}$  Insol in alcohol, ether, chloroform, sl sol in  $\text{CS}_2$

$\text{PAs}_2\text{O}_2$  Product of action of  $\text{H}_2\text{O}$  on above compound, which it resembles (Janowsky, B 6 216)

**Arsenic monoselenide,  $\text{As}_2\text{Se}$**

Insol in most organic and inorganic solvents Sol very slowly in conc  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$  Sol in boiling alkali hydroxides +  $\text{Aq}$  (Szarvasy, B 1897, 30 1245)

**Arsenic triselenide,  $\text{As}_2\text{S}_3$**

Partially sol in  $\text{KOH} + \text{Aq}$  if boiled with it for a long time (Uelsmann, A 116 123)

**Arsenic pentaselenide,  $\text{As}_2\text{Se}_5$**

Insol in most solvents, as conc  $\text{HCl}$  Sol in alkali hydrates and sulpho-hydrates +  $\text{Aq}$  (Szarvasy, B 1895, 28 2655-2656)

Insol in  $\text{H}_2\text{O}$ , in dil acids and in conc  $\text{HCl}$  Sl sol in warm  $\text{HNO}_3 + \text{Aq}$  Oxidized by cold fuming  $\text{HNO}_3$  Sol in alkalis and in hot alkali carbonates +  $\text{Aq}$  Insol in alcohol, ether,  $\text{CS}_2$ , etc (Claver Z inorg 1895, 10 129)

**Arsenic selenosulphide**

See Arsenic sulphoselenide

**Arsenic sulphide,  $\text{As}_2\text{S}_3$**

Ppt Insol in  $\text{NH}_4\text{OH}$  or in colorless  $(\text{NH}_4)_2\text{S} + \text{Aq}$  Sol in yellow  $\text{NH}_4\text{SH} + \text{Aq}$  (Scott, Chem Soc 1900, 77 652)

**Arsenic disulphide,  $\text{As}_2\text{S}_2$**

Min *Realgar* Difficultly sol in alkali sulphides +  $\text{Aq}$  Partly dissolved by  $\text{KOH} + \text{Aq}$  with decomposition Sol at  $150^\circ$  in a sealed tube in  $\text{NaHCO}_3 + \text{Aq}$ , and crystallizes out on cooling (Scharmont A ch (3) 32 158)

**Arsenic trisulphide,  $\text{As}_2\text{S}_3$**

Insol in  $\text{H}_2\text{O}$  when prepared in the dry wa but when prepared moist is very liable to into the colloidal modification mention below Insol in  $\text{H}_2\text{O}$  containing  $\text{H}_2\text{S}, \text{HNO}_3, \text{HCl}, \text{H}_2\text{C}_2\text{O}_4, \text{HC}_2\text{H}_3\text{O}_3, \text{H}_2\text{C}_4\text{H}_4(\text{CO}_2), \text{NH}_4\text{Cl}, \text{KNO}_3, (\text{NH}_4)_2\text{SO}_4, \text{MgSO}_4$  (Bontigny)

Insol in  $\text{H}_2\text{O}$  Traces are dissolved in  $\text{H}_2\text{S} + \text{Aq}$  Sl decomp by boiling with  $\text{H}_2\text{S}$  or long contact with cold  $\text{H}_2\text{O}$  (Fresenius 1 l  $\text{H}_2\text{O}$  dissolves  $2.1 \times 10^{-6}$  mols ppt  $\text{As}_2\text{S}_3$  at  $18^\circ$  (Weigel, Z phys Ch 1907, 8 294)

Insol in dil acids Insol in cold, at scarcely attacked by hot conc  $\text{HCl} + \text{Aq}$

Easily decomp by  $\text{HNO}_3$  or aqua regia Easily sol in cold  $\text{KOH}, \text{NaOH},$  or  $\text{NH}_4\text{O} + \text{Aq}$ , also in alkali carbonates, or sulphates

$\text{Aq}$

Sol in hot  $\text{KHSO}_3 + \text{Aq}$

Sol in citric acid, and alkali citrates +  $\text{A}$  (Spiller)

Slowly sol in cold 2%  $\text{Na}_2\text{B}_4\text{O}_7 + \text{A}$  Easily sol on heating (Materne, C C 190 II 557)

Insol in  $\text{CS}_2$

Min *Orpiment*

$\text{As}_2\text{S}_3$  may also be obtained in a colloid form, sol in  $\text{H}_2\text{O}$  Sat solution contains 34.46%  $\text{As}_2\text{S}_3$ , it is decomp by standing, but may be boiled without decomposition position, most acids and many salts ppt  $\text{As}_2\text{S}_3$  (Schulze, J pr (2) 25 431)

The following solutions cause pptn  $\text{As}_2\text{S}_3$  in a solution of the colloidal modification, when added in the given state of dilution —

$\text{HCl} + \text{Aq}$	1	555
$\text{HNO}_3 + \text{Aq}$	1	276
$\text{H}_2\text{SO}_4 + \text{Aq}$	1	255
$\text{H}_2\text{SO}_3 + \text{Aq}$	1	138
$\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$	1	65
$\text{H}_3\text{PO}_4 + \text{Aq}$	1	26
$\text{HC H}_3\text{O} + \text{Aq}$	1	0 18
$\text{K SO}_4 + \text{Aq}$	1	76
$\text{Na SO}_4 + \text{Aq}$	1	129
$(\text{NH}_4) \text{SO}_4 + \text{Aq}$	1	188
$\text{CaSO}_4 + \text{Aq}$	1	2780
$\text{MgSO}_4 + \text{Aq}$	1	26 30
$\text{ZnSO}_4 + \text{Aq}$	1	55 30
$\text{MnSO}_4 + \text{Aq}$	1	2860
$\text{NiSO}_4 + \text{Aq}$	1	5440
$\text{Fe SO}_4 + \text{Aq}$	1	2 880
$\text{Al (SO}_4)_3 + \text{Aq}$	1	52600
$\text{Al}_2\text{SO}_4 + \text{Aq}$	1	799
$\text{KCl} + \text{Aq}$	1	1 57
$\text{KBr} + \text{Aq}$	1	10 5
$\text{KI} + \text{Aq}$	1	55
$\text{LiI} + \text{Aq}$	1	127
$\text{NaCl} + \text{Aq}$	1	212
$\text{NH}_4\text{Cl} + \text{Aq}$	1	207
$\text{BaCl}_2 + \text{Aq}$	1	2860
$\text{CaCl} + \text{Aq}$	1	4370
$\text{MgCl} + \text{Aq}$	1	10000

FeCl <sub>3</sub> +Aq	1	50000
AlCl <sub>3</sub> +Aq	1	83000
CrCl <sub>3</sub> +Aq	1	20000
KNO <sub>3</sub> +Aq	1	84
NaNO <sub>3</sub> +Aq	1	117
NH <sub>4</sub> NO <sub>3</sub> +Aq	1	138
Ba(NO <sub>3</sub> ) <sub>2</sub> +Aq	1	2080
KClO <sub>3</sub> +Aq	1	88
CaH <sub>2</sub> (CO <sub>3</sub> ) <sub>2</sub> +Aq	1	3120
K <sub>2</sub> C <sub>2</sub> H <sub>4</sub> O <sub>6</sub> +Aq	1	85
K <sub>2</sub> C <sub>2</sub> O <sub>4</sub> +Aq	1	81
NaC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> +Aq	1	78
Urea+Aq	1	25
(NH <sub>4</sub> ) <sub>2</sub> Fe(SO <sub>4</sub> ) <sub>2</sub> +Aq	1	1160
K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +Aq	1	50000
K <sub>2</sub> Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +Aq	1	55500
K <sub>2</sub> Cr <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +Aq	1	25000
K <sub>4</sub> Fe(CN) <sub>6</sub> +Aq	1	67
K <sub>3</sub> Fe(CN) <sub>6</sub> +Aq	1	81

Cold conc solutions of boric, arsenious, tartaric, benzoic, and salicylic acids, also cane sugar, or chloral hydrate cause no pptn. Absolute alcohol and glycerine may also be mixed with the solutions without causing pptn (Schulze, J pr (2) 25 442)

+6H<sub>2</sub>O, decomp completely into As<sub>2</sub>S<sub>3</sub> under a pressure of 6000 to 7000 atmos (Spring, Z anorg 1895, 10 186)

#### Arsenic pentasulphide, As<sub>2</sub>S<sub>5</sub>

Insol in H<sub>2</sub>O. Sol in NH<sub>4</sub>OH, KOH, NaOH+Aq, and solutions of alkali sulphides and carbonates. Sol in BaO H<sub>2</sub> and CaO<sub>2</sub>H<sub>2</sub>+Aq

Sol in citric acid, and alkali citrates+Aq (Spiller)

Alcohol dissolves out S on boiling (Berzelius)

Sol in alkali arsenates+Aq (Nilson, J pr (2) 14 155)

+H<sub>2</sub>O (Nilson, l c)

#### Arsenic trisulphide, with M S

See Sulpharsenites, M

#### Arsenic pentasulphide, with M S

See Sulpharsenates, M

#### Arsenic sulphobromide, AsS Br<sub>3</sub> = AsSBr + SBr<sub>3</sub>

Decomp by H<sub>2</sub>O (Hummel, Chem Soc 33 254)

#### Arsenic sulphochloride, As S Cl

Slowly decomp by boiling H<sub>2</sub>O. Sol in hot AsCl<sub>3</sub> without decomp (Ouvrard, C R 116 1516)

AsS Cl. Decomp by H<sub>2</sub>O. Sol in NH<sub>4</sub>OH, and alkali carbonates+Aq (Ouvrard)

AsS Cl. Slowly decomp by boiling H<sub>2</sub>O. Sol in alkali carbonates and in NH<sub>4</sub>OH+Aq (Ouvrard, C R 1893, 116 1517)

#### Arsenic sulphoiodide, AsSI

Insol in alcohol, chloroform or carbon disulphide (Schneider, J pr (2) 23 456)

Formula is probably As<sub>2</sub>S<sub>3</sub>, AsI<sub>3</sub>

Slowly attacked by HCl+Aq, somewhat more easily by HNO<sub>3</sub>+Aq. Easily sol in KOH, or NH<sub>4</sub>OH+Aq (Schneider, J pr (2) 34 505)

2AsI<sub>3</sub>, SI<sub>6</sub>. Decomp on air (Schneider, J pr (2) 36 509)

As<sub>2</sub>S<sub>5</sub>I<sub>3</sub>. Less sol in CS<sub>2</sub> than AsI<sub>3</sub> (Ouvrard, C R 117 107)

As-SI<sub>4</sub> (Ouvrard)

See also Arsenyl sulphoiodide

#### Arsenic sulphoselenide, As<sub>2</sub>SeS<sub>2</sub>

Easily sol in cold NH<sub>4</sub>SH+Aq. Nearly completely sol in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq (v Gerichten, B 7 29)

As<sub>2</sub>SSe<sub>2</sub>. More difficultly sol than the preceding comp in NH<sub>4</sub>SH+Aq (v Gerichten)

As<sub>2</sub>Se<sub>2</sub>S<sub>3</sub>. Sp gr = 6.402 at ca 750°

Insol in most solvents. Easily sol in alkali hydroxides and sulphides+Aq (Szarvasky, B 1895, 28 2661)

As Se<sub>2</sub>S<sub>2</sub>. Sp gr = 11.35 at 550-600°

Insol in most solvents. Easily sol in alkali hydroxides and sulphides+Aq (Szarvasky, B 1895, 28 2659)

#### Arsenic telluride, As<sub>2</sub>Te<sub>2</sub>

Sol in HNO<sub>3</sub> and HNO<sub>3</sub>+HCl+Aq (Oppenheim, J pr 71 266)

As<sub>2</sub>Te<sub>2</sub>. As above (Oppenheim)

#### Arsenic acid, anhydrous, As<sub>2</sub>O<sub>5</sub>

See Arsenic pentoxide

#### Metaarsenic acid, HAsO<sub>3</sub>

Slowly sol in cold, quite easily sol in hot H<sub>2</sub>O, with considerable evolution of I and conversion into H<sub>3</sub>AsO<sub>4</sub> (Kopp, A (3) 48 196)

#### Orthoarsenic acid, H<sub>3</sub>AsO<sub>4</sub>

Sol in H<sub>2</sub>O, with absorption of heat

1 pt As<sub>2</sub>O<sub>5</sub> dissolves in 0.405 pt H<sub>2</sub>O at 12.5°, or 100 pts H<sub>2</sub>O dissolve 244.81 pts As<sub>2</sub>O<sub>5</sub> at 12.5° (Vogel)

Sol in 0.5 pt H<sub>2</sub>O (Lhéard)

Sol in 6 pts cold H<sub>2</sub>O, and more quickly in 2 pts hot H<sub>2</sub>O (Bucholz)

100 pts H<sub>2</sub>O at 15.56° dissolve 150 pts As<sub>2</sub>O<sub>5</sub> (Ure's Dict)

H<sub>3</sub>AsO<sub>4</sub>+Aq sat at 15° contains 15% As<sub>2</sub>O<sub>5</sub>

Sp gr of H<sub>3</sub>AsO<sub>4</sub>+Aq at 15° a = sp gr of 1% is As<sub>2</sub>O<sub>5</sub> b = sp gr if % is H<sub>3</sub>AsO<sub>4</sub>

c	a	b	%	a	b
5	1.042	1.0337	45	1.540	1.3973
10	1.055	1.0690	50	1.635	1.4617
15	1.154	1.1061	55	1.742	1.5320
20	1.187	1.1457	60		1.6086
25	1.245	1.1882	65		1.6919
30	1.306	1.242	70		1.7827
35	1.378	1.2540	75		
40	1.453	1.3382			

(Schiff, A 113 183, calculated by Gerlach, Z anal 27 303)

Sp gr of  $\text{H}_3\text{AsO}_4 + \text{Aq}$  at  $15^\circ$   $a = \text{sp gr if } \%$   
is  $\text{As}_2\text{O}_5$ ,  $b = \text{sp gr if } \%$  is  $\text{H}_3\text{AsO}_4$

%	a	b	%	a	b
1	1 008	1 006	47	1 564	1 412
2	1 016	1 013	48	1 582	1 425
3	1 023	1 019	49	1 601	1 437
4	1 031	1 026	50	1 620	1 450
5	1 039	1 032	51	1 642	1 464
6	1 048	1 039	52	1 663	1 478
7	1 057	1 046	53	1 685	1 491
8	1 065	1 052	54	1 706	1 505
9	1 074	1 059	55	1 728	1 519
10	1 083	1 066	56	1 752	1 534
11	1 092	1 073	57	1 777	1 549
12	1 102	1 081	58	1 801	1 564
13	1 111	1 088	59	1 825	1 579
14	1 121	1 096	60	1 850	1 594
15	1 130	1 103	61	1 880	1 610
16	1 140	1 111	62	1 910	1 626
17	1 150	1 119	63	1 940	1 643
18	1 160	1 126	64	1 970	1 659
19	1 170	1 134	65	2 000	1 675
20	1 180	1 142	66	2 030	1 693
21	1 191	1 150	67	2 060	1 712
22	1 203	1 158	68	2 090	1 730
23	1 214	1 167	69	2 120	1 749
24	1 226	1 175	70	2 150	1 767
25	1 237	1 183	71		1 788
26	1 249	1 192	72		1 809
27	1 261	1 201	73		1 830
28	1 274	1 210	74		1 851
29	1 286	1 219	75		1 872
30	1 298	1 228	76		1 897
31	1 312	1 238	77		1 921
32	1 325	1 248	78		1 946
33	1 339	1 257	79		1 970
34	1 352	1 267	80		1 995
35	1 366	1 277	81		2 020
36	1 381	1 288	82		2 045
37	1 396	1 299	83		2 070
38	1 411	1 309	84		2 095
39	1 426	1 320	85		2 120
40	1 441	1 331	86		2 146
41	1 458	1 342	87		2 178
42	1 475	1 353	88		2 207
43	1 492	1 366	89		2 236
44	1 509	1 376	90		2 265
45	1 526	1 387	91		2 295
46	1 545	1 400			

(Kopp, calculated by Gerlach, *Z* and 27  
316.)

See also Arsenic pentoxide

### Euroarsenic acid, $\text{H}_4\text{AsO}_7$

Very deliquescent; easily sol in  $\text{H}_2\text{O}$  with evolution of much heat and conversion into  $\text{H}_3\text{AsO}_4$ .

### Arsenates

Arsenates of the alkali metals and acid arsenates of the alkaline-earth metals are sol in  $\text{H}_2\text{O}$ . Neutral and basic arsenates are easily sol in mineral acids including  $\text{H}_3\text{AsO}_4$ .

less sol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . The neutral alkaline-earth arsenates are less sol in  $\text{H}_2\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ , but more sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Field). The alkali arsenates are sol in hot glycerine (Lefèvre, *C R* 108 158).

### Aluminum arsenate, $\text{Al}_2(\text{AsO}_4)_3$

Ppt Insol in  $\text{H}_2\text{O}$ , difficultly sol in acids (Coloniano, *C R* 103 273)

Insol in acetone (Naumann, *B 1* 4, 37 4328)

$2\text{Al}_2\text{O}_3, 3\text{As}_2\text{O}_5$  Nearly unattacked by boiling  $\text{H}_2\text{O}$ , sol in dil acids (Lefèvre, *A ch* (6) 27 5)

### Aluminum potassium arsenate, $2\text{Al}_2\text{O}_3 \cdot 3\text{As}_2\text{O}_5 \cdot 3\text{K}_2\text{O}$

(Lefèvre)

### Aluminum sodium arsenate, $2\text{Al}_2\text{O}_3 \cdot 3\text{As}_2\text{O}_5 \cdot \text{Na}_2\text{O}$

(Lefèvre)

### Ammonium arsenate, $(\text{NH}_4)_3\text{AsO}_4 \cdot 2\text{H}_2\text{O}$

Difficultly sol in  $\text{H}_2\text{O}$ . Less sol than  $(\text{NH}_4)_2\text{HAsO}_4$  (Mitscherlich)

Insol in liquid  $\text{NH}_3$  (Franklin, *A ch* 1898, 20 826)

### Ammonium hydrogen arsenate,

$(\text{NH}_4)\text{HAsO}_4$

Effloresces, giving off  $\text{NH}_3$ , more sol in  $\text{H}_2\text{O}$  than  $(\text{NH}_4)_3\text{AsO}_4$  (Sulkowsky, *J pr* 104 129)

Insol in acetone (Fidmum, *C C* 1899, II 1014)

### Ammonium dihydrogen arsenate,

$\text{NH}_4\text{H}_2\text{AsO}_4$

Not efflorescent. Very sol in  $\text{H}_2\text{O}$

### Ammonium barium arsenate, $\text{NH}_4\text{Ba}(\text{AsO}_4)_2 \cdot 2\text{H}_2\text{O}$

Sol by 10 days contact in 1.91 pt  $\text{H}_2\text{O}$ , in 18.82 pts of a mixture of 1 pt  $\text{NH}_4\text{OH} + \text{Aq}$  and 3 pts  $\text{H}_2\text{O}$  in 227 pts of a solution of 1 pt  $\text{NH}_4\text{Cl}$  in 10 pts  $\text{H}_2\text{O}$  and 2169 pts of a solution of 1 pt  $\text{NH}_4\text{Cl}$  in 0 pts  $\text{NH}_4\text{OH} + \text{Aq}$  and 60 pts  $\text{H}_2\text{O}$  (Lefèvre, *A ch* 1892, (6) 27 13)

$(\text{NH}_4)\text{BaH}(\text{AsO}_4)_2$  Efflorescent. Insol in  $\text{H}_2\text{O}$ ; easily sol in dil  $\text{HNO}_3 + \text{Aq}$  (Baumann, *Arch Pharm* 36 36)

### Ammonium calcium arsenate, $\text{NH}_4\text{Ca}(\text{AsO}_4)_2 \cdot 2\text{H}_2\text{O}$

1000 pts pure  $\text{H}_2\text{O}$  dissolve 0.20 this salt, 1000 pts  $\text{NH}_4\text{Cl} + \text{Aq}$  (containing 50 pts  $\text{NH}_4\text{Cl}$ ) dissolve 1.15 pts this salt (0 pts  $\text{H}_2\text{O} + 100$  pts  $\text{NH}_4\text{OH}$  (sp gr = 0.8)) dissolve 0.01 pt this salt (Field, *Chem* 11 6)

Soluble by 10 days' contact in 2167 pt  $\text{H}_2\text{O}$  at  $15^\circ$ , in 381 pts  $\text{NH}_4\text{Cl} + \text{Aq}$  (17), in

43478 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (1 3), in 10570 pts  $\text{NH}_4\text{Cl} + \text{NH}_4\text{OH} + \text{Aq}$  (1 10 60) (Lefèvre, A ch 1892, (6) 27 13)

+6 $\text{H}_2\text{O}$  Sol in hot, very sl sol in cold  $\text{H}_2\text{O}$ , sl sol in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$  (Wach, Schw J 12 285)

+7 $\text{H}_2\text{O}$  (Bloxam, C N 54 163)

$(\text{NH}_4)_2\text{CaH}_2(\text{AsO}_4)_3$  Efflorescent Insol in  $\text{H}_2\text{O}$ , easily sol in dil  $\text{HNO}_3 + \text{Aq}$  (Bauermann, Arch Pharm 36 36)

$(\text{NH}_4)_3\text{Ca}_2\text{H}_2(\text{AsO}_4)_3 + 3\text{H}_2\text{O}$

$(\text{NH}_4)_3\text{Ca}_2\text{H}_2(\text{AsO}_4)_3 + 3\text{H}_2\text{O}$  (Bloxam, C N 54 163)

**Ammonium glucinum arsenate,  $\text{NH}_4\text{GlAsO}_4 + 4\frac{1}{2}\text{H}_2\text{O}$**

More stable than the corresponding potassium salt (Bleyer, Z anorg 1912, 75 291)

**Ammonium iron (ferric) dihydrogen arsenate,  $\text{NH}_4\text{H}_2\text{AsO}_4, \text{FeAsO}_4$**

Hydrolyzed by  $\text{H}_2\text{O}$

Sol in cold conc  $\text{HCl}$ , hot  $\text{HNO}_3$ , hot dil  $\text{H}_2\text{SO}_4$ , and in hot arsenic acid +  $\text{Aq}$  containing 75% arsenic pentoxide

Sol in hot conc  $\text{NH}_4\text{OH} + \text{Aq}$  Completely hydrolyzed by caustic alkalis

Insol in conc  $\text{NH}_4\text{Cl} + \text{Aq}$  and in 50% acetic acid (Curtman, J Am Chem Soc 1910, 32 628)

**Ammonium magnesium arsenate,**

$\text{NH}_4\text{MgAsO}_4$

Sl sol in  $\text{H}_2\text{O}$  Sol in acids

Anhydrous salt is sol in 2784 pts  $\text{H}_2\text{O}$  at 15°, in 15,904 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (1 3) (0 96 sp gr), in 1386 pts  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 70), in 886 7 pts  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 7), in 3014 pts  $\text{NH}_4\text{Cl}$  (1 pt) +  $\text{NH}_4\text{OH}$  (0 96 sp gr) (10 pts) +  $\text{Aq}$  (60 pts), in 32,827 pts magnesia mixture (Fresenius, Z anal 3 206)

Anhydrous salt is sol in 4389 pts  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (1 50), in 2561 5 pts  $\text{KCl} + \text{Aq}$  (1 165), in 1422 pts ammoniacal solution of 3 5 g tartaric acid in 250 cc  $\text{H}_2\text{O}$ , in 933 5 pts ammoniacal solution of 2 5 g citric acid in 250 cc  $\text{H}_2\text{O}$  (Puller, Z anal 10 62)

+ $\frac{1}{2}\text{H}_2\text{O}$

Sol in 2656 pts  $\text{H}_2\text{O}$  at 15°, in 15,038 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (1 3) (0 96 sp gr), in 844 pts  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 7), in 1315 pts  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 70), in 2871 pts  $\text{NH}_4\text{Cl}$  (1 pt) +  $\text{NH}_4\text{OH}$  (0 96 sp gr) (10 pts) +  $\text{Aq}$  (60 pts) (Fresenius)

1000 pts pure  $\text{H}_2\text{O}$  dissolve 0 14 pt salt, 1000 pts  $\text{NH}_4\text{Cl} + \text{Aq}$  (containing 100 pts  $\text{NH}_4\text{Cl}$ ) dissolve 0 95 pt salt, 900 pts  $\text{H}_2\text{O} + 100$  pts  $\text{NH}_4\text{OH}$  (sp gr 0 880) dissolve 0 07 pt salt (Field, Chem Soc 11 6)

+6 $\text{H}_2\text{O}$  Sl efflorescent Sl sol in  $\text{H}_2\text{O}$

Very sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$

Solubility of  $\text{NH}_4\text{MgAsO}_4 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  and  $\text{NH}_4$  salts +  $\text{Aq}$   
Grams salt dissolved in 100 g solvent

t°	$\text{H}_2\text{O}$	5% $\text{NH}_4\text{NO}_3 + \text{Aq}$	5% $\text{NH}_4\text{Cl} + \text{Aq}$	$\text{NH}_4\text{OH}$ 1 pt $\text{NH}_4\text{OH} + \text{Aq}$ (0 96) + 4 pts $\text{H}_2\text{O}$	4% $\text{NH}_4\text{OH} + \text{Aq} + 5\%$ $\text{NH}_4\text{Cl} + \text{Aq}$	4% $\text{NH}_4\text{Cl} + 10\%$ $\text{NH}_4\text{Cl} + \text{Aq}$
0°	0 03388	0 09216	0 08397	0 00874		
20	0 02066	0 11358	0 12284	0 00958	0 01331	0 03165
30		0 11758	0 11264			
40	0 02746	0 13936	0 19016	0 01173		
50	0 02261	0 18945	0 18889	0 01005		
60	0 02103	0 21115	0 21952	0 00902	0 04691	0 05353
70	0 01564	0 18880	0 22092	0 00949		
80	0 02364	0 18945	0 23144	0 00912		

(Wenger, Dissert 1911)

**Ammonium manganous arsenate,**

$\text{NH}_4\text{MnAsO}_4 + 6\text{H}_2\text{O}$

Nearly insol in cold  $\text{H}_2\text{O}$ , easily sol in dil acids, insol in alcohol (Otto, J pr 2 414)

**Ammonium sodium arsenate,  $\text{NH}_4\text{NAsO}_4 + 4\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  (Ullsman, Zeit f ges Nut 23 347)

**Ammonium sodium hydrogen arsenate,**

$(\text{NH}_4)_3\text{NAsH}_2(\text{AsO}_4)_4 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Fulhol and Sanderens, C R 94 649)

**Ammonium strontium arsenate,  $\text{NH}_4\text{SrAsO}_4 + \frac{1}{2}\text{H}_2\text{O}$**

Sol by 10 days' contact in 3229 pts  $\text{H}_2\text{O}$ , in 11,586 pts dil  $\text{NH}_4\text{OH} + \text{Aq}$ , in 199 pts

of a mixture of 1 pt  $\text{NH}_4\text{Cl}$  in 7 pts  $\text{H}_2\text{O}$ , and in 1519 pts of a solution of 1 pt  $\text{NH}_4\text{Cl}$  in 10 pts  $\text{NH}_4\text{OH} + \text{Aq}$  and 60 pts  $\text{H}_2\text{O}$  (Lefèvre, A ch 1892, (6) 27 13)

**Ammonium uranyl arsenate,  $\text{NH}_4(\text{UO}_2)_2\text{AsO}_4 + x\text{H}_2\text{O}$**

Insol in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{H}_3\text{PO}_4$ , and saline solutions as  $\text{NH}_4\text{Cl} + \text{Aq}$  sol in mineral acids (Puller, Z anal 10 72)

**Ammonium vanadium arsenate,**

$\text{NH}_4(\text{VO})_2\text{AsO}_4$ , and  $(\text{NH}_4)_2\text{HAsO}_4 + 2(\text{VO})_2\text{HAsO}_4$

See Arsenovanadate, ammonium

**Ammonium arsenate tellurate**

See Arsenotellurate, ammonium



**Antimony arsenate (?)**

Insol in  $H_2O$ , insol in acids after ignition, but when fresh is sol in conc boiling  $HCl$  + Aq, and sl sol in  $HNO_3$  + Aq (Dumas)

**Barium arsenate,  $Ba_3(AsO_4)_2$** 

1000 pts pure  $H_2O$  dissolve 0.55 pt  $Ba_3(AsO_4)_2$ , 1000 pts  $NH_4Cl$  + Aq (containing 50 pts  $NH_4Cl$ ) dissolve 1.95 pts  $Ba_3(AsO_4)_2$ , 900 pts  $H_2O$  + 100 pts  $NH_4OH$  + Aq (sp gr = 0.88) dissolve 0.03 pt  $Ba_3(AsO_4)_2$  (Field, Chem Soc 11 6)

Sol in cold  $HNO_3$ , and  $HCl$  + Aq (Berzelius),  $H_2C_2H_4O_6$ , and  $HC_2H_3O_2$  + Aq (Anthon)

Solubility in  $H_2O$  is not increased by presence of  $NH_4$ , Na, or K salts (Laugier)

Not pptd in presence of Na citrate (Spiller)  
+  $1\frac{1}{2}H_2O$  (Salkowsky, J pr 104 129)

**Barium hydrogen arsenate,  $BaHAsO_4 + 1\frac{1}{2}H_2O$** 

Very sl sol in  $H_2O$ , but decomp thereby into  $Ba_3(AsO_4)_2$  and  $BaH_4(AsO_4)$  (Berzelius)

Sl sol in cold acids  
+  $H_2O$  Sl sol in either  $BaCl_2$  + Aq or  $NaHAsO_4$  + Aq (Maumené, J B 1864 237)

**Barium tetrahydrogen arsenate,  $BaH_4(AsO_4)_2 + 2H_2O$** 

Easily sol in  $H_2O$  (Settemberg, Berz J B 26 206)

Difficultly sol in little, but decomp by much  $H_2O$ . Easily sol in  $HCl$  + Aq less easily in  $HCl$  +  $H_2O$  + Aq (Hormann, Dissert, 1879)

**Barium arsenate, acid,  $Ba(O_2)As_2O_5 + 4H_2O$** 

Very sl sol in  $H_2O$  (Mitscherlich)

**Barium pyroarsenate,  $Ba_2As_2O_7$** 

Insol in  $H_2O$  but decomp thereby into  $BaHAsO_4$  +  $H_2O$  (Lefèvre C R 108 1038)

**Barium potassium arsenate,  $KBaAsO_4$** 

Sl decomp by cold  $H_2O$ . Rapidly sol in dil acids (Lefèvre Arch (6) 27 1)

**Barium sodium arsenate,  $NaBaAsO_4 + 9H_2O$** 

(Joly, C R 1887 104 1702)

**Barium arsenate chloride,  $Ba_2(AsO_4)_2 \cdot PbCl_2$** 

Insol in  $H_2O$  sol in dil  $HNO_3$  + Aq (Schubert C R 65 172)

**Bismuth arsenate, basic,  $BiAsO_4 \cdot 3Bi_2O_3$** 

Insol in  $H_2O$ . Sol in mineral acids (Cavazzi Gazz chim 14 289)

$Bi_2O_3 \cdot 2As_2O_5 + 5H_2O$  Min *Rhauit*  
Easily sol in  $HCl$  + Aq sl sol in  $HNO_3$  + Aq

**Bismuth arsenate,  $BiAsO_4 + \frac{1}{2}H_2O$** 

Insol in  $H_2O$  Insol in  $HNO_3$  - Aq in presence of  $H_2AsO_4$ , or alkali arsenates + Aq, sol in  $HCl$  + Aq (Salkowsky, J pr 104 129)

Not wholly insol in  $HNO_3$  + Aq (Schneider, J pr (2) 20 418)

Very sol in  $H_2AsO_4$  + Aq (Dumas)

Insol in  $Bi(NO_3)_3$  + Aq (Dumas)

Sol in  $Bi(NO_3)_3$  + Aq (Salkowsky)

Insol in conc  $Bi(NO_3)_3$  + Aq containing a small quantity of  $HNO_3$  (Schneider)

**Bismuth copper arsenate,  $BiCu_{20}As_{10}H_{44}O_{76}$** 

$= Bi_2O_3, 20CuO, 5As_2O_5 + 22H_2O$   
Min *Mixite* Decomp by dil  $H_2O$  into insol  $BiAsO_4$ , and  $Cu_3(AsO_4)_2$ , which goes into solution (Dana)

**Bismuth uranyl arsenate,  $Bi_2(AsO_4)_3 \cdot 8Bi_2O_3 \cdot H_2O$** 

Min *Walpurgite*

**Cadmium arsenate,  $Cd_3(AsO_4)_2$** 

Ppt (Salkowsky, J pr 104 129)  
 $2CdO, As_2O_5$  (Lefèvre, C R 11 405)  
 $5CdO, 2As_2O_5 + 5H_2O$  Ppt (Salkowsky)

**Cadmium pyroarsenate,  $CdAs_2O_7$** 

(de Schulten)

**Cadmium hydrogen arsenate,  $CdHAsO_4 + H_2O$** 

Decomp by  $H_2O$  (Demel, B 12 1279)  
 $CdH_4(AsO_4)_2 + 2H_2O$  Decomp by excess of  $H_2O$  (de Schulten, Bull Soc (1) 473)

**Cadmium potassium arsenate,  $2CdO, K_2O, As_2O_5$** 

(Lefèvre C R 110 405)

**Cadmium sodium arsenate,  $(CdO)_2Na_2O, As_2O_5$** 

Slowly sol in dil acids (Lefèvre C R 110 405)

$2CdO, 4Na_2O, 3As_2O_5$  (Lefèvre)

**Cadmium arsenate bromide,  $(CdO)_2(AsO_4)_2 \cdot 2H_2O$** 

Sol in very dil  $HNO_3$  + Aq (de Schulten Bull Soc (5) 1 472)

**Cadmium arsenate chloride,  $(CdO)_2(AsO_4)_2 \cdot 2H_2O$** 

Sol in very dil  $HNO_3$  + Aq (de Schulten)

**Cæsium arsenate,  $Cs_2O \cdot 2As_2O_5 + 10H_2O$** 

Ppt (Lippmann Z anorg 1910 55 246)

**Calcium arsenate,  $Ca_3(AsO_4)_2 + 3H_2O$** 

Ppt Insol in  $H_2O$  sol in  $H_2SO_4$  + Aq (Kotschoubey, J pr 49 182)

**Calcium pyroarsenate,  $CaAs_2O_7$** 

Slowly decomp by cold  $H_2O$  into  $HAsO_4$  +  $1\frac{1}{2}H_2O$  (Lefèvre)

**Calcium hydrogen arsenate**,  $\text{CaHAsO}_4 + \frac{1}{2}\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Debray, A ch (3) 61 419)  
 +  $\text{H}_2\text{O}$  Min *Hardingerite* Easily sol in acids  
 +  $2\frac{1}{2}\text{H}_2\text{O}$  Min *Pharmacohite* Easily sol in acids  
 +  $3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{AsO}_4 + \text{Aq}$ , also in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{NO}_3$ ,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , and  $\text{NH}_4\text{Cl} + \text{Aq}$  (Pfaff)

**Calcium tetrahydrogen arsenate**,

$\text{CaH}_4(\text{AsO}_4)_2$   
 Sol in  $\text{H}_2\text{O}$  (Graham)  
 +  $\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  Decomp by much hot  $\text{H}_2\text{O}$  into  $\text{H}_2\text{AsO}_4$  and  $\text{Ca}_3(\text{AsO}_4)_2$  (Hormann, Dissert 1879)

**Calcium iron (ferric) arsenate**,  $6\text{CaO}$ ,  $4\text{Fe}_2\text{O}_3$ ,  $5\text{As}_2\text{O}_5 + 15\text{H}_2\text{O}$  (?)

Min *Arsenosiderite* Sol in acids

**Calcium magnesium arsenate**,  $\text{Ca}_5\text{H}_2(\text{AsO}_4)_4$ ,  $\text{Mg}_5\text{H}_2(\text{AsO}_4)_4 + 10\text{H}_2\text{O}$

Min *Picropharmacohite* Easily sol in acids  
 $\text{Ca}_5(\text{AsO}_4)_2$ ,  $\text{Mg}_5(\text{AsO}_4)_2$  Sol in  $\text{HNO}_3 + \text{Aq}$  (Kuhn)

Min *Berzelzite* Sol in  $\text{HNO}_3 + \text{Aq}$   
 $\text{Ca}_5\text{Mg}_5\text{H}_{14}(\text{AsO}_4)_{14} + 49\text{H}_2\text{O}$  Min *Waplerite*

**Calcium potassium arsenate**,  $\text{CaKAsO}_4$

(Lefèvre, A ch (6) 27 5)

**Calcium sodium arsenate**,  $\text{CaNaAsO}_4$

(Lefèvre, A ch (6) 27 1)  
 $4\text{CaO}$ ,  $2\text{Na}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$  Not attacked by boiling  $\text{H}_2\text{O}$ , easily sol in dil acids (Lefèvre)

**Calcium uranyl arsenate**,  $\text{Ca}(\text{UO})_2(\text{AsO}_4)_2 + \text{SH}_2\text{O}$

Min *Uranospinite*

**Calcium vanadium arsenate**,  $\text{CaHAsO}_4$ ,  $2(\text{VO})\text{HAsO}_4 + 8\text{H}_2\text{O}$

See *Arsenovanadate*, calcium

**Calcium arsenate chloride**,  $\text{Ca}_4(\text{AsO}_4)_3$ ,  $\text{CaCl}_2$

Insol in  $\text{H}_2\text{O}$ , sol in dil  $\text{HNO}_3 + \text{Aq}$  (Lechutier C R 65 172)  
 $3\text{Ca}(\text{AsO}_4)_2$ ,  $\text{CaCl}_2$  As above (Lechutier)

**Cerous arsenate**,  $\text{CeHAsO}_4$

Insol in  $\text{H}_2\text{O}$  Sol in arsenic acid +  $\text{Aq}$  (Berzelius)

**Ceric hydrogen arsenate**,  $\text{Ce}(\text{HAsO}_4)_4 + 6\text{H}_2\text{O}$

Ppt Insol in  $\text{H}_2\text{O}$  and dil acids (Bucher, B 1910, 43 2216)

**Ceric dihydrogen arsenate**,  $\text{Ce}(\text{HAsO}_4)_4 + 4\text{H}_2\text{O}$

Sol in conc  $\text{HNO}_3$  (Barbieri l c)

**Chromic arsenate**,  $2\text{Cr}_2\text{O}_3$ ,  $3\text{As}_2\text{O}_5$

Insol in  $\text{H}_2\text{O}$  and conc boiling acids (Lefèvre, A ch (6) 27 5)

**Chromic potassium arsenate**,  $2\text{Cr}_2\text{O}_3$ ,  $3\text{K}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$

(Lefèvre)

**Chromic sodium arsenate**,  $2\text{Cr}_2\text{O}_3$ ,  $3\text{Na}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$

(Lefèvre)

**Cobaltous arsenate, basic**,  $4\text{CoO}$ ,  $\text{As}_2\text{O}_5$

Easily sol in acids (Gentile, J B 1851 359)

$\text{Co}(\text{CoOH})\text{AsO}_4$  Insol in  $\text{H}_2\text{O}$ , difficultly sol in acids (Coloriano)

**Cobaltous arsenate**,  $\text{Co}_3(\text{AsO}_4)_2 + 8\text{H}_2\text{O}$

Ppt Insol even in boiling  $\text{H}_2\text{O}$ , easily sol in  $\text{HNO}_3$ ,  $\text{HCl}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$ , sol in  $\text{H}_2\text{AsO}_4 + \text{Aq}$  (Proust), sol in dil  $\text{FeSO}_4 + \text{Aq}$  (Karsten, Pogg 60 266)

Min *Cobalt bloom*, *Erythrite* Easily sol in acids

$5\text{CoO}$ ,  $2\text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , difficultly sol in acids (Coloriano, C R 103 273)

$2\text{CoO}$ ,  $\text{As}_2\text{O}_5$  Sl attacked by boiling  $\text{H}_2\text{O}$ , easily sol in dil acids (Lefèvre)

**Cobaltous hydrogen arsenate**  $\text{CoH}(\text{AsO}_4)$

Sol in

**Cobaltous potassium arsenate**,  $\text{CoKAs}$

(Lefèvre)

**Cobaltous sodium arsenate**,  $\text{CoNaAsO}_4$

(Lefèvre)

$4\text{CoO}$ ,  $2\text{Na}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$  (Lefèvre)

**Cobaltous vanadium arsenate**,

$\text{Co}(\text{VO})_2\text{H}(\text{AsO}_4)_2 + 8\text{H}_2\text{O}$

See *Arsenovanadate*, cobaltous

**Cobaltous arsenate ammonia**,  $\text{Co}_3(\text{AsO}_4)_2$ ,  $\text{NH}_3 + 7\text{H}_2\text{O}$

(Ducru, A ch 1901, (7) 22 185)

$\text{Co}_3(\text{AsO}_4)_2$ ,  $2\text{NH}_3 + 6\text{H}_2\text{O}$  (Ducru, l c)

$\text{Co}_3(\text{AsO}_4)_2$ ,  $3\text{NH}_3 + 5\text{H}_2\text{O}$  (Ducru, l c)

**Cuprous arsenate**,  $2\text{CuO}$ ,  $\text{As}_2\text{O}_5$

(Hampe, Dissert 1874)

$4\text{CuO}$ ,  $\text{As}_2\text{O}_5$  (Hampe, l c)

**Cuprous pyroarsenate**,  $\text{Cu}_4\text{As}_2\text{O}_7$

Ppt Sol in  $\text{NH}_4\text{OH}$  or  $\text{KOH} + \text{Aq}$  (Reichard, B 1898, 31 2166)

**Cupric arsenate, basic**,  $\text{SCuO}$ ,  $\text{As}_2\text{O}_5 + 12\text{H}_2\text{O}$

Min *Chalcophyllite* Easily sol in acids and  $\text{NH}_4\text{OH} + \text{Aq}$

$6\text{CuO}$ ,  $\text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$  Min *Aphanesite*,

*Choclosite* Sol in acids and ammonia

$5\text{CuO}$ ,  $\text{As}_2\text{O}_5 + 2\text{H}_2\text{O}$  Min *Erimite* Sol in  $\text{HNO}_3 + \text{Aq}$

+5H<sub>2</sub>O Min *Cornwallite* Sol in acids, and NH<sub>4</sub>OH+Aq  
 +9H<sub>2</sub>O Min *Tyrolite*  
 4CuO, As<sub>2</sub>O<sub>5</sub>+H<sub>2</sub>O Insol in H<sub>2</sub>O (Debray, A ch (3) 61 423)  
 Min *Olivenite* Sol in acids, and NH<sub>4</sub>OH+Aq, decomp by hot KOH+Aq  
 +7H<sub>2</sub>O Min *Euchronite* Sol in HNO<sub>3</sub>+Aq  
 +4½H<sub>2</sub>O (Hirsch, C C 1891, I 15)

#### Cupric arsenate, Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>

Insol in H<sub>2</sub>O Easily sol in HCl+Aq, sl sol in other acids, sol in NH<sub>4</sub>OH+Aq (Coloriano, C R 103 273)  
 Insol in methyl acetate (Naumann, B 1909, 42 3790)  
 Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 827)  
 +4H<sub>2</sub>O Decomp by hot H<sub>2</sub>O (Debray)  
 +5H<sub>2</sub>O Min *Trichalcite* Easily sol in cold HCl+Aq

#### Cupric arsenate, acid, 5CuO, 2As<sub>2</sub>O<sub>5</sub>

Sol in H<sub>2</sub>SO<sub>4</sub>+Aq (Vogel)  
 +3H<sub>2</sub>O (Salkowsky)  
 +8, 9½, and 12½H<sub>2</sub>O (Hirsch)  
 CuHAsO<sub>4</sub>+H<sub>2</sub>O Insol in H<sub>2</sub>O (Coloriano)  
 +1½H<sub>2</sub>O Insol in H<sub>2</sub>O (Debray, A ch (3) 61 419)  
 8CuO, 3As<sub>2</sub>O<sub>5</sub>+12H<sub>2</sub>O (Hirsch)

#### Cupric lead arsenate, 3CuO, PbO, As<sub>2</sub>O<sub>5</sub>+2H<sub>2</sub>O

Min *Bayldonite* Nearly insol in HNO<sub>3</sub>+Aq

#### Cupric potassium arsenate, CuKAsO<sub>4</sub>

Slowly sol in NH<sub>4</sub>OH+Aq, easily sol in acids (Lefevre, A ch (6) 27 5)  
 8CuO, K<sub>2</sub>O, As<sub>2</sub>O<sub>5</sub> Easily sol in dil acids (Lefevre)

#### Cupric sodium arsenate, CuNaAsO<sub>4</sub>

(Lefevre)  
 3CuO, Na<sub>2</sub>O, 2As<sub>2</sub>O<sub>5</sub> Very sol in dil acids (Lefevre)  
 2Cu(AsO<sub>4</sub>), NaHAsO<sub>4</sub>+5H<sub>2</sub>O Ppt (Hirsch, C C 1891, I 15)  
 6Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, 2NaH<sub>2</sub>AsO<sub>4</sub>, Na<sub>2</sub>HAsO<sub>4</sub>+13½H<sub>2</sub>O, or 16H<sub>2</sub>O Ppt (Hirsch)  
 3Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, Na<sub>2</sub>HAsO<sub>4</sub>+9½H<sub>2</sub>O Ppt (Hirsch)  
 4Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, NaHAsO<sub>4</sub>+11H<sub>2</sub>O Ppt (Hirsch)

#### Cupric uranyl arsenate, Cu(UO<sub>2</sub>)(AsO<sub>4</sub>)<sub>2</sub>+8H<sub>2</sub>O

(Werthier, A 68 312)  
 Min *Zeunerite*

#### Cupric vanadium arsenate,

Cu(VO)<sub>2</sub>H(AsO<sub>4</sub>)<sub>2</sub>+3H<sub>2</sub>O

See Arseniovanadate, cupric

#### Cupric arsenate ammonia, (3NH<sub>3</sub>+4H<sub>2</sub>O

Insol in cold or hot H<sub>2</sub>O (Daour, J pr 37 485)  
 2CuO, As<sub>2</sub>O<sub>5</sub>, 4NH<sub>3</sub>+3H<sub>2</sub>O I comp by H<sub>2</sub>O (Schiff, A 123 42)

#### Cupric arsenate calcium carbonate, 5CuO, As<sub>2</sub>O<sub>5</sub>, CaCO<sub>3</sub>+4H<sub>2</sub>O, or 9H<sub>2</sub>O

Min *Tyrolite* Easily sol in acids, and NH<sub>4</sub>OH+Aq

#### Cupric arsenate sodium chloride, 2Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, NaCl+7½H<sub>2</sub>O

Decomp by hot H<sub>2</sub>O (Hirsch, Dissert 1891)  
 3Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, 2NaCl+13½H<sub>2</sub>O  
 +17½H<sub>2</sub>O (Hirsch, l c)  
 5Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, 3NaCl+23H<sub>2</sub>O (Hirsch)

#### Didymium arsenate, D<sub>12</sub>H<sub>5</sub>(AsO<sub>4</sub>)<sub>4</sub>

Ppt Insol in H<sub>2</sub>O, sl sol in weak acids (Marignac, A ch (3) 38 164)  
 5D<sub>12</sub>(AsO<sub>4</sub>)<sub>2</sub>, As<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O P

#### Glucinum arsenate, Gl<sub>3</sub>(AsO<sub>4</sub>)<sub>3</sub>

Insol in H<sub>2</sub>O, sol in H<sub>3</sub>AsO<sub>4</sub>+Aq (Berzelius)

#### Glucinum hydrogen arsenate, GlHAsO<sub>4</sub>

Obtained in impure state by heating As<sub>2</sub>O<sub>5</sub> with Gl(OH)<sub>3</sub> in a sealed tube at 220° (Bleyer, Z anorg 1912, 75 287)

#### Glucinum tetrahydrogen arsenate, GlH<sub>4</sub>(AsO<sub>4</sub>)<sub>2</sub>

Very hygroscopic (Bleyer, Z anorg 1912, 75 287)

#### Glucinum potassium arsenate, KGlAsO<sub>4</sub>, ½GlO+5H<sub>2</sub>O

Unstable Amorphous Easily hydrolyzed, giving more basic salts (Bleyer, Z anorg 1912, 75 289)

#### Glucinum sodium arsenate, NaGlAsO<sub>4</sub>, ½GlO+6H<sub>2</sub>O

Unstable Easily hydrolyzed (Bleyer, Z anorg 1912, 75 290)

#### Iron (ferrous) arsenate, Fe<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>+6H<sub>2</sub>O (?)

Ppt Sl sol in NH<sub>4</sub>OH+Aq Insol in (NH<sub>4</sub>)<sub>3</sub>AsO<sub>4</sub>+Aq or other NH salts+Aq (Wittstein)  
 +8H<sub>2</sub>O Min *Symplectite* Sl in HCl+Aq

#### Iron (ferric) arsenate, basic, 16FeO<sub>3</sub>, As<sub>2</sub>O<sub>5</sub>+24H<sub>2</sub>O

Insol in NH<sub>4</sub>OH+Aq (Berzelius)  
 2Fe<sub>2</sub>O<sub>3</sub>, As<sub>2</sub>O<sub>5</sub>+12H<sub>2</sub>O Insol in NH<sub>4</sub>OH+Aq  
 3Fe<sub>2</sub>O<sub>3</sub>, 2As<sub>2</sub>O<sub>5</sub>  
 3Fe<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>, Fe<sub>2</sub>O<sub>6</sub>H<sub>6</sub>+12H<sub>2</sub>O Min *Pharmacosiderite* Easily sol in acids, decomp by KOH+Aq

**Iron (ferric) arsenate,  $\text{Fe}_2\text{O}_3, \text{As}_2\text{O}_5$** 

Ppt Insol in  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$   
Sol in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3$  (Metzke,  
Z anorg 1898, 19 473)

+4 $\text{H}_2\text{O}$  Min *Scorodite* Easily sol in  
 $\text{HCl} + \text{Aq}$ , insol in  $\text{HNO}_3 + \text{Aq}$   
+8 $\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  When freshly  
pptd, sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in  $\text{HCl}$ , or  
 $\text{HNO}_3 + \text{Aq}$  Insol in  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4$   
salts +  $\text{Aq}$  (Wittstein)

Sol in warm  $\text{H}_2\text{SO}_3 + \text{Aq}$  or  $(\text{NH}_4)_2\text{SO}_3 +$   
 $\text{Aq}$  (Berthier, A ch (3) 7 79)

**Iron (ferric) arsenate, acid,  $\text{Fe}_2\text{O}_3, 3\text{As}_2\text{O}_5$** 

+16  $7\text{H}_2\text{O}$   
Ppt, sl sol in acids with a yellow color, and  
in  $\text{NH}_4\text{OH} + \text{Aq}$  with a red color (Metzke,  
Z anorg 1898, 19 476)

2 $\text{Fe}_2\text{O}_3, 3\text{As}_2\text{O}_5 + 12\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  or  
 $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$

Sol in mineral acids

Sol only in conc  $\text{H}_2\text{AsO}_4 + \text{Aq}$

Sol in  $(\text{NH}_4)_3\text{AsO}_4$ , and other  $\text{NH}_4$  salts  
+  $\text{Aq}$  (Wittstein)

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
+22 $\frac{1}{2}\text{H}_2\text{O}$  Ppt Sl sol in acids with  
a yellow color, and in  $\text{NH}_4\text{OH} + \text{Aq}$  with a red  
color (Metzke, Z anorg 1898, 19 475)

**Iron (ferroferric) arsenate, 6 $\text{FeO}$ , 3 $\text{Fe}_2\text{O}_3$ , 4 $\text{As}_2\text{O}_5 + 32\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  Decomp  
by  $\text{KOH} + \text{Aq}$  (Wittstein, J B 1866 243)

**Iron (ferric) lead arsenate, 5 $\text{Fe}_2(\text{AsO}_4)_2$ ,  $\text{Pb}_3(\text{AsO}_4)_2$** 

Min *Carmine Spar Carminite* Sol in  
acids,  $\text{KOH} + \text{Aq}$  dissolves out  $\text{As}_2\text{O}_5$  (Sand-  
berger)

**Iron (ferric) potassium arsenate, 2 $\text{Fe}_2\text{O}_3$ , 3 $\text{K}_2\text{O}$ , 3 $\text{As}_2\text{O}_5$** 

Not attacked by boiling  $\text{H}_2\text{O}$ , easily sol in  
dil acids (Lefèvre)

$\text{Fe}_2\text{O}_3, \text{K}_2\text{O}, 2\text{As}_2\text{O}_5$  (Lefèvre)

**Iron (ferric) sodium arsenate,  $\text{Fe}_2\text{O}_3, \text{Na}_2\text{O}$ , 2 $\text{As}_2\text{O}_5$** 

(Lefèvre)

2 $\text{Fe}_2\text{O}_3, 3\text{Na}_2\text{O}, 3\text{As}_2\text{O}_5$  (Lefèvre)

**Lanthanum arsenate,  $\text{La}_2\text{H}_3(\text{AsO}_4)_3$** 

(Fierichs and Smith)

Doubtful (Cleve, B 11 910)

**Lead arsenate, basic, 15 $\text{PbO}, 2\text{As}_2\text{O}_5$  (?)**

Ppt (Strömholm Z anorg 1904, 38 446)

**Lead arsenate,  $\text{Pb}_3(\text{AsO}_4)_2$** 

Insol in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4$  salts +  $\text{Aq}$   
(Wittstein)

Sol in 2703 5 pts  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  contain-  
ing 38 94%  $\text{HC}_2\text{H}_3\text{O}_2$  (Bertrand, Monit  
Scient (3) 10 477)

Sol in sat  $\text{NaCl} + \text{Aq}$  (Becquerel, C R  
20 1523)

Not pptd in presence of  $\text{Na}$  citrate  
(Spiller)

**Lead pyroarsenate,  $\text{Pb}_2\text{As}_2\text{O}_7$** 

Insol in  $\text{H}_2\text{O}$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  Sol in  
 $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$  (Rose)

Decomp by cold  $\text{H}_2\text{O}$  (Lefèvre)

+ $\text{H}_2\text{O} = \text{PbHAsO}_4$  Ppt (Salkowsky, J  
pr 104 109)

**Lead potassium arsenate,  $\text{PbKAsO}_4$** 

(Lefèvre, A ch (6) 27 5)

**Lead sodium arsenate,  $\text{PbNaAsO}_4$** 

(Lefèvre)

4 $\text{PbO}, 2\text{Na}_2\text{O}, 3\text{As}_2\text{O}_5$  Superficially de-  
comp by cold  $\text{H}_2\text{O}$  (Lefèvre)

**Lead arsenate chloride, 3 $\text{Pb}_3(\text{AsO}_4)_2, \text{PbCl}_2$** 

Sol in dil  $\text{HNO}_3 + \text{Aq}$  (Lechartier)

Min *Mimetite* Sol in  $\text{HNO}_3$ , and  $\text{KOH} +$   
 $\text{Aq}$

**Lithium arsenate,  $\text{Li}_3\text{AsO}_4$** 

Ppt Sol in dil acids and in  $\text{HC}_2\text{H}_3\text{O}_2 +$   
 $\text{Aq}$  (de Schulten, Bull Soc (3) 1 479)

$\text{LiH}_2\text{AsO}_4 + \frac{3}{2}\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  into  
 $\text{H}_2\text{AsO}_4$  and  $\text{Li}_3\text{AsO}_4$  (Rammelsberg, Pogg  
128 311)

**Magnesium arsenate,  $\text{Mg}_3(\text{AsO}_4)_2$** 

Ppt

Insol in methyl acetate (Naumann, B  
1909, 42 3790)

+7 $\text{H}_2\text{O}$ , +8 $\text{H}_2\text{O}$ , +10 $\text{H}_2\text{O}$ , and +22 $\text{H}_2\text{O}$   
(Grühl, Dissert 1897)

+8 $\text{H}_2\text{O}$  Min *Hörnseite* Insol in  $\text{H}_2\text{O}$ ,  
easily sol in acids

**Magnesium hydrogen arsenate,  $\text{MgHAsO}_4$** 

+ $\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (de Schulten, C  
R 100 263)

+5 $\text{H}_2\text{O}$  (Schiefer)

+6 $\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  1000 pts boiling  
 $\text{H}_2\text{O}$  dissolve 1 5 pts (Thompson)

Sol in  $\text{HNO}_3 + \text{Aq}$  before ignition, but  
insol in acids after ignition (Graham, A 29  
29)

+7 $\text{H}_2\text{O}$  Min *Roesslerite* Sol in  $\text{HCl} +$   
 $\text{Aq}$

**Magnesium tetrahydrogen arsenate,  $\text{MgH}_4(\text{AsO}_4)_2$** 

Very deliquescent, sol in  $\text{H}_2\text{O}$  (Schiefer)

**Magnesium potassium arsenate,  $\text{MgKAsO}_4$** 

Insol in, but decomp by cold  $\text{H}_2\text{O}$  (Rose)

Easily sol in dil acids (Lefèvre)

+7 $\text{H}_2\text{O}$  (Kinkeln, Dissert, 1893)

4 $\text{MgO}, 2\text{K}_2\text{O}, 3\text{As}_2\text{O}_5$  Not attacked by  
boiling  $\text{H}_2\text{O}$ , slowly sol in dil acids (Le-  
fèvre)

**Magnesium potassium hydrogen arsenate,  $\text{KMgH}(\text{AsO}_4)_2 + x\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  (Kinkeln, D essert  
1893)

$\text{Mg}_3\text{KH}_2(\text{AsO}_4)_3 + 5\text{H}_2\text{O}$  (Chevron and Drouhe, J B 1888, 523)

**Magnesium potassium sodium arsenate,**  
 $\text{Mg}_2\text{KNa}(\text{AsO}_4)_2 + 10\text{H}_2\text{O}$   
 (Kinkelin, Dissert 1883)

**Magnesium sodium arsenate,**  $\text{Mg}_2\text{NaAsO}_4$   
 Insol in  $\text{H}_2\text{O}$  Very sl sol in dil acids (Lefèvre)  
 $4\text{MgO}, 2\text{Na}_2\text{O}, 3\text{As}_2\text{O}_5$  (Lefèvre)

**Magnesium vanadium arsenate,**  
 $\text{MgH}_2(\text{VO}_2)_2(\text{AsO}_4)_2 + 9\text{H}_2\text{O}$  and  
 $\text{MgHAsO}_4, 2(\text{VO}_2)_2\text{H}_2\text{AsO}_4 + 9\text{H}_2\text{O}$   
*See Arseniovanadate, magnesium*

**Magnesium arsenate chloride,**  $\text{Mg}_3(\text{AsO}_4)_2$ ,  
 $\text{MgCl}_2$   
 Insol in  $\text{H}_2\text{O}$ , sol in dil  $\text{HNO}_3 + \text{Aq}$   
 (Lechartier, C R 65 172)

**Magnesium arsenate fluoride,**  $\text{Mg}_3(\text{AsO}_4)_2$ ,  
 $\text{MgF}_2$   
 Insol in  $\text{H}_2\text{O}$ , sol in dil  $\text{HNO}_3 + \text{Aq}$   
 (Lechartier)

**Manganous arsenate, basic,**  $6\text{MnO}, \text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$  (?)

Min *Chondroarsenate* Easily and completely sol in dil  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$

**Manganous arsenate,**  $\text{Mn}_3(\text{AsO}_4)_2 + \text{H}_2\text{O}$   
 Insol in  $\text{H}_2\text{O}$ , sl sol in acids (Coloriano, C R 103 273)  
 $5\text{MnO}, 2\text{As}_2\text{O}_5 + 5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Coloriano)

$2\text{MnO}, \text{As}_2\text{O}_5$  Sl decomp by cold  $\text{H}_2\text{O}$ , but rapidly on heating (Lefèvre)  
 $\text{MnHAsO}_4 + \text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}$  into  $5\text{MnO}, 2\text{As}_2\text{O}_5 + 5\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{H}_3\text{AsO}_4 + \text{Aq}$

**Manganous tetrahydrogen arsenate,**  
 $\text{MnH}_4(\text{AsO}_4)$   
 Deliquescent Easily sol in  $\text{H}_2\text{O}$  (Schiefer)

**Manganous potassium arsenate,**  $\text{MnKAsO}_4$   
 (Lefèvre, A ch (6) 27 5)

**Manganous sodium arsenate,**  $\text{MnNaAsO}_4$   
 Very sol in dil acids (Lefèvre)  
 $2\text{MnO}, 4\text{Na}_2\text{O}, 3\text{As}_2\text{O}_5$  Not attacked by boiling  $\text{H}_2\text{O}$ , very sol in dil acids (Lefèvre)

**Manganous arsenate chloride,**  $\text{Mn}_3(\text{AsO}_4)_2$ ,  
 $\text{MnCl}$   
 Insol in  $\text{H}_2\text{O}$ , sol in dil  $\text{HNO}_3 + \text{Aq}$   
 (Lechartier, A 58 259)

**Manganic arsenate,**  $\text{Mn}_2(\text{AsO}_4)_2 + 2\text{H}_2\text{O}$   
 Insol in  $\text{H}_2\text{O}$ , sol in acids

**Mercurous arsenate,**  $(\text{Hg}_2)_3(\text{AsO}_4)_2$   
 Insol in  $\text{H}_2\text{O}$ , difficultly sol in acids (Coloriano, C R 103 273) Ppt (Haack, C C 1890, II 736)

$\text{Hg}(\text{AsO}_3)_2$  Insol in  $\text{H}_2\text{O}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , alcohol Decomp by cold  $\text{HCl} + \text{Aq}$  Sl sol in cold  $\text{HNO}_3 + \text{Aq}$ , from which it is precipitated by  $\text{NH}_4\text{OH}$  as  $\text{Hg}_2\text{HASO}_4$  (Simon Pogg 41 424)

**Mercurous hydrogen arsenate,**  $\text{Hg}_2\text{HASO}_4$

Insol in  $\text{H}_2\text{O}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp by cold  $\text{HCl} + \text{Aq}$ , sol in cold  $\text{HNO}_3 + \text{Aq}$  without decomp, very sl sol with decomp in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Simon, Pogg 424)

**Mercuric arsenate,**  $\text{Hg}_3(\text{AsO}_4)_2$

Ppt Sol in  $\text{H}_3\text{AsO}_4$  or  $\text{HNO}_3 + \text{Aq}$  (Bergemann) Very sl sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HCl} + \text{Aq}$  Sl sol in  $\text{HNO}_3 + \text{Aq}$  Insol in  $\text{H}_3\text{AsO}_4 + \text{Aq}$  (Haack, C C 1890, II 73)

**Mercurous silver arsenate,**  $\text{Hg}_2\text{AgAsO}_4$

Sol in hot conc  $\text{HNO}_3$  (Jacobsen, B Soc 1909, (4) 5 948)

**Mercurous arsenate nitrate,**  $\text{Hg}_3\text{AsO}_4, \text{HgNO}_3 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  or  $\text{HC}_2\text{H}_3\text{O}_2$ , sol in  $\text{HNO}_3 + \text{Aq}$  (Simon, Pogg 41 424)  
 $3\text{Hg}_3\text{AsO}_4, 2\text{HgNO}_3, 2\text{Hg}_2\text{O}$  Ppt (Haack)

**Molybdenum arsenate**

Ppt

**Nickel arsenate, basic,**  $5\text{NiO}, \text{As}_2\text{O}_5$

Min — (Bergemann)  
 $\text{Ni}(\text{NiOH})\text{AsO}_4$  Difficultly attacked by acids or alkalis (Coloriano, Bull Soc 2) 45 241)  
 $5\text{NiO}, 2\text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$  As above

**Nickel arsenate,**  $\text{Ni}_3(\text{AsO}_4)_2$

Min — (Bergemann)  
 $+x\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in  $\text{H}_3\text{AsO}_4$ , and conc mineral acids Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$

$+2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , difficultly sol in acids (Coloriano, Bull Soc 45 241)

$+8\text{H}_2\text{O}$  Min *Nickel-bloom, Annabergite*  
 Easily sol in acids  
 $\text{NiHAsO}_4 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Difficultly attacked by acids (Coloriano, C R 103 274)

**Nickel potassium arsenate,**  $12\text{NiO}, 3\text{K}_2\text{O}, 5\text{As}_2\text{O}_5$

(Lefèvre)  
 $2\text{NiO}, \text{K}_2\text{O}, \text{As}_2\text{O}_5$  Rapidly sol in dil acids (Lefèvre)

**Nickel sodium arsenate,**  $\text{NiNaAsO}_4$

Very slowly sol in dil acids (Lefèvre)  
 $4\text{NiO}, 2\text{Na}_2\text{O}, 3\text{As}_2\text{O}_5$  (Lefèvre)

**Nickel arsenate ammonia,**

$\text{Ni}_3(\text{AsO}_4)_2, \text{NH}_3 + 7\text{H}_2\text{O}$   
 $\text{Ni}_3(\text{AsO}_4)_2, 2\text{NH}_3 + 6\text{H}_2\text{O}$   
 $\text{Ni}_3(\text{AsO}_4)_2, 3\text{NH}_3 + 5\text{H}_2\text{O}$  (Ducru, I 1900, 131 703)

**Palladium arsenate (?)**

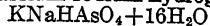
Ppt

**Platinum arsenate (?)**Ppt Sol in  $\text{HNO}_3 + \text{Aq}$ **Potassium arsenate,  $\text{K}_3\text{AsO}_4$** Deliquescent Very sol in  $\text{H}_2\text{O}$  (Graham, Pogg 32 47)

Insol in ethyl acetate (Naumann, B 1904, 37 3601)

**Potassium hydrogen arsenate,  $\text{K}_2\text{HAsO}_4$** Sol in  $\text{H}_2\text{O}$ **Potassium dihydrogen arsenate,  $\text{KH}_2\text{AsO}_4$** Sol in 53 pts  $\text{H}_2\text{O}$  at  $6^\circ$ , forming a solution of sp gr 1.1134 Much more sol in hot  $\text{H}_2\text{O}$  Insol in alcohol

Sol in 26 666 pts boiling conc alcohol (Wenzel)

**Potassium sodium hydrogen arsenate,**Sol in  $\text{H}_2\text{O}$  $\text{K}_2\text{Na}_2\text{H}_6(\text{AsO}_4)_4 + 9\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , and not easily decomp thereby into its constituents (Filhol and Senderens, C R 95 343)**Potassium strontium arsenate,  $\text{K}_2\text{SrAsO}_4$** 

(Lefevre, C R 108 1058)

**Potassium vanadium arsenate,  $\text{K}(\text{VO})_2\text{AsO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$** 

See Arseniovanadate, potassium

**Potassium zinc arsenate,  $\text{KZnAsO}_4$** 

(Lefevre)

**Potassium arsenate sulphate**

See Arseniosulphate, potassium

**Rhodium arsenate (?)**

Ppt

**Rubidium metaarsenate,  $\text{RbAsO}_3$** Sol in  $\text{H}_2\text{O}$  (Bouchonnet, C R 1907 144 642)**Rubidium arsenate,  $\text{Rb}_3\text{AsO}_4 + 2\text{H}_2\text{O}$** Very hygroscopic, sol in  $\text{H}_2\text{O}$  to give an alkaline solution Absorbs  $\text{CO}$  from the air (Bouchonnet, l c)**Rubidium pyroarsenate,  $\text{Rb}_4\text{AsO}_6$** 

(Bouchonnet, l c)

**Rubidium hydrogen arsenate,  $\text{RbHAsO}_4 + \text{H}_2\text{O}$** Absorbs  $\text{CO}$  from the air Very hygroscopic, sol in  $\text{H}_2\text{O}$  Insol in alcohol (Bouchonnet, l c)**Rubidium dihydrogen arsenate,  $\text{RbH}_2\text{AsO}_4$** Not hygroscopic Very sol in  $\text{H}_2\text{O}$ , aq solution is acid to litmus (Bouchonnet, l c)**Silver arsenate,  $\text{Ag}_3\text{AsO}_4$** Insol in  $\text{H}_2\text{O}$  Sol in acids, easily sol in  $\text{H}_3\text{AsO}_4 + \text{Aq}$  (Joly, C R 103 1071)11  $\text{H}_2\text{O}$  dissolves 0.0085 g  $\text{Ag}_3\text{AsO}_4$  at  $20^\circ$  (Whitby, Z anorg 1910, 67 108)Much less sol in  $\text{H}_3\text{AsO}_4$  than  $\text{Ag}_3\text{PO}_4$  (Graham)Sol in  $\text{H}_2\text{OH} + \text{Aq}$  (Scheele)Sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  Insol in  $\text{NH}_4$  sulphate nitrate, or succinate +  $\text{Aq}$  (Wittstein)Very sl sol in  $\text{H}_4\text{NO}_3 + \text{Aq}$ , more easily in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Graham)Sol in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ , but not so easily as  $\text{Ag}_3\text{PO}_4$ Not pptd in presence of  $\text{Na}$  citrate (Spiller)Insol in liquid  $\text{NH}_3$  (Gore Am Ch J 1898, 20 829)**Silver hydrogen arsenate,  $\text{Ag}_2\text{HAsO}_4$** Decomp by  $\text{H}_2\text{O}$ , with formation of  $\text{Ag}_3\text{AsO}_4$  (Setterberg, Berz J B 26 208) $\text{AgHAsO}_4$  Decomp by  $\text{H}_2\text{O}$  (Joly, C R 103 1071) $\text{Ag}_2\text{O}, 2\text{As}_2\text{O}_3$  Decomp by  $\text{H}_2\text{O}$  Rather sl sol in  $\text{HNO}_3 + \text{Aq}$  Very easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Hurtzig and Geuther, A 111 168)**Silver arsenate ammonia,  $\text{Ag}_3\text{AsO}_4 \cdot 4\text{NH}_3$** Easily sol in  $\text{H}_2\text{O}$  (Widmann, Bull Soc (2) 20 64)**Silver arsenate sulphate,  $3\text{AgO} \cdot \text{AsO}_3 \cdot \text{SO}_3$** Decomp by  $\text{H}_2\text{O}$  with separation of  $\text{Ag}_3\text{AsO}_4$  decomp by dil  $\text{HNO}_3 + \text{Aq}$  (Setterberg, Berz J B 26 209)**Sodium arsenate,  $\text{Na}_2\text{AsO}_4 + 12\text{H}_2\text{O}$** Permanent in dry air Sol in 3.57 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Graham) 100 pts  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 28 pts  $\text{NaAsO}_4 - 12\text{H}_2\text{O}$  (Berzelius) Sol in 3.75 pts  $\text{H}_2\text{O}$  at  $17^\circ$  or 100 pts  $\text{H}_2\text{O}$  at  $17^\circ$  dissolve 26.7 pts or sat  $\text{Na}_2\text{AsO}_4 + \text{Aq}$  at  $17^\circ$  contains 21.1%  $\text{NaAsO}_4 + 12\text{H}_2\text{O}$  or 10.4%  $\text{NaAsO}_4$  and has sp gr 1.1186 (Schiff, A 113 550)Melts in crystal  $\text{H}_2\text{O}$  at  $55^\circ$ Sp gr of  $\text{NaAsO}_4 - \text{Aq}$  at  $17^\circ$   
 $c_c = c_{\text{NaAsO}_4 - 12\text{H}_2\text{O}}$ 

$c_c$	Sp gr	$c_c$	Sp	$c_c$	Sp
1	1.0033	9	1.0490	17	1.0943
2	1.0107	10	1.0547	18	1.1005
3	1.0161	11	1.0603	19	1.1061
4	1.0215	12	1.0659	20	1.1121
5	1.0270	13	1.0716	21	1.1179
6	1.0325	14	1.0775	22	1.1238
7	1.0380	15	1.0830		
8	1.0435	16	1.0887		

(Schiff, calculated by Gerlach Z anal 8 289)

Arsenate of soda dissolves in 1 pt boiling alcohol (Wenzel)

 $+41\text{H}_2\text{O}$  (Hall Chem Soc 51 93) $+10\text{H}_2\text{O}$  (Hall Chem Soc 51 93)

**Arsenioarsenic acid**,  $3\text{As}_2\text{O}_3$ ,  $2\text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Joly, C R 100 1221)

$3\text{As}_2\text{O}_3$ ,  $\text{As}_2\text{O}_5 + \text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Joly)

$\text{As}_2\text{O}_3$ ,  $\text{As}_2\text{O}_5 + \text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Joly)

See also *Arsenic trioxide pentoxide*

### Arseniochromic acid

**Ammonium arseniochromate**,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $4\text{CrO}_3 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Friedheim and Mozkin, Z anorg 1894, 6 280)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $8\text{CrO}_3$  Decomp by recryst from  $\text{H}_2\text{O}$  (Friedheim and Mozkin, Z anorg 1894, 6 281)

**Potassium arseniochromate**,  $2\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $4\text{CrO}_3$

Decomp by recryst from  $\text{H}_2\text{O}$  (Friedheim and Mozkin, Z anorg 1894, 6 275)

$2\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $4\text{CrO}_3 + \text{H}_2\text{O}$  Decomp by recryst from  $\text{H}_2\text{O}$  (Friedheim and Mozkin, l c)

**Arseniomolybdic acid**,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 10\text{H}_2\text{O}$

By recryst from  $\text{H}_2\text{O}$  the comp with  $18\text{H}_2\text{O}$  is formed (Pufahl, Dissert 1888)

+  $16\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Debray)  
+  $18\text{H}_2\text{O}$  Completely sol in  $\text{H}_2\text{O}$  Sp gr of sat solution at  $18^\circ = 2.21$  Easily sol in abs alcohol Insol in  $\text{CS}_2$ , liq hydrocarbons and  $\text{CHCl}_3$  (Pufahl, l c)

$\text{As}_2\text{O}_5$ ,  $7\text{MoO}_3 + 14\text{H}_2\text{O}$  (Seyberth, B 7 391)

$\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 28\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  Sp gr of sat solution at  $18^\circ = 2.45$  and 1 cc contains 2.16 g acid Easily sol in absolute alcohol insol in  $\text{CS}_2$  liquid hydrocarbons and  $\text{CHCl}_3$  (Pufahl, l c)

Sol in ether with subsequent separation into two layers See Phosphotungstic acid (Diedrichs B 20 1122)

+  $5\text{H}_2\text{O}$  Fluorescent When recryst comp with  $28\text{H}_2\text{O}$  is formed (Pufahl, l c)

$\text{As}_2\text{O}_5$ ,  $20\text{MoO}_3 + 27\text{H}_2\text{O}$  Sl sol in  $\text{HNO}_3$  + Aq (Debray, C R 78 1408)

**Ammonium arseniomolybdate**,  $(\text{NH}_4)_3\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{MoO}_3 + \text{H}_2\text{O}$

(Friedheim, Z anorg 1894, 6 28)

+  $4\text{H}_2\text{O}$  (Friedheim, l c)

$(\text{NH}_4)_3\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 2\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$  sol in acids (Debray)

+  $4\text{H}_2\text{O}$  Sl sol in cold very easily sol in hot  $\text{H}_2\text{O}$  (Pufahl, l c)

$2(\text{NH}_4)_3\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 6\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  Cannot be recryst therefrom (Pufahl)

+  $12\text{H}_2\text{O}$  (Friedheim, Z anorg 1894, 6 31)

$3(\text{NH}_4)_3\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 4\text{H}_2\text{O}$  (Friedheim, l c)

+  $8\text{H}_2\text{O}$  (Friedheim, l c)

$(\text{NH}_4)_2\text{O}$ ,  $2\text{H}_2\text{O}$ ,  $7\text{MoO}_3$ ,  $\text{As}_2\text{O}_5 + 4\text{H}_2\text{O}$

Sol in hot  $\text{H}_2\text{O}$  (Seyberth, B 7 391)

Not obtained (Pufahl)

$7(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ ,  $14\text{MoO}_3 + 28\text{H}_2\text{O}$  (Friedheim, l c)

$5(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $16\text{MoO}_3 + 5\text{H}_2\text{O}$  (Friedheim, Z anorg 1894, 6 31)

$5(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $16\text{MoO}_3 + 9\text{H}_2\text{O}$  Neely insol in cold, sol in boiling  $\text{H}_2\text{O}$  Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Gibbs, Am Ch J 3 4)

+  $12\text{H}_2\text{O}$  (Pufahl, l c)

$2(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 17\text{H}_2\text{O}$  (Pufahl, l c)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 14\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  and alcohol (Kehrmann, Z anorg 1894, 7 421)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $20\text{MoO}_3$  Easily sol in  $\text{H}_2\text{O}$  (Debray, C R 78 1408)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $24\text{MoO}_3 + 12\text{H}_2\text{O}$  composed by  $\text{H}_2\text{O}$ , especially when boiled

Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , less easily sol in warm  $\text{H}_2\text{SO}_4$  and boiling  $\text{H}_3\text{AsO}_4 + \text{Aq}$

Sl sol in molybdic acid + Aq,  $\text{HNO}_3$ , and conc  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Pufahl, l c)

**Barium arseniomolybdate**,  $\text{BaO}$ ,  $\text{As}_2\text{O}_5$

$6\text{MoO}_3 + 10\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  Partially decomp by boiling (Pufahl, l c)

$3\text{BaO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  Sl sol in  $\text{H}_2\text{O}$  (Pufahl, l c)

$3\text{BaO}$ ,  $\text{As}_2\text{O}_5$ ,  $7\text{MoO}_3$  Ppt (Seyberth)

$3\text{BaO}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3$  Decomp by  $\text{H}_2\text{O}$  (Pufahl, l c)

**Cadmium arseniomolybdate**,  $\text{CdO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$

(Pufahl)

$3\text{CdO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 33\text{H}_2\text{O}$  (Pufahl)

**Cæsium arseniomolybdate**,  $\text{CsO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$

Sl sol in  $\text{H}_2\text{O}$  (Pufahl, l c)

$4\text{CsO}$ ,  $\text{As}_2\text{O}_5$ ,  $26\text{MoO}_3 + 15\text{H}_2\text{O}$  ppt (Lippmann, Z anorg 1910, 65 216)

**Calcium arseniomolybdate**,  $\text{CaO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 10\text{H}_2\text{O}$

Rather difficultly sol in cold  $\text{H}_2\text{O}$  (Pufahl, l c)

$3\text{CaO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  As Ppt salt (Pufahl, l c)

$3\text{CaO}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 32\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  Solution sat at  $18^\circ$  has sp gr = 2.163 (Pufahl, l c)

**Cobalt arseniomolybdate**,  $\text{CoO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$

(Pufahl)

$3\text{CoO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 33\text{H}_2\text{O}$  (Pufahl)

**Cupric arseniomolybdate**,  $\text{CuO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$  (Pufahl)

$3\text{CuO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 34\text{H}_2\text{O}$  (Pufahl)

**Lithium arseniomolybdate**,  $\text{Li}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 14\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Pufahl, *l c*)

$3\text{Li}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 34\text{H}_2\text{O}$  Solution sat at  $15^\circ$  has sp gr of 2.481 (Pufahl, *l c*)

**Magnesium arseniomolybdate**,  $\text{MgO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 13\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Pufahl, *l c*)

$3\text{MgO}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 36\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Pufahl, *l c*)

**Manganese arseniomolybdate**,  $\text{MnO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$

(Pufahl)

$3\text{MnO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 33\text{H}_2\text{O}$  (Pufahl)

**Nickel arseniomolybdate**,  $\text{NiO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$

(Pufahl)

$3\text{NiO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 34\text{H}_2\text{O}$  (Pufahl)

**Potassium arseniomolybdate**,  $\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{MoO}_3 + 5\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Friedheim, Z anorg 2 314)

$\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 5\text{H}_2\text{O}$  Sol in hot  $\text{H}_2\text{O}$  without decomp (Friedheim, Z anorg 1892, 2 330)

$\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 25\text{H}_2\text{O}$  Easily sol in cold  $\text{H}_2\text{O}$  Decomp on dilution (Pufahl, *l c*)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 26\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Pufahl, *l c*)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $20\text{MoO}_3$  Insol in  $\text{H}_2\text{O}$  (Debray, C R 78 1408)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $24\text{MoO}_3 + 12\text{H}_2\text{O}$  Somewhat sol in  $\text{H}_2\text{O}$  acidified with  $\text{HNO}_3$  (Pufahl, *l c*)

**Rubidium arseniomolybdate**,  $3\text{RbO}$ ,  $3\text{AsO}_3$ ,  $5\text{MoO}_3 + 9\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Ephraim, Z anorg 1910, 65 241)

$\text{Rb}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  Sl sol in  $\text{H}_2\text{O}$  (Pufahl, *l c*)

$4\text{RbO}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 40\text{H}_2\text{O}$  Pptd (Ephraim, Z anorg 1910, 65 241-4)

**Silver arseniomolybdate**,  $3\text{AgO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$

(Pufahl, Leipzig 1888)

$6\text{AgO}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 22\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  Very sol in  $\text{NH}_4\text{OH}$  and in dil  $\text{HNO}_3$  (Pufahl, *l c*)

$7\text{AgO}$ ,  $2\text{As}_2\text{O}_5$ ,  $36\text{MoO}_3 + 30\text{H}_2\text{O}$  Sl sol in cold, easily sol in hot  $\text{H}_2\text{O}$  strongly acidified with  $\text{HNO}_3$  (Pufahl, *l c*)

**Sodium arseniomolybdate**,  $\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{MoO}_3 + 5\text{H}_2\text{O}$

(Friedheim, Z anorg 1892, 2 357)

$\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 12\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  Solution sat at  $19.8^\circ$  has sp gr = 1.678 (Friedheim, *l c*)

$3\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O} + 12\text{H}_2\text{O}$ , and  $+13\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$  (Pufahl, *l c*)

$3\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 24\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Pufahl, *l c*)

$+30\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$  (Pufahl, *l c*)

**Strontium arseniomolybdate**,  $\text{SrO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 10\text{H}_2\text{O}$

As Ba salt (Pufahl, *l c*)

$3\text{SrO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  As Ba salt (Pufahl, *l c*)

$3\text{SrO}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 32\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Pufahl, *l c*)

**Thallium arseniomolybdate**,  $6\text{Tl}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 2\text{H}_2\text{O}$

Ppt (Pufahl)

$3\text{Tl}_2\text{O}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 3\text{H}_2\text{O}$  Ppt (Pufahl)

**Zinc arseniomolybdate**,  $\text{ZnO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$

(Pufahl)

$3\text{ZnO}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3 + 37\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Pufahl)

### Arseniophosphovanadicotungstic acid

**Ammonium arseniophosphovanadicotungstate**  
69V

Sol in  
(Rogers, J Am Chem Soc 1903, 25 314)

### Arseniophosphovanadocovanadotungstic acid

**Ammonium arseniophosphovanadocovanadotungstate**,  $99(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ ,  $12\text{P}_2\text{O}_5$ ,  $6\text{V}_2\text{O}_5$ ,  $66\text{V}_2\text{O}_5$ ,  $191\text{WO}_3 + 522\text{H}_2\text{O}$

Sl sol in cold  $\text{H}_2\text{O}$  (Rogers, J Am Chem Soc 1903, 25 314)

### Arseniophosphovanadotungstic acid

**Ammonium arseniophosphovanadotungstate**,  $82(\text{NH}_4)_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ ,  $12\text{P}_2\text{O}_5$ ,  $52\text{V}_2\text{O}_5$ ,  $201\text{WO}_3 + 567\text{H}_2\text{O}$

Very sol in warm  $\text{H}_2\text{O}$  Insol in organic solvents (Rogers, J Am Chem Soc 1903, 25 312)

### Arseniosulphuric acid

**Ammonium arseniosulphate**,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{SO}_3 + 3\text{H}_2\text{O}$

Cubic cryst from  $\text{H}_2\text{O}$  (Friedheim and Mozkin, Z anorg 1894, 6 290)

**Potassium arseniosulphate**,  $2\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{SO}_3 + 3\text{H}_2\text{O}$

(Friedheim and Mozkin, Z anorg 1894, 6 289)

$5\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $\text{SSO}_3 + 6\text{H}_2\text{O}$  (Friedheim and Mozkin, Z anorg 1894 6 291)



**Sodium arseniosulphate**,  $2\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{SO}_3+3\text{H}_2\text{O}$   
(Friedheim and Mozkun, Z anorg 1894, 6 290)

### Arseniotelluric acid

**Ammonium arseniotellurate**,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $\text{TeO}_3+4\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Weinland, Z anorg 1901, 28 65)  
 $4(\text{NH}_4)_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ ,  $2\text{TeO}_3+11\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Weinland)

**Sodium arseniotellurate**,  $2\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{TeO}_3+9\text{H}_2\text{O}$   
Ppt (Weinland l c)

**Arseniotungstic acid**,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $16\text{WO}_3+32\text{H}_2\text{O}=\text{H}_3\text{AsW}_8\text{O}_{28}+16\text{H}_2\text{O}$  ( $\alpha$ -anhydroarsenolutedtungstic acid)  
Sol in  $\text{H}_2\text{O}$  (Kehrmann, A 245 45)  
 $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $19\text{WO}_3$  (?) Sp gr of sat solution in  $\text{H}_2\text{O}$  is 3 279 (Fremery, B 17 296)

Is a mixture containing principally  $\text{H}_3\text{AsW}_8\text{O}_{28}+16\text{H}_2\text{O}$  (Kehrmann)  
 $\text{As}_2\text{O}_5$ ,  $18\text{WO}_3+x\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Kehrmann, Z anorg 1899, 22 292)

### Aluminum ammonium arsenotungstate

See **Aluminicoarsenotungstate**, ammonium

**Ammonium arsenotungstate**,  $4(\text{NH}_4)_2\text{O}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{WO}_3+3\text{H}_2\text{O}$

Sl sol in cold  $\text{H}_2\text{O}$  or  $\text{HNO}_3+\text{Aq}$ , easily sol in boiling  $\text{H}_2\text{O}$  (Gibbs, Proc Am Acad 16 135)

$7(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $14\text{WO}_3+17\text{H}_2\text{O}$  Very sl sol even in boiling  $\text{H}_2\text{O}$  (Fremery, l c)  
 $3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $16\text{WO}_3+16\text{H}_2\text{O}=(\text{NH}_4)_3\text{AsW}_8\text{O}_{28}+8\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Kehrmann)

$5(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $17\text{WO}_3+8\text{H}_2\text{O}$  Can be recryst from  $\text{H}_2\text{O}$  without decomp Decomp by long boiling with  $\text{H}_2\text{O}$  (Kehrmann, Z anorg 1899, 22 294)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{WO}_3+14$ , or  $18\text{H}_2\text{O}$  Very sol in cold  $\text{H}_2\text{O}$  Can be recryst from  $\text{H}_2\text{O}$  (Kehrmann, l c)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $21\text{WO}_3+x\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  Easily decomp on recryst (Kehrmann, l c)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $24\text{WO}_3+12\text{H}_2\text{O}$  More sol in  $\text{H}_2\text{O}$  than corresponding phosphotungstate (Kehrmann, l c)

**Barium arsenotungstate**,  $2\text{BaO}$ ,  $\text{As}_2\text{O}_5$ ,  $16\text{WO}_3+x\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Pechard, A ch (6) 22 262)  
 $7\text{BaO}$ ,  $\text{As}_2\text{O}_5$ ,  $22\text{WO}_3+54\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Can be recryst therefrom (Kehrmann, l c)

**Potassium arsenotungstate**,  $3\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{WO}_3$

Insol in  $\text{H}_2\text{O}$  Readily sol in alk hydroxides + Aq (Gibbs)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $16\text{WO}_3+16\text{H}_2\text{O}=\text{K}_3\text{AsW}_8\text{O}_{28}+8\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Kehrmann)

$5\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $17\text{WO}_3+22\text{H}_2\text{O}$  Scarcely sol in cold  $\text{H}_2\text{O}$  (Kehrmann, Z anorg 899, 22 295)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{WO}_3+14\text{H}_2\text{O}$  Efflorescent (Kehrmann, l c)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $19\text{WO}_3+16\text{H}_2\text{O}$  (?) Sol in  $\text{H}_2\text{O}$  (Fremery)

**Silver arsenotungstate**,  $\text{Ag}_3\text{AsW}_8\text{O}_{28}$

Insol in  $\text{H}_2\text{O}$  (Kehrmann, A 245 55) perhaps identical with—

$6\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $16\text{WO}_3+11\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Gibbs)

**Sodium arsenotungstate**,  $3\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $3\text{WO}_3+20\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Lefort, C R 92 61)

### Arsenous acid, $\text{HAsO}_2$

Solubility of  $\text{HAsO}_2$  in amyl alcohol + 1 at  $25^\circ$

$a_w$  = mol of  $\text{HAsO}_2$  in 1 l of  $\text{H}_2\text{O}$

$a_a$  = mol of  $\text{HAsO}_2$  in 1 l of amyl alcohol

$h$  = partition coefficient

$a_w$	$a_a$	$h$
0 0449	0 0082	5 48
0 0446	0 0083	5 38
0 0887	0 0164	5 41
0 0892	0 0161	5 53
0 1800	0 0324	5 55

(Auerbach, Z anorg 1903, 37 356)

Solubility of  $\text{HAsO}_2$  in sat  $\text{H}_2\text{BO}_3$  + 1 and amyl alcohol

$a_w$  = mol of  $\text{HAsO}_2$  in 1 l of  $\text{H}_2\text{O}$

$a_a$  = mol of  $\text{HAsO}_2$  in 1 l of amyl alcohol

$h$  = partition coefficient

$a_w$	$a_a$	$h$
0 0859	0 0161	5 33
0 1720	0 0321	5 35

(Auerbach, l c)

Insol in ethyl acetate (Nannum B 1904, 37 3601)

See **Arsenic trioxide**

### Arsenites

All arsenites, except those of the alkali metals, are partially or wholly insol in  $\text{H}_2\text{O}$ , but easily sol in acids, several also in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4\text{Cl}+\text{Aq}$

All basic arsenites are sol in acids except those that give an insol salt with the bases. Many are sol in excess of  $\text{As}_2\text{O}_3+\text{Aq}$

**Aluminum arsenite,  $\text{Al}_2\text{O}_3, \text{As}_2\text{O}_3$** 

Sl sol in boiling  $\text{H}_2\text{O}$  Easily sol in  $\text{NaOH} + \text{Aq}$  and in acids (Reichard, B 1894, 27 1029)

**Aluminum arsenite iodide,  $\text{AlI}_3, 6\text{As}_2\text{O}_3 + 16\text{H}_2\text{O}$** 

(Grühl, Dissert 1897)

**Ammonium arsenite,  $\text{NH}_4\text{AsO}_2$** 

Very sol in  $\text{H}_2\text{O}$  (Luynes, J pr 72 180)  
 Insol in acetone (Eidmann, C C 1899, II 1014), (Naumann, B 1904, 37 4328)  
 $(\text{NH}_4)_3\text{AsO}_3$  (?) Sol in  $\text{H}_2\text{O}$  (Stavenhagen, J pr 1895, (2) 51 11)  
 $(\text{NH}_4)_4\text{As}_2\text{O}_5$  Very sol in  $\text{H}_2\text{O}$  Insol in alcohol or ether (Stein, A 74 218)  
 Could not be obtained (Stavenhagen)

**Ammonium arsenite bromide,  $2\text{As}_2\text{O}_3, \text{NH}_4\text{Br}$** 

Sl sol in  $\text{H}_2\text{O}$  (Rudorff, B 19 2679)

**Ammonium arsenite chloride,  $\text{As}_2\text{O}_3, \text{NH}_4\text{Cl}$** 

Sl sol in  $\text{H}_2\text{O}$  Sol in warm dil  $\text{NH}_4\text{OH} + \text{Aq}$  (Rüdorff)

**Ammonium arsenite iodide,  $2\text{As}_2\text{O}_3, \text{NH}_4\text{I}$** 

Sl sol in boiling  $\text{H}_2\text{O}$  Sol in warm dil  $\text{NH}_4\text{OH} + \text{Aq}$  (Rudorff)

**Antimony arsenite (?)**

Ppt Sol in a small amount  $\text{H}_2\text{O}$ , but insol in a large quantity (Berzelius)  
 Completely sol in  $\text{KOH} + \text{Aq}$  (Reynolds)

**Barium arsenite,  $\text{Ba}(\text{AsO}_2)_2$** 

Easily sol in  $\text{H}_2\text{O}$  when recently pptd, but insol after being dried Pptd from aqueous solution by boiling (Filhol, A 68 308)

Only sl sol in  $\text{H}_2\text{O}$  (Stavenhagen, J pr 1895, (2) 51 18)

$\text{Ba}_3(\text{AsO}_4)_2$  Sl sol in cold  $\text{H}_2\text{O}$ , sol in hot  $\text{H}_2\text{O}$  and dil acids (Stavenhagen, J pr 1895, (2) 51 17)

$\text{BaH}_4(\text{AsO}_4)_3$  Ppt (Bloxum, Chem Soc 15 281)

+  $3\text{H}_2\text{O}$  Moderately sol in cold, more easily sol in hot  $\text{H}_2\text{O}$  Insol in alcohol (Perper, Dissert 1894)

$\text{Ba}_4\text{As}_2\text{O}_{11} + 2\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Stavenhagen, J pr 1895, (2) 51 18)

+  $\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  also somewhat sol in alcohol (Stein, A 74 218)

Sl sol in  $\text{H}_4\text{AsO}_4 + \text{Aq}$  und  $\text{BaO} + \text{H}_2 + \text{Aq}$  (Dumais)

Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Wickemeyer, A 41 516)

Not pptd from solutions containing  $\text{Na}$  citrate (Spiller)

$\text{BaAs}_2\text{O}_7$  Sol in  $\text{H}_2\text{O}$  Less sol in alcohol (Reichard, B 1894, 27 1033)

**Bismuth arsenite,  $\text{BiAsO}_3 + 5\text{H}_2\text{O}$  (?)**

Easily sol in  $\text{HNO}_3 + \text{Aq}$  (Schneider, J p (2) 20 419)

Sl sol in  $\text{H}_2\text{O}$  (Stavenhagen, J pr 1895, (2) 51 35)

**Cadmium arsenite,  $\text{Cd}_3(\text{AsO}_3)_2$** 

Sl sol in  $\text{H}_2\text{O}$ , easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  and dil acids (Stavenhagen, l c)

$\text{Cd}_2\text{As}_2\text{O}_5$  Ppt (Reichard, B 1898, 31 2168)

Sol in acids without decomp, insol in alkalis (Reichard, B 1894, 27 1033)

$5\text{CdO}, \text{As}_2\text{O}_3 + 12\text{H}_2\text{O}$  Not attacked by  $\text{KOH}$ ,  $\text{Ba}(\text{OH})_2$  or alkali carbonates +  $\text{Aq}$  Insol in  $\text{KCN} + \text{Aq}$  (Reichard, Ch Z 1902, 26 1145)

**Cæsium arsenite bromide,  $\text{As}_2\text{O}_3, \text{CsBr}$** 

Sol in  $\text{H}_2\text{O}$  (Wheeler, Z anorg 4 451)

**Cæsium arsenite chloride,  $\text{As}_2\text{O}_3, \text{CsCl}$** 

As above

**Cæsium arsenite iodide,  $\text{As}_2\text{O}_3, \text{CsI}$** 

As above

**Calcium arsenite,  $\text{Ca}(\text{AsO}_2)_2$** 

Somewhat sol in  $\text{H}_2\text{O}$ , sol in  $\text{Ca}(\text{OH})_2 + \text{Aq}$  or  $\text{As}_2\text{O}_3 + \text{Aq}$  (Simon, Pogg 47 417)

$\text{Ca}_3(\text{AsO}_3)_2$  Ppt (Kuhn, J B 1852 379)

Only sl sol  $\text{H}_2\text{O}$ , readily sol in dil acids (Stavenhagen, l c)

Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Reichard, B 1894, 27 1036)

$3\text{CaO}, 2\text{As}_2\text{O}_3 + 3\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$ , easily sol in  $\text{NH}_4\text{Cl} + \text{Aq}$ , sol in  $\text{As}_2\text{O}_3 + \text{Aq}$  (Stein)

$\text{CaH}_4(\text{AsO}_3)_2 + x\text{H}_2\text{O}$  Moderately sol in  $\text{H}_2\text{O}$  Insol in abs alcohol (Perper, Dissert 1894)

$\text{Ca}_2\text{As}_2\text{O}_6$  Sl sol in  $\text{H}_2\text{O}$ , 1 pt in 3000-4000 pts  $\text{H}_2\text{O}$  Alkali chlorides increase solubility slightly (Stavenhagen, l c)

Sl sol in  $\text{H}_2\text{O}$  insol in  $\text{H}_2\text{O}$  containing  $\text{CaO}$  H (Berzelius)

Not pptd in presence of 4000-5000 pts  $\text{H}_2\text{O}$  (Harting, Lassaigne)

Not pptd from ac  $\text{H}_2\text{O}$  salts and  $\text{NH}_4\text{H}_2\text{O}$

Sl in  $\text{NH}_4\text{AsO}_2 + \text{Aq}$  (Schwigger)

Sol in  $\text{CaCl}_2 + \text{Aq}$  (Ordway)

Easily sol in dil acids Not pptd from solutions containing sodium citrate (Spiller)

**Calcium arsenite iodide,  $\text{CaI}_2, 3\text{As}_2\text{O}_3 + 12\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  Decomp on heating (Grühl, Dissert 1897)

**Chromic arsenite,  $\text{CrAsO}_3$** 

Sol in  $\text{H}_2\text{O}$ , but slowly decomp by boiling (Neville, C N 34 220)

Sol in  $\text{HCl}$ , pptd by  $\text{NH}_4\text{OH} + \text{Aq}$  sol in  $\text{KOH} + \text{Aq}$  (Reichard, B 1894, 27 1028)

**Cobaltous arsenite basic,  $7\text{CoO}, \text{As}_2\text{O}_3$** 

Very sol in dil, difficultly sol in conc  $\text{H}_2\text{SO}_4$  Sol in conc  $\text{NaOH}$  und in conc  $\text{NaOH} + \text{Aq}$  (Reichard, Z anal 1903, 42 10)

**Cobaltous arsenite,  $3\text{CoO}, \text{As}_2\text{O}_3$** 

Sol KOH+Aq with decomp (Identical with salt of Girard) (Reichard, B 1894, **27** 1031)

+ $4\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$ , easily sol in acids (Stavenhagen, J pr 1895, (2) **51** 39)

$3\text{CoO}, 2\text{As}_2\text{O}_3 + 4\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  (Girard, C R 1852, **34** 918)

$\text{Co}_3\text{H}_6(\text{AsO}_3)_4$  Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  (Proust)

Only sol in KOH, or NaOH+Aq when formed in a solution containing an excess of those reagents (Reynoso, C R **31** 68)

$\text{Co}_2\text{As}_2\text{O}_5$  Ppt (Reichard, B 1898, **31** 2165)

Sol in  $\text{HNO}_3$  and  $\text{HCl} + \text{Aq}$  (Proust)

**Cupric arsenite,  $\text{Cu}(\text{AsO}_2)_2$** 

(Avery, J Am Chem Soc 1906, **28** 1161)  
Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, **20** 827)

+ $\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Stavenhagen, *lc*)

+ $2\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$ , insol in alcohol (Stavenhagen, *lc*)

$3\text{CuO}, \text{As}_2\text{O}_3$  Ppt (Stavenhagen, *lc*)

$2\text{CuO}, \text{As}_2\text{O}_3$  (Scheele's green) Insol in  $\text{H}_2\text{O}$ , sol in KOH+Aq,  $\text{NH}_4\text{OH} + \text{Aq}$ , and in most acids Formula is  $\text{Cu}_3(\text{AsO}_2)_2 + 2\text{H}_2\text{O}$  (Sharples, C N **35** 89)

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp Sol in KOH+Aq with decomp (Reichard, B 1894, **27** 1026)

Insol in pyridine (Schroeder, Dissert **1901**)

$5\text{CuO}, \text{As}_2\text{O}_3$  Insol in  $\text{H}_2\text{O}$ , sol in acids,  $\text{NH}_4\text{OH} + \text{Aq}$  and conc  $\text{MOH} + \text{Aq}$  (Reichard, Ch Z 1902, **26** 1142)

$x\text{CuO}, y\text{As}_2\text{O}_3$  Min *Trippkeite* Easily sol in  $\text{HNO}_3$  and in  $\text{HCl} + \text{Aq}$

**Didymium arsenite,  $\text{Dy}_2\text{H}_3(\text{AsO}_3)_3$** 

Ppt (Frerichs and Smith, A **191** 355)

Does not exist (Cleve, B **11** 910)

**Glucinum arsenite iodide,  $\text{GII}_2, 3\text{As}_2\text{O}_3 + 8\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  (Gruhl, Dissert **1897**)

**Gold (aurous) arsenite,  $3\text{Au}_2\text{O}, \text{As}_2\text{O}_3$** 

Decomp by light (Reichard B 1894, **27** 1027)

**Gold (auric) arsenite,  $\text{AuAsO}_3 + \text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  and dil acids (Stavenhagen, J pr 1895, (2) **51** 28)

**Iron (ferrous) arsenite,  $\text{FeO}, \text{As}_2\text{O}_3$** 

Decomp in the air when moist sol in  $\text{NH}_4\text{OH} + \text{Aq}$  when freshly pptd (Reichard, B 1894, **27** 1029-30)

$\text{FeAsO}_3$  Ppt Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , insol in  $\text{NH}_4$  arsenite, or other  $\text{NH}_4$  salts+Aq (Wittstein)

**Iron (ferric) arsenite, basic,  $4\text{Fe}_2\text{O}_3, \text{As}_2\text{O}_3 + 5\text{H}_2\text{O}$** 

Ppt  $\text{H}_2\text{O}$  extracts  $\text{As}_2\text{O}_3$  Sol in one acid with separation of  $\text{As}_2\text{O}_3$  Acetic acid is without action (Bunsen and Berzold, **1834**)

Sol in KOH, or NaOH+Aq

**Iron (ferric) arsenite,  $\text{Fe}_2\text{O}_3, \text{As}_2\text{O}_3$** 

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  when freshly pptd (Reichard, B 1894, **27** 1030)

$\text{Fe}_4\text{As}_2\text{O}_9$  Ppt (Reichard, B 1895, **31** 2170)

+ $7\text{H}_2\text{O}$  Sol in NaOH, and KOH+Aq "Ferric arsenite" is sl sol in  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$  (Kynaston, Dingl **235** 326)

**Lanthanum arsenite,  $\text{La}_2\text{H}_3(\text{AsO}_3)_3$** 

Ppt (Frerichs and Smith, A **191** 355)

Does not exist (Cleve, B **11** 910)

**Lead arsenite,  $\text{Pb}(\text{AsO}_2)_2 + x\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  Insol in KOH, but sl in NaOH+Aq (Berzelius)

$\text{Pb}_2\text{As}_2\text{O}_5$  Insol in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$   $\text{NH}_4$  arsenite, or other  $\text{NH}_4$  salts+Aq (Wittstein)

$\text{Pb}_3(\text{AsO}_3)_2$  Scarcely sol in  $\text{H}_2\text{O}$ , easily sol in  $\text{HNO}_3$ , or  $\text{HC}_2\text{H}_3\text{O} + \text{Aq}$  Insol in  $\text{H}_2\text{O}$  dissolves some  $\text{As}_2\text{O}_3$  Not completely insol in KOH+Aq (Streng, A **129** 23)

Sol in acetic acid, insol in  $\text{H}_2\text{O}$  the presence of ammonium salts, sol in NaOH+Aq, sl sol in KOH+Aq (Reichard, B 1894, **27** 1024)

+ $\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$ , easily sol in dil acids (Stavenhagen, J pr 1895, (2) **33**)

**Lead arsenite chloride,  $\text{Pb}_3\text{As}_2\text{O}_8, 2\text{PbCl}_2$** 

Min *Ekdemite* Easily sol in  $\text{HNO}_3 + \text{Aq}$ , and warm  $\text{HCl} + \text{Aq}$

**Magnesium arsenite,  $\text{Mg}_3(\text{AsO}_3)_3$** 

Insol in  $\text{NH}_4\text{OH} + \text{Aq}$ , but sol in large excess of  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rosen)

Very sol in boiling  $\text{H}_2\text{O}$  and in dil acids Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Reichard, B 1894, **27** 1032)

Very sol in  $\text{H}_2\text{O}$  and dil acids (Stavenhagen, *lc*)

$\text{Mg}_2\text{As}_2\text{O}_7 + 4\text{H}_2\text{O}$  Hygroscopic Very sol in  $\text{H}_2\text{O}$  and acids (Stavenhagen, *lc*)

$3\text{MgO}, 2\text{As}_2\text{O}_3 + 3\text{H}_2\text{O} + 15\text{H}_2\text{O}$ , and + $18\text{H}_2\text{O}$  (Perper Dissert **1894**)

**Magnesium arsenite iodide,  $\text{Mg}_3\text{I}_3(\text{AsO}_3)_3 + 12\text{H}_2\text{O}$** 

Moderately sol in  $\text{H}_2\text{O}$  (Gruhl, Dissert **1897**)

**Manganous arsenite,  $\text{Mn}_3(\text{AsO}_3)_3 + 3\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$ , insol in alcohol, easily oxidized by moist air (Stavenhagen, *lc*)

$3\text{MnO}, 2\text{As}_2\text{O}_3$  (Reichard B 1895, **27** 1032)

$Mn_3H_2As_4O_{10} + 4H_2O$  Sl sol in  $H_2O$   
Very sol in acids and alkali (Stavenhagen, *lc*)  
 $Mn_3As_2O_8$  Ppt (Reichard, B 1898, 31 2165)

**Mercurous arsenite,  $Hg_2O, As_2O_3$**

Decomp by light Decomp by  $H_2O$   
(Reichard, B 1894, 27 1022)

$Hg_3AsO_3$  Only sl sol in  $H_2O$ , sol in dil acids (Stavenhagen, J pr 1895, (2) 51 24)

Gradually and completely decomposed by  $H_2O$  (Reichard, Ch Z 1902, 26 1143)

**Mercuric arsenite,  $Hg_3(AsO_3)_2$**

Sl sol in  $H_2O$  (Stavenhagen, *lc*)

Decomp more easily by  $H_2O$  than is the mercurous comp (Reichard, Ch Z 1902, 26 1143)

$2HgO, As_2O_3$  Not decomp by boiling with  $H_2O$  Undecomp by boiling acids  
Decomp by  $KOH + Aq$ ,  $K_2CO_3 + Aq$  and  $NH_4OH + Aq$  (Reichard, B 1894, 27 1021)

$Hg_3As_2O_8$  Ppt Decomp by boiling  $H_2O$   
Very sl sol in  $H_2SO_4 + HCl$  (Reichard, B 1898, 31 2170)

**Nickel arsenite,  $Ni_3(AsO_3)_2$**

Insol in  $H_2O$ , easily sol in  $NH_4OH + Aq$  (Proust)

Ppt (Reichard, B 1898, 31 2165)

$3NiO, 2As_2O_3$  Sol in  $NH_4OH + Aq$  (identical with salt of Girard) (Reichard, B 1894, 27 1031)

$+ 4H_2O$  Insol in  $H_2O$ , sol in  $NH_4OH + Aq$  (Proust)

Sol in  $KOH + Aq$  (Girard, C R 34 918)

$2NiO, As_2O_3$  Insol in  $H_2O$ , sol in  $NH_4OH + Aq$ , sol in  $KOH + Aq$  (Reynoso, C R 31 68)

**Platinum arsenite,  $Pt_3(AsO_3)_4$**

Sol in  $H_2O$  and alcohol, very unstable (Stavenhagen, *lc*)

**Potassium arsenite,  $K_3AsO_3$**

Sol in  $H_2O$  sl sol in alcohol (Proust, A 68 309)

Insol in ethyl acetate (Nannum, B 1904, 37 5601)

Does not exist (Stavenhagen, *lc*)

$K_3AsO_3$  Very sol in  $H_2O$ , sol in alcohol (Stavenhagen, *lc*)

$K_4AsO_7 + 6H_2O$  Very sol in  $H_2O$ , sol in alcohol (Stavenhagen, *lc*)

$K_4As_4O_{17} + 2H_2O$  Sol in  $H_2O$ , sl sol in alcohol (Proust, A 68 309)

**Potassium arsenite bromide,  $4AsO_3, 2KBr$**

More sol in  $H_2O$  than iodide (Schiff and Sestini, A 228 72)

$2AsO_3, KBr$  (Rudorff, B 19 2675)

**Potassium arsenite chloride,  $2As_2O_3, KCl$**

Much more quickly sol in hot  $H_2O$  than bromide or iodide (Rudorff, B 19 2675)

$As_2O_3, KCl$  Decomp by  $H_2O$

**Potassium arsenite iodide,  $3As_2O_3, 2KI + H_2O$**

Sl sol in cold  $H_2O$ , sol in 20 pts boiling, and 40 pts cold  $H_2O$  (Emmet, Sill Am J (2) 18 583)

$6KAsO_3, 2KI + 3H_2O$  Sol in  $H_2O$  and alcohol Decomp by acids (Harms)

$2KH(AsO_3)_2, As_2O_3, 2KI$  Sl sol in  $H_2O$  (Harms, A 91 371)

$2As_2O_3, KI$  Very difficultly sol even in boiling  $H_2O$  Very easily sol in  $KOH + Aq$ , but much less so in  $K_2CO_3 + Aq$  (Rudorff, B 19 2670)

Sol in 40 pts cold, 20 pts hot  $H_2O$ , sol in alkalies (Schiff and Sestini, A 228 72)

**Potassium arsenite sulphate,  $K_3AsO_3, 10K_2SO_4$**

(Stavenhagen, Zeit angew ch 1894, 8 166)

**Rubidium arsenite,  $RbAsO_3$**

Sol in  $H_2O$ , aq solution is alkaline to litmus Insol in alcohol (Bouchonnet, C R 1907, 144 641)

**Rubidium arsenite bromide,  $As_2O_3, RbBr$**

Decomp by  $H_2O$  (Wheeler, Z anorg 4 451)

**Rubidium arsenite chloride,  $As_2O_3, RbCl$**

As above

**Rubidium arsenite iodide,  $As_2O_3, RbI$**

As above

**Silver arsenite,  $Ag_3AsO_3$**

Insol in  $H_2O$  Not pptd in presence of 20,000 pts  $H_2O$  (Harting)

11  $H_2O$  dissolves 0.0115 g  $Ag_3AsO_3$  at  $20^\circ$  (Whitby, Z anorg 1910, 67 108)

Only sl sol in  $H_2O$  and in dil acids, readily sol in  $NH_4OH + Aq$  and conc acids (Stavenhagen, *lc*)

Decomp by light, by  $KOH + Aq$  and by  $NH_4OH + Aq$  (Reichard, B 1894, 27 1022-23)

Easily sol in  $HNO_3 + Aq$  and other acids (Maret)

More easily sol in  $HClH_3O + Aq$  than  $Ag_3PO_4$  sl sol in  $HClH_3O + Aq$  (Santos, C N 38 94)

Insol in  $KOH + Aq$  (Kuhn, Arch Pharm (2) 69 267)

Easily sol in  $NH_4OH + Aq$  (Maret)

Insol in  $NH_4OH + Aq$ , but sol therein in presence of alkali nitrates (Santos *lc*)

Incompletely sol in  $(NH_4)CO_3$ ,  $(NH_4)SO_4$ , or  $NH_4NO_3 + Aq$  (Wittstein, Report 51 41)

Decomp by  $\text{NH}_4\text{Cl} + \text{Aq}$  Sol in  $\text{KAsO}_4 + \text{Aq}$  (Kuhn, *l c*)  
 Not pptd in solutions containing sol citrates (Spiller)  
 Sol in methyl acetate (Naumann, B 1909, **42** 3790)  
 Sl sol in methyl acetate (Bezold, Dissert 1908)

Insol in ethyl acetate (Hamers, Dissert 1906), (Naumann, B 1910, **43** 314)  
 $+ \text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  and in dil acids (Stavenhagen, J pr 1895, (2) **51** 29)

$2\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_3$  Ppt (Pasteur, J Pharm (3) **13** 395)

Could not be obtained (Stavenhagen, *l c*)  
 $3\text{Ag}_2\text{O}$ ,  $2\text{As}_2\text{O}_3$  Sol in cold  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Santos)

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  and in potassium arsenite +  $\text{Aq}$  (Girard, C R **34** 918)

Ppt (Reichard, B 1898, **31** 2167)  
 Could not be obtained (Stavenhagen, *l c*)

**Silver arsenite ammonia**,  $2\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $4\text{NH}_3$

Insol in  $\text{H}_2\text{O}$  or alcohol (Girard)

### Sodium arsenites

Correspond to potassium arsenites, but have not been obtained in crystalline form. All are very sol in  $\text{H}_2\text{O}$  (Pasteur, A **68** 308)  
 $\text{Na}_3\text{AsO}_3$  Very sol in  $\text{H}_2\text{O}$  (Stavenhagen, *l c*)

Insol in ethyl acetate (Naumann, B 1904, **37** 3602)

**Sodium arsenite bromide**,  $2\text{AsO}_3$ ,  $\text{NaBr}$

Decomp by warm  $\text{H}_2\text{O}$  (Rudorff, B **21** 3052)

**Sodium arsenite iodide**,  $2\text{AsO}_3$ ,  $\text{NaI}$

Decomp by hot  $\text{H}_2\text{O}$  (Rudorff)

**Strontium arsenite**,  $\text{Sr}_3(\text{AsO}_3)_4$

Sol in  $\text{H}_2\text{O}$  (Stavenhagen, *l c*)  
 Sol in  $\text{H}_2\text{O}$ , insol in alcohol (identical with Stein)

(Reichard, B 1894, **27** 1036)  
 $\text{Sr}_2\text{AsO}_5 + 2\text{H}_2\text{O}$  Quite easily sol in  $\text{H}_2\text{O}$  (Stein)

Sl sol in  $\text{H}_2\text{C}$ ,  $\text{SrO}_2\text{H} + \text{Aq}$ , or  $\text{H}_3\text{AsO}_4 + \text{Aq}$  (Dumas)

Very sl sol in alcohol (Stein)  
 Easily sol in  $\text{H}_2\text{O}$  and in acids (Stavenhagen, J pr 1895, (2) **51** 17)

$\text{Sr}_3\text{As}_4\text{O}_{13}$  Moderately sol in  $\text{H}_2\text{O}$  (Reichard, B 1894, **27** 1036)

**Strontium arsenite iodide**,  $\text{SrI}_2$ ,  $3\text{AsO}_3 + 12\text{H}_2\text{O}$

As Ba comp (Grühl, Dissert 1897)

**Thallium arsenite**,  $\text{Tl}_3\text{AsO}_3$

Sl sol in  $\text{H}_2\text{O}$  and alcohol, easily sol in acids, especially in dil  $\text{H}_2\text{SO}_4$  (Stavenhagen, *l c*)

**Tin (stannous) arsenite**,  $\text{Sn}_3(\text{AsO}_3)_2$

Ppt, decomp by acids and alkali (Reichard, B 1898, **31** 2169)

$+ 2\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  Easily so in dil acids and alkalies (Stavenhagen, *l c*)

**Tin (stannic) arsenite**,  $\text{Sn}_3(\text{AsO}_3)_4 + 5\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Stavenhagen, *l c*)  
 $5\text{SnO}_2$ ,  $2\text{As}_2\text{O}_3$  Ppt Sol in acids (Reichard, B 1894, **27** 102)

decomp (Reichard, B 1894, **27** 102)  
 $\text{Sn}_7\text{As}_2\text{O}_{17}$  Ppt (Reichard, B 1 2169)

**Uranium arsenite**,  $\text{UO}_2$ ,  $\text{As}_2\text{O}_3$

Insol in  $\text{NH}_4\text{OH} + \text{Aq}$ , only sl sol in  $\text{H}_2\text{O}$  (Reichard, B 1 1029)

**Zinc arsenite**,  $\text{ZnO}$ ,  $\text{As}_2\text{O}_3$

Ppt (Avery, J Am Chem Soc 1 **16**, **28** 1163)

$3\text{ZnO}$ ,  $\text{As}_2\text{O}_3$  Sol in acids without comp Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Reichard, B 1894, **27** 1033)

**Arsenovanadic acid**,  $\text{As}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5$ ,  $2\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$ , but solution easily decomposes, crystallizes from  $\text{H}_2\text{O}$  with  $3\text{H}_2\text{O}$

Composition is vanadium dihydrogen arsenate  $(\text{VO}_2)_2\text{H}_2\text{AsO}_4$  (Friedheim, B **23** 2600)

$+ 14$ , and  $+ 18\text{H}_2\text{O}$  (Ditte, C **102** 757) Could not be obtained (Friedheim)

$3\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5$  (Berzelius) Correlation formula is as above (Friedheim)

$3\text{H}_2\text{O}$ ,  $7\text{As}_2\text{O}_5$ ,  $6\text{V}_2\text{O}_5$  (Gibbs, Am Ch J **7** 209) Could not be obtained (Friedheim)

$3\text{H}_2\text{O}$ ,  $5\text{As}_2\text{O}_5$ ,  $8\text{V}_2\text{O}_5 + 24\text{H}_2\text{O}$  (Gibbs) Could not be obtained (Friedheim)

### Arsenovanadates

According to Friedheim (Z anorg 1892, **2** 319) the arsenovanadates include arsenates of  $\text{VO}_2$  and  $\text{NH}_4$

**Ammonium arsenovanadate**,  $(\text{NH}_4)_3\text{AsO}_4$ ,  $2\text{V}_2\text{O}_5$ ,  $+ 5\text{H}_2\text{O}$

Efflorescent in dry air, sl sol in cold, decomp by hot  $\text{H}_2\text{O}$  Composition is ammonium divanadium arsenate  $(\text{VO}_2)_2(\text{NH}_4)\text{AsO}_4 + 2\text{H}_2\text{O}$  (Friedheim, B **23** 2600)

Sl sol in cold  $\text{H}_2\text{O}$  Somewhat more easily sol in hot  $\text{H}_2\text{O}$  with separation of  $\text{V}_2\text{O}_5$

(Schmitz-Dumont, Dissert 1891)

$2(\text{NH}_4)_2\text{O}$ ,  $3\text{AsO}_3$ ,  $2\text{V}_2\text{O}_5 + 4\text{H}_2\text{O}$  Cannot be crystallized from  $\text{H}_2\text{O}$  Composition is  $(\text{NH}_4)_3\text{HAsO}_4 + 2(\text{VO}_2)_2\text{HAsO}_4$  (Friedheim)

Decomp under  $\text{H}_2\text{O}$  to  $(\text{NH}_4)_3\text{AsO}_4$  and  $\text{V}_2\text{O}_5$

$\text{AsO}_3 + 5\text{H}_2\text{O}$  (Schmitz-Dumont, *l c*)  
 $5(\text{NH}_4)_2\text{O}$ ,  $4\text{AsO}_3$ ,  $2\text{V}_2\text{O}_5 + 18\text{H}_2\text{O}$  sol in  $\text{H}_2\text{O}$  (Ditte, C R **102** 1019) Does not exist (Friedheim, B **23** 2605)

**Calcium arseniovanadate**,  $2\text{CaO}$ ,  $3\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 21\text{H}_2\text{O} = \text{CaHAsO}_4 + 2(\text{VO}_2)_2\text{H}_2\text{AsO}_4 + 8\text{H}_2\text{O}$

Can be crystallized in presence of vanadic acid without decomp (Friedheim)

Efflorescent Sol in  $\text{H}_2\text{O}$  (Schmitz-Dumont, *lc*)

**Cobalt arseniovanadate**,  $\text{CoO}$ ,  $\text{As}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 9\text{H}_2\text{O} = \text{Co}(\text{VO}_2)_2\text{H}_2(\text{AsO}_4)_2 + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Friedheim)

**Copper arseniovanadate**,  $\text{CuO}$ ,  $\text{As}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 4\text{H}_2\text{O} = \text{Cu}(\text{VO}_2)_2\text{H}_2(\text{AsO}_4)_2 + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Friedheim)

**Magnesium arseniovanadate**,  $\text{MgO}$ ,  $\text{As}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 10\text{H}_2\text{O} = (\text{VO}_2)_2\text{MgH}_2(\text{AsO}_4)_2 + 9\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Friedheim)

Moderately sol in  $\text{H}_2\text{O}$  Solution decomps on standing (Schmitz-Dumont, *lc*)

$2\text{MgO}$ ,  $3\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 23\text{H}_2\text{O} = \text{MgHAsO}_4 + 2(\text{VO}_2)_2\text{H}_2\text{AsO}_4 + 9\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Friedheim)

Sol in  $\text{H}_2\text{O}$  but solution decomps on evaporation (Schmitz-Dumont, *lc*)

**Potassium arseniovanadate**,  $\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 5\text{H}_2\text{O} = (\text{VO}_2)_2\text{KAsO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Friedheim)

Sl sol in cold  $\text{H}_2\text{O}$  Partially decomps on heating (Schmitz-Dumont)

**Strontium arseniovanadate**,  $2\text{SrO}$ ,  $3\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 20\text{H}_2\text{O} = \text{SrHAsO}_4 + 2(\text{VO}_2)_2\text{H}_2\text{AsO}_4 + 7\frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Friedheim)

+  $21\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Schmitz-Dumont)

**Zinc arseniovanadate**,  $\text{ZnO}$ ,  $\text{As}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 6\frac{1}{2}\text{H}_2\text{O} = \text{Zn}(\text{VO}_2)_2\text{H}_2(\text{AsO}_4)_2 + 5\frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Friedheim)

$2\text{ZnO}$ ,  $3\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 51\text{H}_2\text{O}$ , and +  $18\text{H}_2\text{O} = \text{ZnHAsO}_4 + 2(\text{VO}_2)_2\text{H}_2\text{AsO}_4$ , and +  $6\frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Friedheim)

### Arseniovanadicotungstic acid

**Ammonium arseniovanadicotungstate**,

$17(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ ,  $14\frac{1}{2}\text{V}_2\text{O}_5$ ,  $29\text{WO}_3 + 98\text{H}_2\text{O}$

Sl sol in cold  $\text{H}_2\text{O}$  Readily sol in boiling  $\text{H}_2\text{O}$  Insol in alcohol, ether, benzene,  $\text{CS}_2$ ,  $\text{CHCl}_3$ , acetone, nitrobenzene, aniline and acetic acid (Rogers, J Am Chem Soc 25 17)

### Arseniovanadicovanadic acid

**Ammonium arseniovanadicovanadate**,

$5(\text{NH}_4)_2\text{O}$ ,  $12\text{As}_2\text{O}_5$ ,  $12\text{VO}$ ,  $6\text{V}_2\text{O}_5 + 7\text{H}_2\text{O}$

Sl sol in cold, sol in hot  $\text{H}_2\text{O}$ , from which crystallizes—

$4(\text{NH}_4)_2\text{O}$ ,  $9\text{As}_2\text{O}_5$ ,  $9\text{VO}_2$ ,  $8\text{V}_2\text{O}_5 + 11\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 7 209)

### Arseniovanadicovanadotungstic acid

**Ammonium arseniovanadicovanadotungstate**,

$17(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ ,  $7\text{V}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_3$ ,  $32\text{WO}_3 + 73\text{H}_2\text{O}$

Sl sol in cold, readily sol in boiling  $\text{H}_2\text{O}$  (Rogers, J Am Chem Soc 1903, 25 310)

### Arseniovanadotungstic acid

**Ammonium arseniovanadotungstate**,

$18(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ ,  $13\text{V}_2\text{O}_5$ ,  $39\text{WO}_3 + 88\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Insol in organic solvents (Rogers, J Am Chem Soc 1903, 25 306)

### Arseniuretted hydrogen, $\text{AsH}_3$

See Arsenic hydride

### Arsenochromic acid

**Potassium arsenochromate**,  $\text{K}_4\text{Cr}_2\text{As}_2\text{O}_{18} + 12\text{H}_2\text{O}$

Sol in moderately conc mineral acids (Tarugi, C C 1897, II 724)

$\text{K}_7\text{Cr}_2\text{As}_2\text{O}_{22} + 24\text{H}_2\text{O}$  Ppt Sol in dil warm acids (Tarugi)

**Potassium hydrogen arsenochromate**,

$\text{K}_4\text{H}_5\text{Cr}_2\text{As}_2\text{O}_{18}$

(Tarugi, C C 1897, II 724)

### Arsenosarsenotungstic acid

**Potassium arsenosarsenotungstate**,  $10\text{K}_2\text{O}$ ,  $4\text{As}_2\text{O}_5$ ,  $\text{As}_2\text{O}_3$ ,  $21\text{WO}_3 + 26\text{H}_2\text{O}$

Precipitate Sol in a large amount of hot  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 7 313)

### Arsenosomolybdic acid

**Ammonium arsenosomolybdate**,  $3(\text{NH}_4)_2\text{O}$ ,  $5\text{As}_2\text{O}_5$ ,  $12\text{MoO}_3 + 24\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 7 313)

**Ammonium barium arsenosomolybdate**,

$3(\text{NH}_4)_2\text{O}$ ,  $2\text{BaO}$ ,  $5\text{As}_2\text{O}_5$ ,  $10\text{MoO}_3 + 50\text{H}_2\text{O}$

Ppt (Ephraim, Z anorg 1910, 66 57)

**Ammonium cupric arsenosomolybdate**,

$(\text{NH}_4)_2\text{O}$ ,  $\text{CuO}$ ,  $2\text{As}_2\text{O}_5$ ,  $4\text{MoO}_3 + 2\text{H}_2\text{O}$ , and  $2(\text{NH}_4)_2\text{O}$ ,  $\text{CuO}$ ,  $3\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 13\text{H}_2\text{O}$

Ppts (Ephraim, Z anorg 1910, 66 58)

**Barium arsenosomolybdate**,  $3\text{BaO}$ ,  $2\text{As}_2\text{O}_5$ ,  $8\text{MoO}_3 + 13\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$  (Gibbs)

**Copper arsenosomolybdate**,  $2\text{CuO}$ ,  $3\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$

Sol in  $\text{H}_2\text{O}$  (Gibbs)

**Manganese arsenosomolybdate**,  $2\text{MnO}$ ,  $3\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 6\text{H}_2\text{O}$ , and +  $15\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Gibbs)

**Potassium arsenosomolybdate**,  $3K_2O, As_2O_3, 5MoO_3 + 3H_2O$

Easily sol in  $H_2O$  (Ephraim, Z anorg 1910, 66 54)

$3K_2O, As_2O_3, 8MoO_3 + 18H_2O$  Easily sol in  $H_2O$  (Ephraim)

**Sodium arsenosomolybdate**,  $Na_2O, As_2O_3, 2MoO_3 + 6H_2O$

Easily sol in  $H_2O$  (Ephraim, Z anorg 1910, 66 56)

$2Na_2O, As_2O_3, 4MoO_3 + 13H_2O$  Ppt (Ephraim)

**Zinc arsenosomolybdate**,  $2ZnO, 3As_2O_3, 6MoO_3 + 6H_2O$

Sol in  $H_2O$  (Gibbs)

### Arsenosophosphotungstic acid

**Potassium arsenosophosphotungstate**,  $10K_2O, 14As_2O_3, 3P_2O_5, 32WO_3 + 28H_2O$

Moderately sol in cold, very easily in hot  $H_2O$  (Gibbs)

$7K_2O, 2As_2O_3, 4P_2O_5, 60WO_3 + 55H_2O$  Sol in hot  $H_2O$  with decomp (Gibbs)

**Potassium sodium arsenosophosphotungstate**,  $5K_2O, Na_2O, 2As_2O_3, 2P_2O_5, 12WO_3 + 15H_2O$

(Gibbs, Am Ch J 7 313)

### Arsenosotungstic acid

**Ammonium arsenosotungstate**,  $7(NH_4)_2O, 2As_2O_3, 18WO_3 + 18H_2O$

Sol in  $H_2O$  (Gibbs)

**Barium arsenosotungstate**,  $4BaO, As_2O_3, 9WO_3 + 21H_2O$

Precipitate Nearly insol in  $H_2O$  (Gibbs)

**Sodium arsenosotungstate**,  $9Na_2O, 8As_2O_3, 18WO_3 + 55H_2O$

Very sol in  $H_2O$  (Gibbs, Am Ch J 7 313)

**Arsenyl bromide**,  $AsOBr$

$H_2O$  dissolves out  $As_2O_3$ , insol in alcohol (Serullas)

$+H_2O$  (Wallace, Phil Mag (4) 17 122)  
 $As_2O_3Br_2 = 2AsBr_3, 3As_2O_3 + 12H_2O$

**Arsenyl bromide with MBr**

See Arsenite bromide, M

**Arsenyl chloride**,  $AsOCl$

Sol in  $H_2O$  with decomp

$+H_2O$  (Wallace, Phil Mag (4) 16 358)  
 $As_2O_4Cl$  (Wallace)

**Arsenyl chloride with MCl**

See Arsenite chloride, M

**Arsenyl potassium fluoride**,  $AsOF_3, KF + H_2O$

(Margnac, A 145 237)

**Arsenyl iodide**,  $As_2I_2O_{11} = 2AsO 3As_2O_3 + 12H_2O$

Decomp by  $H_2O$  (Wallace, Phil Mag (4) 17 122)

Sl sol in cold  $H_2O$ , less sol in alcohol (Phisson, J Pharm 14 46)

**Arsenyl iodide with MI**

See Arsenite iodide, M

**Arsenyl sulphoiodide**,  $As_2I_2S_2O_8$

Scarcely attacked by cold  $H_2O$  Boiling  $H_2O$  extracts  $AsI_3$  Decomp by  $HNO_3$  or  $H_2SO_4$  Easily sol in  $KOH$ , or  $NH_4OH + Aq$  (Schneider, J pr (2) 36 513)

### Arsine

See Arsenic hydride

### Atmospheric air

See Air, atmospheric

**Auriamine**,  $Au(OH)_2NH_2$

(Jacobsen, C R 1908, 146 12)

**Dauriamine**,  $Au_2(OH)_4NH_2$

(Jacobsen, C R 1908, 146 12)

**Sesquauriamine**,  $NAu_3, NH_3$

Decomp by  $H_2O$  into  $NAu_3$  taschig, A 235 341)

**Auric acid**,  $HAu_2O_4$

Sol in  $HBr$ , or  $HCl + Aq$  (Fuss, B 19 2546)

**Ammonium aurate**

See Auroamidoimide

**Barium aurate**,  $BaAuO_4 + 5H_2O$

Sl sol in  $H_2O$  (Weigand, Zeit angew Ch 1905, 19 139)

$+6H_2O$  Sl sol in  $H_2O$  Sol in dil  $H_2SO_4$  and in dil  $HNO_3$  Sol in  $HCl$  Decomp by alcohol (Meyer, C R 1907, 14 806)

**Calcium aurate (?)**

Insol in  $H_2O$ , sol in  $CaCl_2 + Aq$  (Fremy, A ch (3) 31 485)

$CaAu_2O_4 + 6H_2O$  As But sa (Meyer, C R 1907, 145 806)

**Magnesium aurate (?)**

Ppt Insol in  $H_2O$ , sol in  $IgCl + Aq$  (Pellat)

**Potassium aurate**,  $KAuO_2 + 3H_2O$

Very sol in  $H_2O$ , and easily decomp (Fremy, A ch (3) 31 183)

Sol in alcohol, the solution in alcohol does not decomp below  $50^\circ$  (Lugnet, A ch (3) 11 364)

**Potassium aurate sulphite**,  $KAuO_2, 2K_2SO_3 + 5H_2O$

Sol in  $H_2O$  with decomp early insol in alkaline solutions (Fremy, A ch (3) 31 485)

**Sodium aurate**,  $\text{Na}_2\text{Au}_2\text{O}_4 + 2\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  Sol in dil  $\text{H}_2\text{SO}_4$ , dil  $\text{HNO}_3$ , and  $\text{HCl}$  with decomp Decomp by alcohol (Meyer, C R 1907, **145** 806)

**Strontium aurate**,  $\text{SrAu}_2\text{O}_4 + 6\text{H}_2\text{O}$ 

As Ba salt (Meyer)

**Aurumide chloride**,  $\text{Au}(\text{NH})\text{Cl}$ 

(Raschig)

**Aurumide nitrate**,  $\text{Au}_2\text{N}_2\text{H}_2\text{O}$ ,  $2\text{HNO}_3$ , or  $\text{AuN}$ ,  $\text{HNO}_3 + \frac{1}{2}\text{H}_2\text{O}$ , or  $\text{Au}_2\text{O}(\text{NH})_2$ ,  $2\text{HNO}_3$ 

Not deliquescent Decomp by hot  $\text{H}_2\text{O}$  into  $\text{Au}_2\text{O}(\text{NH})_2$  (Schottlander, J B 1884 453)

**Auroamidoumide**,  $\text{Au}(\text{HN})\text{NH}_2 + 3\text{H}_2\text{O}$ 

(Fulminating gold) Insol in  $\text{H}_2\text{O}$ , not attacked by dil acids, sol in conc acids, and in moderately dil acids, when freshly precipitated Insol in alkalis or alcohol Sol in  $\text{KCN} + \text{Aq}$

**Triauroamine**,  $\text{Au}_3\text{N} + 5\text{H}_2\text{O}$ 

Not decomp by boiling dil acetic acid,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4$  (Raschig, A 1886, **235** 349)

**Auricyanhydric acid**,  $\text{HAu}(\text{CN})_4 + 1\frac{1}{2}\text{H}_2\text{O}$ 

Easily sol in  $\text{H}_2\text{O}$ , alcohol, or ether

See also Bromauricyanides

Chlorauricyanides

Iodauricyanides

**Ammonium auricyanide**,  $\text{NH}_4\text{Au}(\text{CN})_4$ 

Easily sol in  $\text{H}_2\text{O}$  or alcohol Insol in ether

**Cobaltous auricyanide**,  $\text{Co}[\text{Au}(\text{CN})_4]_2 + 9\text{H}_2\text{O}$ 

Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  Sl sol in alcohol (Lindbom)

**Potassium auricyanide**,  $\text{KAu}(\text{CN})_4 + 1\frac{1}{2}\text{H}_2\text{O}$ 

Efflorescent Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  Easily sol in alcohol

**Silver auricyanide**,  $\text{AgAuCN}_4$ 

Insol in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Diaurodiamine nitrate**

See Aurumide nitrate

**Aurobromhydric acid**

See Bromauric acid

**Aurobromic acid**

See Bromauric acid

**Aurochlorhydric acid**

See Chlorauric acid

**Aurochloric acid**

See Chlorauric acid

**Aurocyanhydric acid****Aurocyanides with MCN**

See Cyanide, aurous with MCN

**Azinosulphonic acid****Ammonium azinosulphonate**,  $\text{N}_3\text{SO}_3\text{NH}_4$ 

(Traube, B 1914, **47** 944)

**Barium azinosulphonate**,  $(\text{N}_3\text{SO}_3)_2\text{Ba}$ 

(Traube, B 1914, **47** 944)

**Potassium azinosulphonate**,  $\text{N}_3\text{SO}_3\text{K}$ 

Easily sol in  $\text{H}_2\text{O}$  Can be cryst from boiling abs alcohol (Traube, B 1914, **47** 943)

**Sodium azinosulphonate**,  $\text{N}_3\text{SO}_3\text{Na}$ 

(Traube, B 1914, **47** 944)

**Azoumide**,  $\text{HN}_3$ 

Miscible with  $\text{H}_2\text{O}$  and alcohol (Curtius and Radershausen, J pr (2) **43** 207)

Stable in aq solution, decomp slowly by dil boiling  $\text{HCl}$  (Curtius, J pr 1898, (2) **58** 265)

For salts of  $\text{HN}_3$ , see azoumide of metal under metal

**Azoumide, hydroxylamine**,  $\text{N}_3\text{H} \cdot 2\text{NH}_2\text{OH}$ 

Sol in  $\text{H}_2\text{O}$  Gradually volatilizes at ord temp (Dennis, J Am Chem Soc 1907, **29** 22)

**Azophosphoric acid**

See Pyrophosphamic acid

**Deutazophosphoric acid**

See Pyrophosphodiamic acid

**Barium, Ba**

Decomp by  $\text{H}_2\text{O}$  and abs alcohol (Guntz, C R 1901, **133** 874)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, **20** 827)

**Barium amalgam**,  $\text{BaHg}_{13}$ 

Stable in contact with liquid amalgam up to  $30^\circ$  Can be cryst from  $\text{Hg}$  without decomp if temp does not exceed  $30^\circ$  (Kerp, Z anorg 1900, **25** 68)

$\text{BaHg}_{12}$  Stable in contact with liquid amalgam from  $30^\circ$ – $100^\circ$  Can be cryst from  $\text{Hg}$  without decomp at any temp within these limits (Kerp)

**Barium amide**,  $\text{Ba}(\text{NH})_2$ 

B-pt  $280^\circ$  (Mentrel, C C 1903, I 276) Decomp by  $\text{H}_2\text{O}$  (Guntz and Mentrel, Bull Soc 1903, (3) **29** 578)

**Barium potassium amide**

See Potassium ammonobarate

**Barium ammonia**,  $\text{Ba}(\text{NH}_3)_6$ 

Takes fire in the air Only sl sol in liquid  $\text{NH}_3$  Violently decomp by  $\text{H}_2\text{O}$  (Mentrel, C R 1902, **135** 740)



**Barium arsenide, Ba<sub>3</sub>As<sub>2</sub>**

Decomp by H<sub>2</sub>O (Lebeau, C R 1899, 129 48)

**Barium azonide, Ba(N<sub>3</sub>)<sub>2</sub>**

Very sl hygroscopic, explosive

12 5 pts are sol in 100 pts H<sub>2</sub>O at 0°  
 16 2 " " " " 100 " H<sub>2</sub>O " 10 5°  
 16 7 " " " " 100 " H<sub>2</sub>O " 15°  
 17 3 " " " " 100 " H<sub>2</sub>O " 17°  
 0 0172 pts are sol in 100 pts abs alcohol at 16°

Insol in ether (Curtius, J pr 1898, (2) 58 290)

See also Barium nitride

**Barium boride, BaB<sub>2</sub>**

Sol in fused oxidizing agents, not decomp by H<sub>2</sub>O, insol in aq acids, sl sol in conc H<sub>2</sub>SO<sub>4</sub>, sol in dil and conc HNO<sub>3</sub> (Moissan, C R 1897, 125, 634)

**Barium subbromide sodium bromide, BaBr, NaBr**

Decomp by H<sub>2</sub>O (Guntz, C R 1903, 136 750)

**Barium bromide, BaBr<sub>2</sub>, and +2H<sub>2</sub>O**

100 pts H<sub>2</sub>O dissolve—  
 at 0° 20° 40° 60° 80° 100°  
 98 104 114 123 135 149 pts BaBr<sub>2</sub>

Sat BaBr<sub>2</sub>+Aq contains at  
 —20° —9° +7° 16° 19° 40°  
 45 7 46 5 48 5 48 8 49 3 50 9% BaBr<sub>2</sub>  
 71° 76° 77° 104° 145° 160° 175°  
 55 1 55 5 55 6 56 6 60 5 59 4 60 3% BaBr<sub>2</sub>  
 (Étard, A ch 1894, (7) 2 540)

Sp gr of BaBr<sub>2</sub>+Aq at 19 5° containing  
 5 10 15 20 25 30% BaBr<sub>2</sub>  
 1 045 1 092 1 114 1 201 1 262 1 329

35 40 45 50 55% BaBr<sub>2</sub>

1 405 1 485 1 580 1 685 1 800  
 (Kremers, Pogg 99 444, calculated by Gerlach Z anal 8 285)

BaBr + Aq containing 7 74% BaBr<sub>2</sub> has sp gr 20°/20° = 1 0716

BaBr<sub>2</sub>+Aq containing 16 76% BaBr<sub>2</sub> has sp gr 20°/20° = 1 1674

(Le Blanc and Rohland, Z phys Ch 1896, 19 279)

Sat BaBr<sub>2</sub>+Aq boils at 113° (Kremers, Pogg 99 43)

**Solubility in BaI<sub>2</sub>+Aq at t°**

t°	Sat solution contains	
	% BaBr	% BaI
—16	4 7	57 9
—16	5 0	59 0
+60	5 5	66 0
135	9 3	67 3
135	9 0	67 2
170	11 0	67 4
210	14 9	67 7

(Étard, A ch 1894, (7) 3 287)

Very sol in absolute alcohol (Hülfeld) 100 pts absolute methyl alcohol dissolve 50 pts BaBr<sub>2</sub> at 22 5°

100 pts absolute ethyl alcohol dissolve 3 pts BaBr<sub>2</sub> at 22 5° (de Bruyn, Z phys Ch 10 783)

Sat solution in 87% alcohol contains 6% BaBr<sub>2</sub> (Richards, Z anorg 3 455)

100 pts absolute methyl alcohol dissolve 45 8 pts BaBr<sub>2</sub>+2H<sub>2</sub>O at 15°

100 pts 93 5% methyl alcohol dissolve 27 3 pts BaBr<sub>2</sub>+2H<sub>2</sub>O at 15°

100 pts 50% methyl alcohol dissolve 4 pts BaBr<sub>2</sub>+2H<sub>2</sub>O at 15° (de Bruyn, Z phys Ch 10 787)

100 g BaBr<sub>2</sub>+CH<sub>3</sub>OH contain 0 4 g BaBr<sub>2</sub> at the critical temp (Centnerszwer, Z phys Ch 1910, 72 437)

At 15°, 1 pt by weight is sol in

36 pts methyl alcohol, sp gr 0 7 9

207 " ethyl " " " 0 8 35

652 " propyl " " " 0 8 35

(Rohland, Z anorg 1897, 15 413)

Nearly insol in boiling amyl alcohol, 10 cc dissolving only an amt equal to 3 mg BaO (Browning, Sill Am J 144 45)

Sol in acetone (Naumann, B 19 1, 37 4328, Eidmann, C C 1899, II 1014)

Insol in benzonitrile (Naumann, E 1914, 47 1370)

Difficultly sol in methyl acetate (Naumann, B 1909, 42 3789)

Insol in ethylacetate (Naumann, E 1910, 43 314)

**Barium cadmium bromide, BaBr, CdBr<sub>2</sub>+4H<sub>2</sub>O**

Sol in H<sub>2</sub>O (v Hauer, W A B 20 40)

**Barium rhodium bromide**

See Bromorhodite, barium

**Barium bromide ammonia, BaBr<sub>2</sub>·8NH<sub>3</sub>**

Decomp by H<sub>2</sub>O (Joannis, C R 1905, 140 1244)

**Barium bromide hydrazine, BaBr<sub>2</sub>·2N<sub>2</sub>H<sub>4</sub>**

Hygroscopic Very sol in H<sub>2</sub>O Insol in alcohol (Fruizen, Z anorg 1908, 60 91)

**Barium bromofluoride, BaBr<sub>2</sub>·BaF<sub>2</sub>**

Insol in and undecomp by boiling alcohol Sol in HBr and in HNO<sub>3</sub> Decomp by H<sub>2</sub>O, hot H<sub>2</sub>SO<sub>4</sub>, dil HCl, dil HNO<sub>3</sub>, or dil acetic acid (Deffoe, C R 1904, 138 199)

**Barium carbide, BaC<sub>2</sub>**

Decomp by H<sub>2</sub>O (Maquenne, C I 144 360)

Sp gr 3 75 Easily decomp by H<sub>2</sub> and dil acids (Moissan, Bull Soc 1894, (1) 11 1008)

**Barium carbonyl, Ba(CO)<sub>2</sub>**

Sol in H<sub>2</sub>O (Guntz and Mentrel, Bull Soc 1903, (3) 29 586)

**Barium subchloride, BaCl**

Decomp by H<sub>2</sub>O (Guntz, C R 1903, 136 751)

**Barium subchloride sodium chloride, BaCl, NaCl**

Decomp by H<sub>2</sub>O (Guntz, C R 1903, 136 750)

**Barium chloride, BaCl<sub>2</sub>, and +2H<sub>2</sub>O**

Permanent in dry air

100 pts H<sub>2</sub>O at t° dissolve (a) pts BaCl<sub>2</sub> and (b) pts BaCl<sub>2</sub>+2H<sub>2</sub>O

t°	a	b	t°	a	b
15 64	34 86	43 50	74 89	59 94	65 51
49 31	43 84	55 63	105 48	59 58	77 89

(Gay Lussac A ch. (2) 11 309)

100 pts H<sub>2</sub>O at t° dissolve 32 62+0 2711 pts BaCl<sub>2</sub> (Kopp)

100 pts H<sub>2</sub>O dissolve pts BaCl<sub>2</sub>+2H<sub>2</sub>O at t°

t°	Pts BaCl <sub>2</sub> +2H <sub>2</sub> O	t°	Pts BaCl <sub>2</sub> +2H <sub>2</sub> O
16 25	39 66	62 50	48 0
20 00	42 22	75 00	63 0
22 50	43 7	87 00	65 0
37 50	51 0	100	72 0
50 00	65 0		

(Brandes)

Sol in 2 67 pts H O at 18 75° (Abl)

1 pt BaCl<sub>2</sub> is sol in 2 86 pts H<sub>2</sub>O at 15 5° and 1 67 pts at boiling temp (M R and P)

100 pts H<sub>2</sub>O at 15 5° dissolve 20 pts BaCl and 43 pts at 87 5° (Ure s Diet)

Solubility in 100 pts H O at t°

t°	Pts BaCl	t°	Pts BaCl <sub>2</sub>
0	31 1	77 5	51 9
12 2	43 9	95 65	57 7
38 4	41 2	102 5	58 9
62 7	47 7	10	59 7

(Nordenskiöld Pogg 136 316)

100 pts H O dissolve pts BaCl at t

t	Pts BaCl <sub>2</sub>	t	Pts BaCl <sub>2</sub>
9	33 2	50	43 7
30	35 1	58	44 9
37	40 0		

(Gerardin A ch (4) 5 143)

1 pt BaCl<sub>2</sub>+2H O is sol in 2 18 pts H<sub>2</sub>O at 21 5°, and the solution has sp gr = 1 2878 (Schiff, A 109 326)

1 pt anhydrous BaCl is sol in 2 86 pts H<sub>2</sub>O at 15° (Gerlach)

Solubility in 100 pts H<sub>2</sub>O at t°

t°	Pts BaCl <sub>2</sub>	t°	Pts BaCl <sub>2</sub>	t°	Pts BaCl <sub>2</sub>
0	30 9	36	39 7	71	49 7
1	31 2	37	40 0	72	50 0
2	31 5	38	40 2	73	50 3
3	31 7	39	40 5	74	50 6
4	31 9	40	40 7	75	50 9
5	32 2	41	41 0	76	51 2
6	32 4	42	41 3	77	51 5
7	32 6	43	41 6	78	51 8
8	32 8	44	41 9	79	52 1
9	33 1	45	42 2	80	52 4
10	33 3	46	42 5	81	52 7
11	33 5	47	42 7	82	53 0
12	33 8	48	43 0	83	53 3
13	34 0	49	43 3	84	53 6
14	34 2	50	43 6	85	54 0
15	34 5	51	43 9	86	54 3
16	34 7	52	44 2	87	54 6
17	35 0	53	44 4	88	55 0
18	35 2	54	44 7	89	55 3
19	35 5	55	45 0	90	55 6
20	35 7	56	45 3	91	55 9
21	36 0	57	45 6	92	56 2
22	36 2	58	45 9	93	56 6
23	36 5	59	46 2	94	56 9
24	36 7	60	46 4	95	57 2
25	37 0	61	46 7	96	57 6
26	37 2	62	47 0	97	57 9
27	37 5	63	47 3	98	58 2
28	37 7	64	47 6	99	58 5
29	38 0	65	47 9	100	58 8
30	38 2	66	48 2	101	59 2
31	38 5	67	48 5	102	59 5
32	38 7	68	48 8	103	59 8
33	39 0	69	49 1	104	60 2
34	39 2	70	49 4	104 1	60 3
35	39 5				

(Mulder, calculated from his own and other observations Scheik Verhandel 1864 45)

The saturated solution contains—

60 3 pts BaCl<sub>2</sub> to 100 pts H<sub>2</sub>O, and boils at 104 1° (Mulder)

60 1 pts BaCl to 100 pts H<sub>2</sub>O, and boils at 104 4° (Legrand)

61 8 pts BaCl<sub>2</sub> to 100 pts H<sub>2</sub>O, and boils at 104 5° (Griffith)

59 58 pts BaCl<sub>2</sub> to 100 pts H<sub>2</sub>O, and boils at 105 45° (Gay-Lussac), at 106° (Krimers)

54 1 pts BaCl to 100 pts H O, and forms crust at 104 4°, highest temperature observed, 104 9° (Gerlach, Z anal 26 426)

Sat BaCl<sub>2</sub>+Aq contains at

100° 130 144° 160° 180° 215°  
36 37 37 5 38 9 40 7 43 1% BaCl<sub>2</sub>  
(Etard, A ch 1894, (7) 2 535)

Aq solution contains 27 6% BaCl<sub>2</sub> at 30° (Shimminakers, C C 1910, 1 9)

Solubility of  $\text{BaCl}_2 + 2\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  equals 1.745 mol-litre at  $30^\circ$  (Masson, Chem Soc 1911, 99 1136)

$\text{BaCl}_2 + \text{Aq}$  sat at  $8^\circ$  has sp gr 1.27 (Anthon)  
 $\text{BaCl}_2 + \text{Aq}$  sat at  $15^\circ$  has sp gr 1.282 (Michel and Kraft)

$\text{BaCl}_2 + \text{Aq}$  sat at  $18.1^\circ$  has sp gr 1.285 and contains 44.31 pts  $\text{BaCl}_2 + 2\text{H}_2\text{O}$  to 100 pts  $\text{H}_2\text{O}$  (Karsten.)

Sp gr of  $\text{BaCl}_2 + \text{Aq}$  at  $19.5^\circ$

% $\text{BaCl}_2$	Sp gr	% $\text{BaCl}_2$	Sp gr
8.88	1.0760	27.53	1.2245
18.24	1.1521	35.44	1.2837

(Kremers Pogg 99 444)

Sp gr of  $\text{BaCl}_2 + \text{Aq}$  at  $15^\circ$

% $\text{BaCl}_2$	Sp gr	% $\text{BaCl}_2$	Sp gr
1	1.00917	14	1.13778
2	1.01834	15	1.14846
3	1.02750	16	1.15999
4	1.03667	17	1.17152
5	1.04584	18	1.18305
6	1.05569	19	1.19458
7	1.06554	20	1.20681
8	1.07538	21	1.21892
9	1.08523	22	1.23173
10	1.09508	23	1.24455
11	1.10576	24	1.25736
	1.11643	25	1.27017
	1.12711		

(Gerlach, Z anal 8 283)

Sp gr of  $\text{BaCl}_2 + \text{Aq}$  at  $21.5^\circ$

% $\text{BaCl}_2 + 2\text{H}_2\text{O}$	Sp gr	% $\text{BaCl}_2 + 2\text{H}_2\text{O}$	Sp gr
1	1.0073	16	1.1302
2	1.0147	17	1.1394
3	1.0222	18	1.1488
4	1.0298	19	1.1584
5	1.0374	20	1.1683
6	1.0452	21	1.1783
7	1.0530	22	1.1884
8	1.0610	23	1.1986
9	1.0692	24	1.2090
10	1.0776	25	1.2197
11	1.0861	26	1.2304
12	1.0947	27	1.2413
13	1.1034	28	1.2523
14	1.1122	29	1.2636
15	1.1211	30	1.2750

(Schiff, calculated by Gerlach, l c)

Sp gr of  $\text{BaCl}_2 + \text{Aq}$  at  $18^\circ$

% $\text{BaCl}_2$	Sp gr	% $\text{BaCl}_2$	Sp gr
5	1.0445	20	1.2047
10	1.0939	24	1.2559
15	1.1473		

(Kohlrausch, W Ann 1879 1)

Sp gr of  $\text{BaCl}_2 + \text{Aq}$  at  $20^\circ$

g mols $\text{BaCl}_2$ per l	Sp gr
0.01	1.001878
0.025	1.00475
0.05	1.00929
0.075	1.01369
0.10	1.01766
0.25	1.0456
0.40	1.0726

(Jones and Pearce, Am Ch J 1907, 38 11)

$\text{BaCl}_2 + \text{Aq}$  containing 6.94%  $\text{BaCl}_2$  has sp gr  $20^\circ/20^\circ = 1.0640$

$\text{BaCl}_2 + \text{Aq}$  containing 11.38%  $\text{BaCl}_2$  has sp gr  $20^\circ/20^\circ = 1.1086$

(Le Blanc and Rohland, Z phys Ch 1906, 19 279)

Sp gr of  $\text{BaCl}_2 + \text{Aq}$  at  $25^\circ$

$\text{BaCl}_2 + \text{Aq}$	Sp gr
1-normal	1.0884
$\frac{1}{2}$ "	1.0441
$\frac{1}{4}$ "	1.0226
$\frac{1}{8}$ "	1.0114

(Wagner, Z phys Ch 1890, 5 35)

Sp gr of  $\text{BaCl}_2 + \text{Aq}$

$t^\circ$	Concentration of $\text{BaCl}_2 + \text{Aq}$	Sp gr
$25^\circ$	1 pt $\text{BaCl}_2$ in 3.684 pts $\text{H}_2\text{O}$	2194
$22.8^\circ$	1 " " " 52.597 " "	0145

(Hittorf, Z phys Ch 1902, 39 62)

Temp of Maximum Density

Weight of $\text{BaCl}_2$ in 1000 grams $\text{H}_2\text{O}$	Temp of maximum density	Molecular weight of $\text{BaCl}_2$	Sp gr of $\text{BaCl}_2 + \text{Aq}$
0	$3.982^\circ$		
6.73	$3.207^\circ$	23	
10.42	$2.783^\circ$	23	
20.83	$1.572^\circ$	24	
41.72	$-0.843^\circ$	24	

(De Coppet, C R 1897, 125 53)

$\text{BaCl}_2 + \text{Aq}$  containing 10%  $\text{BaCl}_2$  has sp gr at  $100.6^\circ$  (Gerlach)

$\text{BaCl}_2 + \text{Aq}$  containing 20%  $\text{BaCl}_2$  has sp gr at  $101.9^\circ$  (Gerlach)

B-pt of  $\text{BaCl}_2 + \text{Aq}$  containing pts  $\text{BaCl}_2$  to 100 pts  $\text{H}_2\text{O}$  G = according to Gerlach (Z anal 26 443), I = according to I and (A ch (2) 59 452)

B pt	C	I
100.5	6.4	11
101.0	12.7	19
101.5	19.0	26
102.0	25.3	32
102.5	31.6	38
103.0	37.7	44
103.5	43.7	50
104.0	49.5	56
104.4		60
104.5	55.2	

Less sol in H<sub>2</sub>O containing HCl than in pure H<sub>2</sub>O, and scarcely sol in conc HCl + Aq (Berzelius)

Solubility of BaCl<sub>2</sub> in HCl + Aq at 0°  
BaCl<sub>2</sub> = no ½ mols (in milligrammes) dissolved in 10 cc of the liquid, HCl = no mols (in milligrammes) contained in the same quantity of liquid

BaCl <sub>2</sub>	HCl	Sum of mols	Sp gr
29 45	0	29 45	1 250
27 8	1 1	28 9	1 242
26 075	2 8	28 875	1 228
23 4	5 0	28 4	1 210
14 0	14 36	28 36	1 143
10 2	18 775	28 975	1 118
6 67	22 75	29 42	1 099
2 74	32 0	34 74	1 079
0 29	50 5	50 79	1 088

(Engel, Bull Soc (2) 45 653)

Sol in about 8000 pts conc HCl + Aq  
Sol in about 20,000 pts conc HCl + Aq through which HCl gas was passed

Practically insol in conc HCl + Aq containing ½ vol ether (Mar, Sil Am J 143)

Solubility in HCl + Aq at 30°

Composition of the solution		Solid phase
% by wt HCl	% by wt BaCl <sub>2</sub>	
0	27 6	BaCl <sub>2</sub> , 2H <sub>2</sub> O
5 94	12 97	"
11 55	3 85	"
18 11	0 46	"
32 35	0 00	"
37 34	0 00	BaCl, 2H <sub>2</sub> O + BaCl <sub>2</sub> , H <sub>2</sub> O
38 63	0 00	BaCl, H <sub>2</sub> O

(Schreinemakers, Z phys Ch 1909, 68 89)

Much less sol in HNO<sub>3</sub> + Aq than in H<sub>2</sub>O, because Ba(NO<sub>3</sub>)<sub>2</sub> is nearly insol therein (Wurtz)

BaCl<sub>2</sub> is sol in about—

4 00 pts H<sub>2</sub>O

5 00 pts NH<sub>4</sub>OH + Aq (conc)

5 33 pts NH<sub>4</sub>OH + Aq (1 vol conc 3 vols H<sub>2</sub>O)

5 33 pts HCl + Aq (1 vol conc 4 vols H<sub>2</sub>O)

8 00 pts HC<sub>2</sub>H<sub>3</sub>O + Aq (1 vol commercial acid 1 vol H<sub>2</sub>O)

6 00 pts NH<sub>4</sub>Cl + Aq (1 pt NH<sub>4</sub>Cl 10 pts H<sub>2</sub>O)

6 00 pts NH<sub>4</sub>C<sub>2</sub>H<sub>3</sub>O + Aq (dil NH<sub>4</sub>OH + Aq neutralized by dil HC<sub>2</sub>H<sub>3</sub>O + Aq)

6 67 pts NaC<sub>2</sub>H<sub>3</sub>O + Aq (commercial HC<sub>2</sub>H<sub>3</sub>O neutralized by Na<sub>2</sub>CO<sub>3</sub>, and dil with 4 vols H<sub>2</sub>O)

6 33 pts Cu(C<sub>2</sub>H<sub>3</sub>O)<sub>2</sub> + Aq See Stolba (Z anal 2 390)

5 67 pts grape sugar (1 pt grape sugar 10 pts H<sub>2</sub>O) (Penon, Zeit Chem 1869 662)

BaCl<sub>2</sub> + NH<sub>4</sub>Cl Solubility of BaCl<sub>2</sub> in NH<sub>4</sub>Cl + Aq at 30°

Composition of the solution		Solid phase
% NH <sub>4</sub> Cl	% BaCl <sub>2</sub>	
0	27 6	BaCl <sub>2</sub> , 2H <sub>2</sub> O
5 71	22 16	"
10 06	18 36	"
13 84	15 42	"
20 00	10 89	"
24 69	8 33	"
25 79	7 95	BaCl <sub>2</sub> , 2H <sub>2</sub> O + NH <sub>4</sub> Cl
26 06	7 99	"
27 47	3 56	NH <sub>4</sub> Cl
29 5	0	"

(Schreinemakers, Z phys Ch 1909, 66 688)

See also under Ammonium chloride

BaCl<sub>2</sub> + Ba(OH)<sub>2</sub> Solubility of BaCl<sub>2</sub> in BaO + Aq at 30°

Composition of the solution		Solid phase
% by wt BaO	% by wt BaCl <sub>2</sub>	
0	27 6	BaCl <sub>2</sub> , 2H <sub>2</sub> O
1 78	27 42	"
1 79	27 31	BaCl <sub>2</sub> , 2H <sub>2</sub> O + BaCl(OH), 2H <sub>2</sub> O
1 75	27 41	"
2 33	24 98	BaCl(OH), 2H <sub>2</sub> O
2 50	24 20	"
3 27	21 46	"
4 67	19 18	"
4 86	18 97	BaCl(OH), 2H <sub>2</sub> O + BaO, 9H <sub>2</sub> O
4 29	18 83	"
4 64	18 77	"
4 65	18 10	"
4 62	18 04	BaO, 9H <sub>2</sub> O
4 60	17 08	"
4 58	12 81	"
4 45	10 77	"
4 99	0	"

(Schreinemakers, Z phys Ch 1909, 68 88)

Sol in CuCl<sub>2</sub>, NH<sub>4</sub>Cl + Aq at 30° (Schreinemakers, Z phys Ch 1909, 66 688)

The solubility data for the system BaCl + CuCl<sub>2</sub> + HCl + Aq have been determined at 40° and 60° (Schreinemakers, C C 1915, I 933)

BaCl + HgCl Solubility of BaCl + HgCl in H<sub>2</sub>O

t	Cms per 100 g solution		Solid phase
	BaCl	HgCl	
10 4°	23 58	50 54	BaCl, 2H <sub>2</sub> O + HgCl
10 4	23 44	50 74	BaCl <sub>2</sub> , 3HgCl 6H <sub>2</sub> O
10 4	22 58	51 23	
10 4	22 48	51 41	
10 4	22 10	51 66	
10 4	21 64	51 74	BaCl, 2H <sub>2</sub> O + HgCl <sub>2</sub>
25 0	23 02	54 83	

(Foote and Bristol, Am Ch J 32 248)

Solubility of  $\text{BaCl}_2 + \text{HgCl}_2$  in  $\text{H}_2\text{O}$ 

Temp = 30			Temp = 0°		
% $\text{HgCl}_2$	% $\text{BaCl}_2$	Solid phase	% $\text{HgCl}_2$	% $\text{BaCl}_2$	Solid phase
0	27 77	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$	0	23 70	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
2 90	27 56	"	14 25	24 0	"
7 09	27 47	"	36 20	24 89	"
12 98	26 99	"	46 12	24 07	$\text{BaCl}_2 \cdot 3\text{HgCl}_2 \cdot 6\text{H}_2\text{O} +$
22 61	26 89	"	46 05	24 03	" $\text{BaCl}_2$ $\text{I}_2\text{O}$
34 57	26 69	"	46 07	24 05	"
46 50	25 22	"	46 59	23 28	$\text{BaCl}_2 \cdot 3\text{HgCl}_2 \cdot 6\text{H}_2\text{O}$
55 16	23 46	$\text{HgCl}_2 + \text{BaCl}_2 \cdot 2\text{H}_2\text{O}$	47 78	21 05	"
55 32	23 08	"	48 43	20 64	$\text{BaCl}_2 \cdot 3\text{HgCl}_2 \cdot 6\text{H}_2\text{O} + \text{I}_2\text{Cl}_2$
55 19	22 98	"	48 49	20 71	"
48 97	17 87	$\text{HgCl}_2$	44 33	18 50	$\text{HgCl}_2$
41 30	14 26	"	29 0	11 59	"
27 62	8 41	"	16 36	6 11	"
14 19	2 65	"	3 95	0	"
7 67	0	"			
Temp = 40°			Temp = 40°		
56 57	22 98	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O} + \text{HgCl}_2$			

(Schreinemakers, Ch Weekbl 1911, 7 202)

$\text{BaCl}_2 + \text{KCl}$  Sol in sat  $\text{KCl} + \text{Aq}$ , at first without pptn. The  $\text{KCl}$  is pptd after a time until a state of equilibrium is reached.

100 pts  $\text{H}_2\text{O}$  at 16.6° dissolve 33.8–27.2 pts  $\text{KCl}$  and 18.2–34.9 pts  $\text{BaCl}_2$  (Kopp, A 34 267)

100 g sat solution of  $\text{BaCl}_2 + \text{KCl}$  contain 13.83 g  $\text{BaCl}_2$  and 18.97 g  $\text{KCl}$  at 25° (Foote, Am Ch J 32 253)

$\text{BaCl}_2 + \text{Ba}(\text{NO}_3)_2$   $\text{BaCl}_2$  is sol in sat  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$

Solubility of  $\text{BaCl} + \text{Ba}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$  Both salts present in solid phase

t°	Gms per 100 gms solution		t°	Gms per 100 gms solution	
	$\text{BaCl}$	$\text{Ba}(\text{NO}_3)_2$		$\text{BaCl}$	$\text{Ba}(\text{NO}_3)_2$
0	22 5	4 3	100	31	14
20	24 5	6 0	140	32	20
40	26 5	7 5	180	33	26
60	28 5	9 5	210	32	32

(Lutrd, A Ch (7) 2 535)

Very slowly sol in sat  $\text{NaNO}_3 + \text{Aq}$  with separation of  $\text{Ba}(\text{NO}_3)_2$

Rapidly sol in sat  $\text{KNO}_3 + \text{Aq}$ , forming  $\text{Ba}(\text{NO}_3)_2$ , which separates out (Karsten)

$\text{BaCl}_2 + \text{NaCl}$   $\text{BaCl}_2$  is sol in  $\text{NaCl} + \text{Aq}$  at first without separation of  $\text{NaCl}$ , which, however, finally separates

100 pts  $\text{H}_2\text{O}$  dissolve, when both salt are in excess—

	1	2	3	4	5	6
$\text{NaCl}$	35 9	4 1		40 4	35	
$\text{BaCl}_2$		34 5	35 0		19 4	0 3
		38 6			54	

1, 2, and 3 are at 17° (Kopp, A 34 68)  
4, 5, and 6 are at b-pt (Mulder)

Solubility of  $\text{BaCl}_2 + \text{NaCl}$   
100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{BaCl}$  and  $\text{NaCl}$  at t°

t°	Pts $\text{BaCl}$	Pts $\text{NaCl}$	t°	Pts $\text{BaCl}$	Pts $\text{NaCl}$
10	4 1	33 9	60	9 7	5
20	4 1	33 8	70	11 7	6
30	5 0	33 7	80	13 9	6
40	6 3	33 6	90	15 9	6
50	7 9	33 5	100	17 9	6

(Pfecht und Wittgen, B 14 1667)

Solubility of  $\text{BaCl} + \text{NaCl}$  in  $\text{HCl} + \text{Aq}$  30°

Solid phase $\text{NaCl}$			Solid phase $\text{BaCl}$		
Sp gr of sat solution	C mol litre		Sp gr of sat solution	C mol	
	$\text{HCl}$	$\text{NaCl}$		$\text{HCl}$	$\text{NaCl}$
1 2018	0 0000	5 400	1 3056	0 0000	745
1 1906	0 4575	4 932	1 2651	0 4709	468
1 1801	0 969	4 386	1 2147	1 107	122
1 1633	1 786	3 589	1 1789	1 622	861
1 1512	2 412	2 978	1 1419	2 234	592
1 1427	3 052	2 463	1 1068	3 041	307
1 1289	4 152	1 628	1 0880	3 953	124
1 1188	5 950	0 630	1 0895	3 059	020
1 1258	7 205	0 268	1 1024	6 234	00
			1 1609	10 25	00

(Masson, Chem Soc 1911, 99 1136)

Solubility of  $\text{BaCl}_2 + \text{NaCl}$  in  $\text{HCl} + \text{Aq}$  at  $30^\circ$ 

%HCl	%NaCl	%BaCl <sub>2</sub>	Solid phase
0	23 85	3 8	$\text{NaCl}, \text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
4 84	18 07	2 27	"
12 02	9 55	0 82	"
17 20	4 65	0 29	"
23 16	1 54	0 00	"
28 66	0 47	0 00	"
36 51	0 12	0 00	$\text{NaCl} + \text{BaCl}_2 \cdot \text{H}_2\text{O}$

(Schrenemakers, Arch Néer Sc ex nat (2) 15 91)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

Solubility in alcohol 100 pts alcohol of given sp gr dissolve pts of the anhydrous and crystallized salt

Sp gr	Pts BaCl <sub>2</sub>	Pts BaCl <sub>2</sub> + 2H <sub>2</sub> O
0 900	1 00	1 56
0 848	0 29	0 43
0 834	0 185	0 32
0 817	0 09	0 06

(Kirwan)

Insol in abs alcohol, or below  $19^\circ$  in alcohol of over 91% Dil alcohol dissolves less  $\text{BaCl}_2$  than corresponds to the amount of  $\text{H}_2\text{O}$  present (Gerardin, A ch (4) 5 142)Solubility in 100 pts alcohol at  $t^\circ$  D=sp gr of alcohol, S=solubility

D=0 9904		D=0 9848		D=0 9793		D=0 9726	
$t^\circ$	s	t	s	t	s	$t^\circ$	s
14	29 1	14	25 0	11	19 6	13	13 6
25	32 0	32	29 1	15	20 4	23	17 0
32	33 3	39	30 9	20	21 7	33	19 1
47	37 4	50	33 2	35	24 0	50	22 0
60	39 8	63	37 6	45	26 8		

D=0 9573		D=0 9390		D=0 8967		D=0 8429	
t	s	$t^\circ$	s	$t^\circ$	s	t	s
13	10	12	6 3	12	0 1	12	0 00
24	11 4	23	7 2	30	4 3	19	0 00
34	12 9	31	8 3	47	4 9	20	0 04
39	13 8	37	9 0			20	0 25
50	15 2	47	10 1			67	0 377

(Gerardin, A ch (4) 5 142)

Solubility in dil alcohol of x% by weight at  $15^\circ$ 

% alcohol	0	10	20	30	40	60	80
Pts BaCl <sub>2</sub> · 2H <sub>2</sub> O	30 2	23 7	18 0	12 8	9 3	3 4	0 5

(Scheff, A 118 365)

Sol in 6885-8108 pts 99 3% alcohol at  $14.5^\circ$ , and in 1857 pts at ebullition (Fresenius)Solubility of  $\text{BaCl}_2$  in alcohol + Aq

$t^\circ$	% alcohol	% BaCl <sub>2</sub>	Solid phase
30°	0	27 95	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
"	32 67	10 63	"
"	50 16	5 68	"
"	66 72	2 23	"
"	92 53	0 05	"
"	94 83	0 07	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O} + \text{BaCl}_2 \cdot \text{H}_2\text{O}$
"	94 75	0 05	"
"	94 60	0 07	"
"	97 14		$\text{BaCl}_2 \cdot \text{H}_2\text{O}$
"	98 17	0 08	$\text{BaCl}_2 \cdot \text{H}_2\text{O} + \text{BaCl}_2$
"	99 41		$\text{BaCl}_2$
60°	0	31 57	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
"	16 68	20 16	"
"	34 10	13 21	"
"	66 02	2 82	"
"	88 55	0 25	"
"	90 11	0 09	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O} + \text{BaCl}_2 \cdot \text{H}_2\text{O}$
"	90 39		"
"	93 95		$\text{BaCl}_2 \cdot \text{H}_2\text{O}$

(Schrenemakers and Massink, Chem Weekbl 1910, 7 213)

100 pts absolute methyl alcohol dissolve 2 18 pts  $\text{BaCl}_2$  at  $15.5^\circ$ , and 7 3 pts  $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$  at  $6^\circ$  (de Bruyn, Z phys Ch 10 783)At  $15^\circ \text{C}$  1 pt by weight is sol in —

78 pts methyl alcohol of sp gr 0 790  
 7,000 " ethyl " " " 0 8035  
 100,000 " propyl " " " 0 8085  
 (Rohland, Z anorg 1897, 15 413)

Absolutely insol in boiling amyl alcohol (Browning, Sill Am J 144 459)

Absolutely insol in acetic ether (Cann, C R 102 363)

Very sl sol in acetone (Krug and M'Elroy, J Anal Ch 6 184)

100 pts by weight of glycerine dissolve 10 pts  $\text{BaCl}_2$  at  $15.5^\circ$  (de Bruyn, Z phys Ch 10 783)

Insol in acetone (Naumann, B 1904, 37 4329) (Ludmann, C C 1899, 11 1014)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in anhydrous pyridine, 97% pyridine + Aq and 95% pyridine + Aq. Sl sol in 93% pyridine + Aq (Kahlenberg, J Am Chem Soc 1908, 30 1107)

+  $\text{H}_2\text{O}$  Solution of monohydrate sat at  $6^\circ$  contains 31 57%  $\text{BaCl}_2$  (Schrenemakers, Chem Weekbl 1910, 7 213)2 5 grams of the monohydrate are sol in 100 cc of methyl alcohol at  $14^\circ$  (Kirschner, Z phys Ch 1911, 76 176)Exact solubility in methyl alcohol cannot be determined as  $\text{BaCl}_2 + \text{H}_2\text{O}$  separates out from a sat solution of the dihydrate (Kirschner, Z phys ch 1911, 76 177)Barium cadmium chloride,  $\text{BaCl}_2 \cdot \text{CdCl}_2 + 4\text{H}_2\text{O}$ Easily sol in  $\text{H}_2\text{O}$  (v Hauer)

Solubility in  $H_2O$  at  $t^\circ$ 

$t^\circ$	100 pts solution contain pts			100 g of solution contain g salt	100 g $H_2O$ dissolve g salt	100 mol dissolve anhydro	H O ls of salt
	Cl	Ba	Cd				
22 5	15 19	14 71	11 98	41 88	72 06	3	
32 9	16 18	16 09	12 40	44 59	80 73	3	
41 4	16 95	16 81	13 05	46 87	88 01	4	
53 4	18 21	18 13	13 95	50 30	101 21	4	
62 0	18 81	18 74	14 73	52 28	109 56	5	
97 8	22 48	22 00	17 57	62 05	163 50	7	
108 3	23 51	22 79	18 53	64 83	184 33	8	
109 2	23 69	29 95	18 67	65 31	188 27	8	

(Rimbach, B 1897, 30 3083)

 $BaCl_2 \cdot 2CdCl_2 + 5H_2O$  Quite difficultly sol in  $H_2O$  (v Hauer)Solubility in  $H_2O$  at  $t^\circ$ 

$t^\circ$	100 pts by wt of solution contain pts by wt			100 g of solution contain g salt	100 g $H_2O$ dissolve g salt	100 mol dissolve anhydro	H O ls of salt
	Cl	Ba	Cd				
22 6	16 89	11 00	17 71	45 60	83 82	2	
41 3	18 15	11 77	19 22	49 14	96 62	3	
53 9	18 78	12 41	19 85	51 04	104 25	3	
62 2	19 66	12 83	20 59	53 08	113 13	3	
69 5	20 18	13 09	21 20	54 47	119 64	3	
107 2	23 31	14 87	24 11	62 29	165 18	5	
107 2	23 16	14 93	24 39	62 48	166 53	5	

(Rimbach, B 1897, 30 3083)

**mercuric chloride, basic,  $BaCl_2 \cdot HgO$** Decomp by  $H_2O$  (André, C R 104 431)**Barium mercuric chloride,  $BaCl_2 \cdot 2HgCl_2 + 2H_2O$** Efflorescent in dry air, sol in  $H_2O$  (v Bonsdorff, Pogg 17 130)The salt  $BaCl_2 \cdot 2HgCl_2 + 2H_2O$  described by Bonsdorff does not form under the conditions which he gives (Foote, Am Ch J 1904, 32 251) $BaCl_2 \cdot 3HgCl_2 + 6H_2O$  Solubility determinations with mixtures of  $BaCl_2$  and  $HgCl_2$  show that these chlorides do not form a double salt at  $25^\circ$ , but that a transition temp exists at about  $17.2^\circ$  below which the salt  $BaCl_2 \cdot 3HgCl_2 + 6H_2O$  forms (Foote, Am Ch J 1904, 32 251) $+8H_2O$  Less sol in  $H_2O$  than the Sr and Mg double salts (Swan, Am Ch J 1898, 20 633)**Barium rhodium chloride,  $3BaCl_2 \cdot RhCl_3$** 

See Chlororhodite, barium

**Barium stannous chloride,  $BaCl_2 \cdot SnCl_2 + 4H_2O$** Sol in  $H_2O$  (Poggialk, C R 20 1183)**Barium stannic chloride**

See Chlorostannate, barium

**Barium uranium chloride,  $BaCl_2 \cdot UCl_4$** Decomp by  $H_2O$  (Aloy, Bull Soc 1899, (3) 21 265)**Barium zinc chloride,  $BaCl_2 \cdot ZnCl_2 + 4H_2O$**   
Deliquescent, and sol in  $H_2O$  (Werner, C N 27 271)Pptd from warm solution only (Epbaum, Z anorg 1910, 67 381)  
 $+2\frac{1}{2}H_2O$  Pptd from cold solution (Ephraim)**Barium chloride hydrazine,  $BaCl_2 \cdot 2NH_4$**   
Hydrosopic (Franzen, Z anorg 1908, 60 290)**Barium chloride hydroxylamine,  $BaCl_2 \cdot 2NH_2OH$** Very sol in  $H_2O$  (Crismer, Bull S 3 118)**Barium chloride sulphuric anhydride,  $BaCl_2 \cdot 2SO_3$** Decomp by  $H_2O$  (Schultz-Schlick B 4 113)**Barium chlorofluoride,  $BaClF$** Difficultly sol in  $H_2O$ , but much more sol than  $BaF_2$ . Decomp by  $H_2O$ , so that when washed on filter, the filtrate contains more  $BaCl_2$  than  $BaF_2$  (Berzelius, Pogg 1 9)Insol in and undecomp by boiling alcohol, sol in conc  $HCl$  and  $HNO_3$ . Decomposed by hot  $H_2SO_4$ , dil acetic acid, dil  $HCl$  or dil  $HNO_3$  (Defacqz, C R 190 138 198)**Barium cyanamide,  $BaCN_2$** Decomp by  $H_2O$  (Frank, C C 16 2, II 774)

**Barium subfluoride sodium fluoride, BaF, NaF**

Decomp by H<sub>2</sub>O (Guntz, C R 1903, 136 750)

**Barium fluoride, BaF<sub>2</sub>**

Scarcely sol in H<sub>2</sub>O (Berzelius), less sol in H<sub>2</sub>O than CaF<sub>2</sub>

1 liter H<sub>2</sub>O dissolves 1630 mg BaF<sub>2</sub> at 18° (Kohlrausch, Z phys Ch 1904, 50 356)

1605 mg are contained in 1 l of sat solution at 18° (Kohlrausch, Z phys Ch 1908, 64 168)

Insol in molten MnCl<sub>2</sub>, MnBr<sub>2</sub>, MnI<sub>2</sub>, MnCl<sub>2</sub>+BaCl<sub>2</sub>, MnBr<sub>2</sub>+BaBr<sub>2</sub> and MnI<sub>2</sub>+BaI<sub>2</sub> (Defacqz, A ch 1904, (8) 1 350)

Easily sol in HCl, HNO<sub>3</sub>, or HF+Aq (Gay-Lussac and Thénard)

Sl sol in liquid HF (Franklin, Z anorg 1905, 46 2)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Sol in an aqueous solution of sodium citrate (Spiller)

**Barium tin (stannic) fluoride**

See Fluostannate, barium

**Barium tellurium fluoride, BaF<sub>2</sub>, 2TeF<sub>4</sub>**

Decomp by H<sub>2</sub>O (Hogbom, Bull Soc (2) 35 60)

**Barium titanium fluoride**

See Fluotitanate, barium

**Barium titanyl fluoride, TiO<sub>2</sub>F<sub>2</sub>, BaF<sub>2</sub>**

See Fluoxypertitanate and fluoxytitanate, barium

**Barium uranyl fluoride**

See Fluoxyuranate, barium

**Barium vanadyl fluoride**

See Fluoxyvanadate, barium

**Barium zirconium fluoride, 3BaF<sub>2</sub>, 2ZrF<sub>4</sub>+2H<sub>2</sub>O**

Insoluble precipitate (Marignac)

See also Fluozirconate, barium

**Barium fluoiodide, BaF<sub>2</sub>, BaI<sub>2</sub>**

Decomp by H<sub>2</sub>O, dil HCl, dil HNO<sub>3</sub> or hot H<sub>2</sub>SO<sub>4</sub>. Sol in HI and HNO<sub>3</sub>. Insol in and undecomp by boiling alcohol. Decomp by dil acetic acid (Defacqz, C R 1904, 138 199)

**Barium hydride, BaH<sub>2</sub>**

Decomp by H<sub>2</sub>O or HCl+Aq (Winkler, B 24 1979)

Decomp by H<sub>2</sub>O (Guntz, C R 1901, 132 964)

**Barium hydrosulphide, BaS<sub>2</sub>H<sub>2</sub>**

Easily sol in H<sub>2</sub>O. Insol in alcohol +4H<sub>2</sub>O. Sol in H<sub>2</sub>O, and the solution dissolves S (Veley, Chem Soc 49 369)

**Barium hydroxide, BaO<sub>2</sub>H<sub>2</sub>**

100 pts cold H<sub>2</sub>O dissolve 5 pts BaO<sub>2</sub>H<sub>2</sub> boiling 50

(Davy)

100 pts H<sub>2</sub>O at 20° dissolve 3.45 pts BaO (Bineau C R 41. 509)

100 pts H<sub>2</sub>O at 13° dissolve 2.86 pts BaO  
47° 13 3  
70° 17 9

(Osann)

100 pts H<sub>2</sub>O dissolve pts BaO at t°

t°	Pts BaO	t°	Pts BaO	t°	Pts BaO
0	1 5	30	5 0	60	18 76
5	1 75	35	6 17	65	24 67
10	2 22	40	7 36	70	31 9
15	2 89	45	9 12	75	56 85
20	3 48	50	11 75	80	90 77
25	4 19	55	14 71		

(Rosenthal and Ruhlmann, J B 1870 314)

100 pts H<sub>2</sub>O dissolve at 25° 55.08 millimols BaO<sub>2</sub>H<sub>2</sub> (Herz and Knoch, Z anorg 1904, 41 315)

Sp gr of BaO<sub>2</sub>H<sub>2</sub>+Aq

%BaO	Sp gr	%BaO	Sp gr
30	1 6	1 8	1 02
19	1 3	0 9	1 01
2 6	1 03		

(Dalton)

Sp gr of BaO<sub>2</sub>H<sub>2</sub>+Aq at 18° containing 1 25% BaO<sub>2</sub>H<sub>2</sub>=1 0120, containing 2 5%=1 0253 (Kohlrausch, W Ann 1879, 6 41)

Sp gr of BaO<sub>2</sub>H<sub>2</sub>+Aq at 80°

Sp gr	% BaO <sub>2</sub> H <sub>2</sub> by volume	% BaO <sub>2</sub> H <sub>2</sub> by weight	Sp gr	% BaO <sub>2</sub> H <sub>2</sub> by volume	% BaO <sub>2</sub> H <sub>2</sub> by weight
1 514	58 22	38 45	1 219	24 53	20 12
1 500	56 31	37 54	1 200	23 00	19 17
1 479	54 14	36 60	1 195	22 15	18 53
1 458	49 38	33 87	1 174	19 83	16 89
1 450	48 90	33 72	1 152	17 78	15 43
1 413	45 99	32 55	1 129	16 01	14 18
1 400	45 00	32 14	1 125	15 80	14 04
1 390	44 22	31 81	1 114	14 56	13 07
1 375	42 40	30 84	1 100	13 06	11 87
1 368	41 45	30 30	1 076	10 58	9 83
1 350	38 60	28 59	1 062	9 16	8 62
1 338	37 30	27 88	1 049	7 55	7 20
1 312	35 02	26 69	1 040	6 51	6 26
1 301	34 02	26 13	1 031	5 18	5 02
1 278	31 48	24 67	1 022	4 78	4 67
1 249	28 14	22 52	1 015	3 90	3 84
1 236	26 41	21 36	1 009	3 37	3 34

(Haff, C N 1902, 86 284)

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 827)

More sol in NaCl+Aq, KNO<sub>3</sub>+Aq, or NaNO<sub>3</sub>+Aq than in H<sub>2</sub>O (Karsten)

Not precipitated by alcohol



Sol with combination in absolute alcohol and anhydrous methyl alcohol Insol in ether

Insol in acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

Solubility in acetone + Aq at 25°

A = cc acetone in 100 cc acetone + Aq

$\text{BaO}_2\text{H}_2 = \text{millimols BaO}_2\text{H}_2 \text{ in } 100 \text{ cc of}$

the solution

S = sp gr of the solution

A	$\frac{\text{BaO}_2\text{H}_2}{2}$	S
0	55 08	1 04790
10	31 84	1 01677
20	17 79	0 99268
30	9 10	0 97630
40	4 75	0 95605
50	1 54	0 93980
60	0 48	0 91790
70	0 08	0 89562

(Herz, Z anorg 1904, 41 321)

$\text{BaO}_2\text{H}_2$  is sol in an aqueous solution of cane sugar (Hunton, Phil Mag (3) 11 156), also in an aqueous sol of mannite (Favre, A ch (3) 11 76), sorbine (Pelouze), hot solution of quercite, separating on cooling (Des-saignes)

+3H<sub>2</sub>O Decomp by H<sub>2</sub>O free from carbonic acid Sl sol in alcohol and ether (Bauer, Z anorg 1905, 47, 416)

Solubility in H<sub>2</sub>O the same as that of the comp with 8H<sub>2</sub>O Insol in alcohol and ether (Bauer, Zeit angew Ch 1903, 17 341)

Nearly insol in alcohol and ether (Bauer, Zeit angew Ch 1903, 16 349)

+8H<sub>2</sub>O Sol in 20 pts cold, and 3 pts boiling H<sub>2</sub>O (Graham), 175 pts H<sub>2</sub>O at 155°, and in all proportions of hot H<sub>2</sub>O (Hope) Sol in 19 pts H<sub>2</sub>O at 15°, and 2 pts at 100° (Wittstein)

If  $\text{BaO}_2\text{H}_2 + 8\text{H}_2\text{O}$  is heated it dissolves in the crystal H<sub>2</sub>O and the solution has the following bpts

%BaO 49 05 50 05 52 43 53 72  
B-pt 103° 104° 105° 106°

%BaO 55 35 57 49 58 74 61 44  
B-pt 107° 108° 108 5° 109°

$\text{BaO}_2\text{H}_2 + 3\text{H}_2\text{O}$  separates at 109° (Bauer, Zeit angew Ch 1903, 17 345)

B-pt of  $\text{BaO}_2\text{H}_2 \cdot 8\text{H}_2\text{O} + \text{Aq}$  at 732 mm

Bpt	Time	%BaO
78° (mpt)	0	48 45
78	4'	48 45
103	6' 30"	49 05
104	6' 45"	50 05
105	7' 30"	52 43
106	9' 25"	53 72
107	10' 45"	55 35

B-pt of  $\text{BaO}_2\text{H}_2 \cdot 8\text{H}_2\text{O} + \text{Aq}$ , etc — C *continued*

Bpt	Time	%	BaO
108	12'	5	49
108 5	—	5	74
109	13'	6	44
109	17' 40"	6	65
108	17' 50"	6	53
105	18'	6	51
100	18' 45"	6	17

(Bauer, Z anorg 1905, 47 40)

Solubility in  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at 25°  
Solution sat with respect to both 1 and  $\text{BaO}_2\text{H}_2 \cdot 8\text{H}_2\text{O}$  ( $\text{NO}_3$ )<sub>2</sub>

Sp gr 25°/25°	g BaO as $\text{Ba}(\text{OH})_2$ in 100 g H <sub>2</sub> O	g Ba 100	(NO <sub>3</sub> ) <sub>2</sub> in H <sub>2</sub> O
1 1448	5 02	1	48
1 1371	4 93	1	21
1 1288	4 83		66
1 1220	4 72		55
1 1133	4 72		01
1 1062	4 65		82
1 1044	4 61		55
1 1010	4 64		08
1 0975	4 60		66
1 0949	4 55		46
1 0937	4 54		32
1 0885	4 52		44
1 0864	4 53		41
1 0840	4 52		04
1 0790	4 48		47
1 0774	4 46		14
1 0731	4 40		79
1 0711	4 42		53
1 0651	4 35		88
1 0626			
1 0640	4 35		45
1 0538	4 29		43
1 0512	4 29		

(Parsons and Coison, J Am Chem Soc 1910, 32 1385)

Solubility of  $\text{Ba}(\text{OH})_2 + \text{H}_2\text{O}$  (solid phase) in  $\text{MCl} + \text{Aq}$  (mol per litre of solution) at 25°

Solution of	(Cl)	(C)
LiCl	0	0 35
"	0 75	0 15
"	1 42	0 37
"	2 30	1 36
KCl	0 86	0 15
"	1 75	0 30
"	3 10	0 76
NaCl	0	0 35
"	0 73	0 30
"	1 43	0 39
"	2 82	0 36
RbCl	1 25	0 18

(Herz, Z anorg 1910, 67 36)

## Solubility of BaO in NaOH + Aq at 30°

% Na <sub>2</sub> O	% BaO	Solid phase
0	4.99	BaO 9H <sub>2</sub> O
4.78	1.29	"
6.43	0.89	"
9.63	0.57	"
11.62	0.53	"
17.87	0.47	"
23.28	1.06	"
24.63	1.87	BaO 9H <sub>2</sub> O + BaO 4H <sub>2</sub> O
26.14	1.84	BaO 4H <sub>2</sub> O
27.72	1.75	"
28.43	1.58	"
29.24	1.34	BaO 4H <sub>2</sub> O + BaO 2H <sub>2</sub> O
32.12	0.82	BaO 2H <sub>2</sub> O
34.72	0.59	"
41.09	0.57	BaO 2H <sub>2</sub> O + NaOH H <sub>2</sub> O
42	0	NaOH H <sub>2</sub> O

(Schreinemakers, Z phys Ch 1909, 68 84)

50% alcohol dissolves less than 0.5% of its wt of BaO<sub>2</sub>·H<sub>2</sub>+8H<sub>2</sub>O (Beckmann, J pr 1883, (2) 27 138)

**Barium subiodide sodium iodide**, BaI, NaI  
Decomp by H<sub>2</sub>O (Guntz, C R 1903, 136 750)

**Barium iodide**, BaI<sub>2</sub>

Not deliquescent. Very sol in H<sub>2</sub>O and alcohol. 100 pts of anhydrous salt dissolve at 0° 19 5° 30° 40° 60° 90° 106°  
in 59 48 44 43 41 37 35 pts H<sub>2</sub>O  
(Kremers, Pogg 103 66)

Sp gr of BaI<sub>2</sub> + Aq containing

5	10	15	20	25	30% BaI <sub>2</sub>
1.045	1.091	1.143	1.201	1.265	1.333
35	40	45	50	55	60% BaI <sub>2</sub>
1.412	1.495	1.596	1.704	1.825	1.970

(Kremers, Pogg 111 63, calculated by Grulich, Z anal 8 279)

Easily sol in alcohol (Henry)

Sl sol in benzotritile (Naumann, B 1914, 47 1369)

Sol in acetone (Naumann, B 1904, 37 4328; Ludm un, C C 1899, II 1014)

Sol in methyl acetate (Naumann, B 1909, 42 3789)

+2H<sub>2</sub>O At 15°C, 1 pt by weight in sol in

22 pts	methyl alcohol	sp gr	0.790
93 "	"	"	0.5035
307 "	"	"	0.8085

(Rohland, Z anorg 1897, 15 413)

+7H<sub>2</sub>O (Thomson, B 10 1343)

The composition of the hydrates formed by BaI<sub>2</sub> at different dilutions is calculated from determinations of the lowering of the fr-pt produced by BaI<sub>2</sub> and of the conductivity and sp gr of BaI<sub>2</sub> + Aq (Jones, Am Ch J 1905, 34 306)

**Barium iodide, basic**, Ba(OH)I + 9H<sub>2</sub>O

See Barium oxyiodide

**Barium bismuth iodide**, BaI<sub>2</sub>, 2BiI<sub>3</sub> + 18H<sub>2</sub>O  
Deliquescent, decomp by H<sub>2</sub>O (Linna, Pogg 111 240)

**Barium cadmium iodide**, BaI<sub>2</sub>, CdI<sub>2</sub> + 5H<sub>2</sub>O  
Deliquescent (Croft)

**Barium mercuric iodide**, BaI<sub>2</sub>, 2HgI<sub>2</sub>  
Decomp by much H<sub>2</sub>O (Boullay)  
BaI<sub>2</sub>, HgI<sub>2</sub> Sol in H<sub>2</sub>O (Boullay)  
Sp gr of sat solution = 3.575–3.588 (Rohrbach, W Ann 20 169)  
+5H<sub>2</sub>O (Duboin, C R 1906, 143 314)  
2BaI<sub>2</sub>, 3HgI<sub>2</sub> + 16H<sub>2</sub>O (Duboin, C R 1906, 142 888)  
BaI<sub>2</sub>, 5HgI<sub>2</sub> + 8H<sub>2</sub>O As the corresponding Ca salt (Duboin, C R 1906, 142 888)  
3BaI<sub>2</sub>, 5HgI<sub>2</sub> + 21H<sub>2</sub>O Very deliquescent (Duboin, C R 1906, 142 889)

**Barium stannous iodide**

Very sol in H<sub>2</sub>O (Boullay)

**Barium zinc iodide**, BaI<sub>2</sub>, 2ZnI<sub>2</sub>  
Deliquescent, and sol in H<sub>2</sub>O (Rammelsberg)  
+4H<sub>2</sub>O Very hygroscopic (Ephraim, Z anorg 1910, 67 385)

**Barium nitride**, Ba<sub>3</sub>N

Decomp H<sub>2</sub>O violently, not alcohol  
quenne, A ch (6) 29 219)  
BaN<sub>8</sub>

See Barium azonide

**Barium oxide**, BaO

Sol in H<sub>2</sub>O with evolution of heat  
Easily sol in dil HNO<sub>3</sub>, or HCl + Aq  
Solubility in NaOH + Aq See Barium hydroxide

Solubility in Na<sub>2</sub>O, HCl, +H<sub>2</sub>O at 30° (Schreinemakers, Z phys Ch 1909, 68 98)  
Solubility in Na<sub>2</sub>O, NaCl, BaCl + Aq at 30° (Schreinemakers)  
Insol in liquid NH<sub>3</sub> (Gore, Am Ch J 1898, 20 827)

Sol with combination in absolute alcohol and anhydrous wood-spirit Insol in ether  
Easily sol in absolute methyl alcohol  
1 l absolute ethyl alcohol sat with BaO at 0° contains 213 g BaO (Berthelot, Bull Soc 8 389)

Sol in methyl alcohol (Neuberg and Neumann, Biochem Z 1906, 1 173)

Insol in acetone (Fiedmann, C C 1899, II 1014; Naumann, B 1904, 37 4329)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

See also Barium hydroxide

**Barium peroxide**, BaO<sub>2</sub>

Insol in H<sub>2</sub>O, decomp by boiling H<sub>2</sub>O

Sol in acids with formation of hydrogen dioxide

Forms hydrate with  $8\text{H}_2\text{O}$ , also  $10\text{H}_2\text{O}$  (Berthelot, A ch (5) 21 157), also a compound  $\text{BaO}_2 \cdot \text{H}_2\text{O}_2$ , which is very unstable, sl sol in cold  $\text{H}_2\text{O}$ , and insol in alcohol or ether (Schone, A 192 257)

+ $8\text{H}_2\text{O}$  100 cc pure  $\text{H}_2\text{O}$  dissolve 0.168 g  $\text{BaO}_2 \cdot 8\text{H}_2\text{O}$ , if  $\text{H}_2\text{O}$  contains 0.3 g  $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$ , only 0.102 g  $\text{BaO}_2 \cdot 8\text{H}_2\text{O}$  are dissolved, if 0.6 g  $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$  only 0.019 g  $\text{BaO}_2 \cdot 8\text{H}_2\text{O}$  are dissolved (Schone, A 1878, 192 266)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)

**Barium oxybromide**,  $\text{Ba}(\text{OH})\text{Br} \cdot 2\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Beckmann, J pr (2) 27 132)

$\text{BaBr}_2 \cdot \text{BaO} + 5\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Tassilly, C R 1895, 120 1340)

**Barium oxychloride**,  $\text{Ba}(\text{OH})\text{Cl} \cdot 2\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Beckmann, J pr (2) 26 388, 474)

**Barium mercury oxychloride**,  $\text{BaCl}_2 \cdot \text{HgO} + 6\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (André, C R 104 431)

**Barium oxyiodide**,  $\text{Ba}(\text{OH})\text{I} \cdot 9\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  and alcohol (Beckmann, B 14 2154)

$\text{BaI}_2 \cdot \text{BaO} + 9\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Tassilly, C R 1895, 120 1340)

**Barium oxysulphides**,  $\text{Ba}_2\text{O}_4\text{S}_8 + 58\text{H}_2\text{O}$ ,

$\text{Ba}_2\text{OS} + 10\text{H}_2\text{O}$ ,  $\text{Ba}_2\text{OS}_2 + 28\text{H}_2\text{O}$

Very unstable, decomp by recrystallization into  $\text{BaS}_2\text{H}_2$  and  $\text{BaO}_2\text{H}$

**Barium phosphide**,  $\text{Ba}_3\text{P}_2$

Decomp by  $\text{H}_2\text{O}$  (Dumas, A ch 32 364)

$\text{Ba}_3\text{P}_2$  Crystallized Sol in dil acids, insol in conc acids, decomp by  $\text{H}_2\text{O}$  Insol in organic solvents at ord temp (Jaboin, C R 1899, 129 765)

**Barium selenide**,  $\text{BaSe}$

Sol in  $\text{H}_2\text{O}$  with decomp

Sl sol in  $\text{H}_2\text{O}$  (Favre, C R 102 1469)

**Barium silicide**,  $\text{BaSi}$

(Jungst, C C 1905, I 195)

$\text{BaSi}$  Slowly decomp by  $\text{H}_2\text{O}$ , not by  $\text{NH}_4\text{OH} + \text{Aq}$  Rapidly decomp by conc  $\text{NaOH}$  Sol in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and  $\text{H}_3\text{PO}_4$  with evolution of spontaneously inflammable gas Sol in  $\text{HCl}$  and  $\text{HCl}$  Sol in acetic acid without evolution of gas (Moissan, Compt Rend 1904, III 680)

Decomp rapidly in both hot and cold  $\text{H}_2\text{O}$  (Bradley, C N 1900, 82 150)

**Barium sulphide**,  $\text{BaS}$

Sol in  $\text{H}_2\text{O}$  with decomp

Crystallized Decomp by  $\text{H}_2\text{O}$

Attacked by cold conc  $\text{HNO}_3$  (Mourlot, A ch. 1899, (7) 17 521)

Cryst modification is less readily attacked on by air and other reagents than the amorphous modification, sol in fuse oxidizing agents (Mourlot, C R 1898, 126 645)

+ $\text{H}_2\text{O}$  (Neuberg and Neumann, J chem Z 1906, 1 174)

+ $6\text{H}_2\text{O}$  Slowly sol in boiling  $\text{F}_2$ , with decomp, insol in, but decomp by boiling alcohol (Schone)

**Barium sulphide**,  $\text{Ba}_4\text{S}_7 + 25\text{H}_2\text{O}$  (?)

Sol in  $\text{H}_2\text{O}$  (Schone, Pogg 112 215)

**Barium trisulphide**,  $\text{BaS}_3$

Sol in large amount of boiling  $\text{H}_2\text{O}$  (Schone, Pogg 112 215)

**Barium tetrasulphide**,  $\text{BaS}_4 + \text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$ , especially if heated, sol in 2.42 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , insol in  $\text{CS}_2$  or alcohol (Schone, Pogg 112 224)

+ $2\text{H}_2\text{O}$  (Velej, Chem Soc 49 69)

**Barium pentasulphide**,  $\text{BaS}_5$

Known only in solution

**Barium mercuric sulphide**,  $\text{BaS} \cdot \text{HgS} - 5\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Wagner, J pr 98)

**Barium nickel sulphide**,  $\text{BaS} \cdot 4\text{NiS}$

Sol in warm conc  $\text{HCl}$  (Bellucci, C A 1909, 293)

**Barium stannic sulphide**

See Sulphostannate, barium

**Barium uranyl sulphide**,  $6\text{BaS} \cdot 10\text{UO}_2\text{S} + x\text{H}_2\text{O}$  (?)

Decomp by  $\text{HCl} + \text{Aq}$  (Rumcliff, Pogg 124 159)

**Baryta**

See Barium oxide,  $\text{BaO}$

**Beryllium**,  $\text{Be}$

For beryllium and its salts, see Cerium and the corresponding salts

**Bismuth**,  $\text{Bi}$

Not attacked by  $\text{H}_2\text{O}$  Very slowly attacked by  $\text{HCl} + \text{Aq}$  (Groost) Very sl sol in conc  $\text{HCl} + \text{Aq}$  (Schutzenberger, Willm) Not attacked by dil  $\text{HCl} + \text{Aq}$  (Niet and Humot) Very slowly attacked by cold  $\text{HCl} + \text{Aq}$  (Godffroy) According to very careful experiments pure  $\text{Bi}$  is absolutely unattacked by hot or cold, dil or conc  $\text{HCl} + \text{Aq}$  in presence of oxygen (Ditte and Metzner, A ch (6) 29 397)

Not attacked by dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  decomp

by hot conc  $\text{H}_2\text{SO}_4$ . Easily sol in dil or conc  $\text{HNO}_3$ +Aq, or aqua regia.

Not attacked by pure  $\text{HNO}_3$ +Aq of 1.52 to 1.42 sp gr at  $20^\circ$ ; violently attacked by a more dil acid, but the acid becomes concentrated thereby. Conc  $\text{HNO}_3$ +Aq attacks only by heating or adding  $\text{NO}_2$  (Millon, A ch (3) 6 95).

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 827).

$\frac{1}{2}$  ccm oleic acid dissolves 0.0091 g Bi in 6 days (Gates, J phys Chem 1911, 15 143).

#### Bismuth arsenide, $\text{Bi}_2\text{As}_3$

(Descamp, C R 86 1065)

#### Bismuth dibromide, $\text{Bi}_2\text{Br}_4$

Not known in a pure state (Weber, Pogg 107 599).

#### Bismuth tribromide, $\text{Bi}_2\text{Br}_3$

Very deliquescent. Decomp by  $\text{H}_2\text{O}$ . Sol in alcohol or ether.

Sol in  $\text{AlBr}_3$  (Isbekow, Z anorg 1913, 84 27).

#### Bismuth hydrogen bromide, $\text{BiBr}_3$ , $2\text{HBr} + 4\text{H}_2\text{O}$

Deliquescent.

Decomp in the air (Aloy, Bull Soc 1906, (3) 35 398).

#### Bismuth caesium bromide, $2\text{BiBr}_3$ , $3\text{CsBr}$

Ppt. Insol in  $\text{HBr}$ .

Sol in  $\text{HCl}$  and in  $\text{HNO}_3$  (Hutchins, J Am Chem Soc 1907, 29 33).

#### Bismuth potassium bromide, $\text{BiBr}_3 \cdot 2\text{KBr}$

Decomp by  $\text{H}_2\text{O}$  (Aloy, Bull Soc 1906, (3) 35 398).

#### Bismuth bromide ammonia, $\text{BiBr}_3 \cdot 3\text{NH}_3$

Sol in  $\text{HCl} + \text{Aq}$ .

$\text{BiBr}_3 \cdot 2\text{NH}_3$  (?)

$2\text{BiBr}_3 \cdot 5\text{NH}_3$ . Not deliquescent, not decomp by  $\text{H}_2\text{O}$ , easily sol in dil acids (Mun, Chem Soc 29 144).

#### Bismuth bromide potassium chloride,

$\text{K BiCl}_2\text{Br} + 1\frac{1}{2}\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Atkinson, Chem Soc 43 289).

#### Bismuth dichloride, $\text{BiCl}_2$

Very deliquescent. Decomp by  $\text{H}_2\text{O}$  dil acids, or conc  $\text{NH}_4\text{Cl} + \text{Aq}$  (Weber, Pogg 107 596).

#### Bismuth trichloride, $\text{BiCl}_3$

Deliquescent. Decomp by  $\text{H}_2\text{O}$ . Sol in dil  $\text{HCl} + \text{Aq}$ , and alcohol. Not decomp by  $\text{H}_2\text{O}$  in presence of citrates (Spiller).

0.08 g sol in 100 ccm liquid  $\text{H}_2\text{S}$  (Antony, C C 1905, I 1692).

Moderately sol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 827).

1 g  $\text{BiCl}_3$  is sol in 5.59 g acetone at  $18^\circ$ . Sp gr of sat solution  $18^\circ/4^\circ = 0.9194$  (Naumann, B 1904, 37 4331).

Sol in acetone and in methylal (Erdmann, C C 1899, II 1014).

Sol in benzonitrile (Naumann, B 1914, 47 1369).

Sol in ethyl acetate (Naumann, B 1910, 43 314).

1 pt is sol in 60.36 pts ethyl acetate at  $18^\circ$ . Sp gr at  $18^\circ/40^\circ = 0.9106$  (Naumann, B 1910, 43 320).

Sol in methyl acetate (Naumann, B 1909, 42 3790).

#### Bismuth chloride, $\text{Bi}_2\text{Cl}_3$ (?)

Decomp by  $\text{H}_2\text{O}$  (Dehérain, C R 54 724).

#### Bismuth hydrogen chloride, $2\text{BiCl}_3$ , $\text{HCl} + 3\text{H}_2\text{O}$

Not deliquescent. Decomp by  $\text{H}_2\text{O}$  (Engel, C R 106 1797).

$\text{BiCl}_3$ ,  $2\text{HCl}$  (Jacquelin, A ch (2) 62 363).

#### Bismuth caesium chloride, $\text{BiCl}_3$ , $3\text{CsCl}$

Decomp by  $\text{H}_2\text{O}$ . Sl sol in cold dil  $\text{HCl} + \text{Aq}$ , but easily sol on warming (Brigham, Am Ch J 14 181).

$2\text{BiCl}_3$ ,  $3\text{CsCl}$ . As above (Brigham).  $\text{BiCl}_3$ ,  $6\text{CsCl}$ . Easily sol in  $\text{H}_2\text{O}$  and in  $\text{HCl} + \text{Aq}$  (Godfrey, B 8 9).

Does not exist (Brigham).

#### Bismuth hydrazine chloride, $\text{BiCl}_3$ , $3\text{N H}_4\text{HCl}$

Sol in acids, from which it is pptd by  $\text{H}_2\text{O}$  (Ferratin, C A 1912 1613).

#### Bismuth nitrosyl chloride, $\text{BiCl}_3$ , $\text{NOCl}$

Very deliquescent. Decomp by  $\text{H}_2\text{O}$  (Sudborough, Chem Soc 59 662).

#### Bismuth potassium chloride, $\text{BiCl}_3$ , $\text{KCl} + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$ . Cannot be recryst except from conc  $\text{BiCl}_3 + \text{HCl}$ . Decomp by  $\text{HCl} + \text{Aq}$  into  $\text{BiCl}_3$ ,  $2\text{KCl} + 2\text{H}_2\text{O}$  (Brigham, Am Ch J 14 167).

$\text{BiCl}_3$ ,  $2\text{KCl}$ . Decomp by  $\text{H}_2\text{O}$  (Aippe, Pogg 64 37).

Deliquescent.

Sol in  $\text{H}_2\text{O}$  with decomp into the oxychloride when excess  $\text{H}_2\text{O}$  is used (Aloy, Bull Soc 1906, (3) 35 397).

+  $2\text{H}_2\text{O}$ . Decomp by  $\text{H}_2\text{O}$  (Jacquelin, J pr 14 1).

Sol in moderately conc  $\text{HCl} + \text{Aq}$ .

$\text{BiCl}_3$ ,  $3\text{KCl}$ . Decomp by  $\text{H}_2\text{O}$  (Aippe). Does not exist (Brigham).

**Bismuth rubidium chloride**,  $\text{BiCl}_3$ ,  $\text{RbCl} + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$ , sol in dil  $\text{HCl} + \text{Aq}$ , from which  $\text{BiCl}_3$ ,  $3\text{RbCl}$  crystallizes (Brigham, Am Ch J 14 174)

$\text{BiCl}_3$ ,  $3\text{RbCl}$  Decomp by  $\text{H}_2\text{O}$ , sol in dil  $\text{HCl} + \text{Aq}$  without decomp (Brigham)

$\text{BiCl}_3$ ,  $6\text{RbCl}$  Decomp by  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$  (Godeffroy, B 8 9), does not exist (Brigham)

$10\text{BiCl}_3$ ,  $23\text{RbCl}$  (?) As above (Brigham)

**Bismuth sodium chloride**,  $\text{BiCl}_3$ ,  $2\text{NaCl} + \text{H}_2\text{O}$

+  $3\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Arppe, Pogg 64 237)

$\text{BiCl}_3$ ,  $3\text{NaCl}$

**Bismuth thallous chloride**,  $\text{BiCl}_3$ ,  $3\text{TlCl}$

Ppt (Ephraim, Z anorg 1909, 61 254)

$\text{BiCl}_3$ ,  $6\text{TlCl}$  Ppt (Ephraim)

**Bismuth chloride ammonia**,  $2\text{BiCl}_3$ ,  $\text{NH}_3$

Stable (Dehéram, C R 54 724)

$\text{BiCl}_3$ ,  $2\text{NH}_3$  (D)

$\text{BiCl}_3$ ,  $3\text{NH}_3$  (D)

**Bismuth chloride nitric oxide**,  $\text{BiCl}_3$ ,  $\text{NO}$

Very hygroscopic (Thomas, C R 1895, 121 129)

**Bismuth chloride nitrogen peroxide**,  $\text{BiCl}_3$ ,  $\text{NO}_2$

Decomp by moist air, but stable in dry air (Thomas, C R 1896, 122 612)

**Bismuth chloride selenide**

See Bismuth selenochloride

**Bismuth trifluoride**,  $\text{BiF}_3$

Insol in  $\text{H}_2\text{O}$  or alcohol (Gott and Muir, Chem Soc 53 138)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 827)

**Bismuth hydrogen fluoride**,  $\text{BiF}_3$ ,  $3\text{HF}$

Deliquescent. Decomp by boiling  $\text{H}_2\text{O}$  (Muir, Chem Soc 39 21)

**Bismuth gold**,  $\text{Au}_3\text{Bi}$

Insol in equal pts of  $\text{HNO}_3$  and tartaric acids (Roessler, Z anorg 1895, 9 71)

**Bismuthous hydroxide**,  $\text{Bi}(\text{OH})_3$

Sol in strong acids. Insol in solutions of alkalis, alkali carbonates,  $(\text{NH}_4)_2\text{CO}_3$ , or  $\text{NH}_4\text{NO}_3$ , or of amyl amine (Wurtz). When recently pptd is sol in  $\text{NH}_4\text{Cl} + \text{Aq}$ , but insol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett, 1837). Not pptd in presence of Na citrates (Spiller)

Solubility of freshly pptd  $\text{Bi}(\text{OH})_3$  in  $\text{NaOH} + \text{Aq}$

g NaOH per l	g Bi dissolved per l at 20°	g Bi dissolved per l at 100°
400	0 16	1 1
320	0 11	1 1
240	0 11	
200	0 10	0 1
160	0 08	0 1
120	0 07	
80	0 04	0
40	trace	0 1
20	0	0 1

(Moser, Z anorg 1909, 61 386)

Solubility of freshly pptd  $\text{Bi}(\text{OH})_3$  in  $\text{KOH} + \text{Aq}$

KOH per l g	g Bi dissolved per l at 20°	g Bi dissolved per l at 100°
560	0 14	1 6
448	0 11	1 2
336	0 11	
280	0 10	0 5
224	0 08	0 5
168	0 06	
112	0 03	0 3
56	trace	0 2
28	0	0 1

(Moser, Z anorg 1909, 61 386)

$\text{Bi}_2\text{O}_3$ ,  $2\text{H}_2\text{O}$

$\text{Bi}_2\text{O}_3$ ,  $\text{H}_2\text{O}$  (Muir, Chem Soc 32 31)

See also Bismuth trioxide

**Bismuth tetrahydroxide**,  $\text{Bi}_2\text{O}_4$ ,  $\text{H}_2\text{O}$

$\text{Bi}_2\text{O}_4$ ,  $2\text{H}_2\text{O}$  (Wernicke, Pogg 141 109)

**Bismuthic hydroxide (Bismuthic acid)**,  $\text{Bi}_2\text{O}_5$ ,  $\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , easily decomp by acids (Fremy, A ch (3) 12 495). Decomp by  $\text{H}_2\text{SO}_4$ , not attacked by  $\text{SO} + \text{Aq}$ , neither dissolved nor decomp by dil  $\text{HNO}_3 + \text{Aq}$ , but slowly converted into an allotropic modification (?) Partially decomp by conc  $\text{HNO}_3$ . Slowly but wholly dissolved by hot conc  $\text{HNO}_3$ . Sol in conc  $\text{KOH} + \text{Aq}$  (Arppe). Sol in about 100 pts boiling  $\text{KOH} + \text{Aq}$ , so conc that it solidifies on removing the unp (Muir, Chem Soc 51 77)

$\text{Bi}_2\text{O}_5$ ,  $2\text{H}_2\text{O}$  (Bodcker, A 123 61)

Does not exist (Hoffmann und Gmelin)

**Bismuth iodide**,  $\text{BiI}_3$

Not attacked by cold  $\text{H}_2\text{O}$ , but by boiling.  $\text{BiOI}$  is formed. 100 pts absolute alcohol dissolve  $3\frac{1}{2}$  pts salt at 20° (Gott and Muir, Chem Soc 57 138)

Sol in  $\text{HNO}_3$ , and  $\text{HI} + \text{Aq}$ , from which it is reprecipitated by  $\text{H}_2\text{O}$  or alcohol. Sol in  $\text{K} + \text{Aq}$  or  $\text{KOH} + \text{Aq}$  (Rammelsberg)

Sl sol in liqnd  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

100 g absolute alcohol dissolve 3.5 g  $\text{BiI}_3$  at  $20^\circ$  (Gott and Muir, Chem Soc 57 138)

Sol in acetone (Naumann, B 1904, 37 4328)

100 pts methylene iodide dissolve 0.15 pt  $\text{BiI}_3$  at  $12^\circ$ , and very little more at higher temperatures (Retgers, Z anorg 3 343)

Sol in methyl acetate (Naumann, B 1909, 42 3790)

**Bismuth hydrogen iodide,  $\text{BiI}_3$ ,  $\text{HI}+4\text{H}_2\text{O}$**   
(Arppe, Pogg 44 248)

**Bismuth caesium iodide,  $3\text{CsI} \cdot 2\text{BiI}_3$**

Very sl sol in  $\text{H}_2\text{O}$  (Wells, Am J Sci 1897, (4) 3 464)

**Bismuth calcium iodide,  $2\text{BiI}_3$ ,  $\text{CaI}_2+18\text{H}_2\text{O}$**   
Deliquescent, decomp by  $\text{H}_2\text{O}$  (Linna, Pogg 111 240)

**Bismuth magnesium iodide,  $2\text{BiI}_3$ ,  $\text{MgI}_2+12\text{H}_2\text{O}$**

Deliquescent, decomp by  $\text{H}_2\text{O}$  (Linna, Pogg 111 240)

**Bismuth potassium iodide,  $\text{BiI}_3$ ,  $4\text{KI}$**

Ppt (Arppe, Pogg 44 237)

$\text{BiI}_3$ ,  $3\text{KI}$  (Astre, C R 110 1137)

$\text{BiI}_3$ ,  $2\text{KI}$  Sol in acetic ether (Astre)

$+4\text{H}_2\text{O}$  Sol in small amt  $\text{H}_2\text{O}$  without pptn, but decomp by much  $\text{H}_2\text{O}$

$\text{BiI}_3$ ,  $2\text{KI}$ ,  $\text{HI}$  (Arppe)

$2\text{BiI}_3$ ,  $3\text{KI}+2\text{H}_2\text{O}$  (Astre)

$\text{BiI}_3$ ,  $\text{KI}+\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Nickles, C R 51 1097)

$2\text{BiI}_3$ ,  $\text{KI}$  Sol in acetic ether (Astre)

**Bismuth sodium iodide,  $\text{BiI}_3$ ,  $\text{NaI}+\text{H}_2\text{O}$**

Deliquescent, decomp by  $\text{H}_2\text{O}$  (Nickles, C R 51 1097)

$2\text{BiI}_3$ ,  $3\text{NaI}+12\text{H}_2\text{O}$  As above (Linna, Pogg 111 240)

**Bismuth zinc iodide,  $2\text{BiI}_3$ ,  $\text{ZnI}_2+12\text{H}_2\text{O}$**

Very deliquescent (Linna, Pogg 111 240)

**Bismuth iodide ammonia,  $\text{BiI}_3$ ,  $3\text{NH}_3$**

Decomp by  $\text{H}_2\text{O}$  (Rammelsberg)

**Bismuth iodide zinc bromide**

Sol in  $\text{H}_2\text{O}$  (Linna, Pogg 111 240)

**Bismuth nitride**

Explosive (Fischer, B 1910, 43 1471)

$\text{BiN}$  Ppt Decomp by  $\text{H}_2\text{O}$  or dil acids (Franklin, J Am Chem Soc 1905, 27 847)

**Bismuth dioxide,  $\text{Bi}_2\text{O}_3$**

Sol in conc  $\text{HNO}_3+\text{Aq}$  Decomp by strong acids, and boiling  $\text{KOH}+\text{Aq}$

Decomp by  $\text{H}_2\text{O}$  (Linna, Z anorg 1901, 27 438)

**Bismuth trioxide,  $\text{Bi}_2\text{O}_3$**

Insol in  $\text{H}_2\text{O}$  Sol in conc acids

Solubility of  $\text{Bi}_2\text{O}_3$  in  $\text{HNO}_3+\text{Aq}$  at  $20^\circ$

In 100 g of the liqnd phase		Solid phase
g $\text{Bi}_2\text{O}_3$	g $\text{N}_2\text{O}_5$	
0 321	0 963	$\text{Bi}_2\text{O}_3$ $\text{N}_2\text{O}_5$ $2\text{H}_2\text{O}$
0 337	0 982	"
3 54	4 68	"
6 37	7 17	"
13 67	12 50	"
14 85	13 31	"
18 74	15 90	$\text{Bi}_2\text{O}_3$ $\text{N}_2\text{O}_5$ $\text{H}_2\text{O}$
23 50	19 21	"
23 50	19 29	"
27 15	20 96	"
28 11	21 64	"
29 50	22 53	"
30 19	22 90	"
31 48	23 70	"
32 93	24 83	{ $\text{Bi}_2\text{O}_3$ $\text{N}_2\text{O}_5$ $\text{H}_2\text{O}+$ $\text{Bi}_2\text{O}_3$ $3\text{N}_2\text{O}_5$ $10\text{H}_2\text{O}$ $\text{Bi}_2\text{O}_3$ $3\text{N}_2\text{O}_5$ $10\text{H}_2\text{O}$
32 80	24 86	
32 67	24 70	
32 59	24 60	"
32 24	24 68	"
30 74	25 13	"
29 83	25 30	"
24 16	28 25	"
16 62	35 40	"
12 17	43 37	"
11 66	46 62	"
11 19	49 38	"
11 19	50 20	"
15 20	54 66	"
20 76	53 75	"
27 85	51 02	{ $\text{Bi}_2\text{O}_3$ $3\text{N}_2\text{O}_5$ $10\text{H}_2\text{O}+$ $\text{Bi}_2\text{O}_3$ $3\text{N}_2\text{O}_5$ $3\text{H}_2\text{O}$ $\text{Bi}_2\text{O}_3$ $3\text{N}_2\text{O}_5$ $3\text{H}_2\text{O}$
8 58	68 28	
4 05	74 90	

(Rutten, Z anorg 1902, 30 386)

Solubility of  $\text{Bi}_2\text{O}_3$  in  $\text{HNO}_3+\text{Aq}$  at  $t^\circ$

t	g $\text{Bi}_2\text{O}_3$	g $\text{N}_2\text{O}_5$	Solid phase
$9^\circ$	20 8	17 1	{ $\text{Bi}_2\text{O}_3$ $\text{N}_2\text{O}_5$ $\text{H}_2\text{O}+$ $\text{Bi}_2\text{O}_3$ $3\text{N}_2\text{O}_5$ $10\text{H}_2\text{O}$
	24 02	19 1	
	31 09	23 8	
	31 2	25 9	
$30^\circ$	34 2	26 5	$\text{Bi}_2\text{O}_3$ $3\text{N}_2\text{O}_5$ $10\text{H}_2\text{O}$
	28 2	29 6	
	16 1	17 7	
$65^\circ$	5 55	7 11	$\text{Bi}_2\text{O}_3$ $\text{N}_2\text{O}_5$ $\text{H}_2\text{O}$
	27 62	22 16	
	10 80	31 60	
	37 82	55 80	
	55 73	47 02	
	4 59	77 90	{ $\text{Bi}_2\text{O}_3$ $3\text{N}_2\text{O}_5$ $3\text{H}_2\text{O}$ $\text{Bi}_2\text{O}_3$ $3\text{N}_2\text{O}_5$ $3\text{H}_2\text{O}$

(Rutten)

Solubility of $\text{Bi}_2\text{O}_3$ in $\text{HNO}_3 + \text{Aq}$ at $t^\circ$			
$t^\circ$	% $\text{Bi}_2\text{O}_3$	% $\text{N}_2\text{O}_5$	Solid phase
72°	37 23	47 76	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 4\text{H}_2\text{O}$ "
75°	36 74	47 91	
80°	39 75	45 16	
9°	31 2	23 9	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O} + \text{Bi}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 \cdot \text{H}_2\text{O}$ "
20°	32 8	24 8	
30°	34 2	26 4	
50°	36 9	28 9	"
64°	40 6	31 1	"
65°	40 8	31 6	"
75 5°	45 4	34 6	"
72°	45 9	35 6	"
11 5°	25 36	52 57	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O} + \text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 3\text{H}_2\text{O}$ " " "
20°	27 85	51 02	
50°	32 22	49 29	
65°	35 73	47 02	

(Rutten)

Solubility in  $\text{NaOH} + \text{Aq}$  at  $25^\circ$ 

Conc of $\text{NaOH}$ Mol/l	g $\text{Bi}_2\text{O}_3$ in 100 cc of solution Mean result
1 0	0 0013 $\pm$ 0 0002
2 0	0 0026 $\pm$ 0 0002
3 0	0 0049 $\pm$ 0 0005

(Knox, Chem Soc 1909, 95 1767)

Insol in acetone (Fidmunn, C C 1899, II 1011)

Min *Bismate* Easily sol in  $\text{HNO}_3 + \text{Aq}$

See also **Bismuthous hydroxide**

**Bismuth tetroxide,  $\text{Bi}_2\text{O}_4$** 

Sol in conc  $\text{HCl} + \text{Aq}$ , with evolution of  $\text{Cl}_2$  in oxygen acids with evolution of  $\text{O}_2$ . Easily sol in conc  $\text{H}_2\text{SO}_4$  than in  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$

**Bismuth oxide,  $\text{Bi}_2\text{O}_3$  (?)**

(Hoffmann and Cuthbert)

**Bismuth pentoxide,  $\text{Bi}_2\text{O}_5$** 

Sol in dil acids. Combines with  $\text{H}_2\text{O}$  to form bismuthic hydroxide which see (Husebroek B 20 213)

**Bismuth oxybromide, etc**

See **Bismuthyl bromide, etc**

**Bismuth palladium,  $\text{PdBi}$** 

Insol in equal pts  $\text{HNO}_3$  and tartaric acids (Roessler Z anorg 1899, 9 70)

**Bismuth platinum,  $\text{PtBi}$** 

Insol in equal pts  $\text{HNO}_3$  and tartaric acids (Roessler Z anorg 1899, 9 69)

**Bismuth phosphide,  $\text{BiP}$** 

(Cavazzi)

**Bismuth triselenide,  $\text{Bi}_2\text{Se}_3$** 

Insol in  $\text{H}_2\text{O}$ , alkalies, or alkali sulphides +  $\text{Aq}$ , sl attacked by  $\text{HCl} + \text{Aq}$ , oxidised by  $\text{HNO}_3 + \text{Aq}$  (Schneider, Pogg 94 6)

Min Frenzelte

**Bismuth potassium selenide**See **Selenobismuthite, potassium****Bismuth selenochloride,  $\text{BiSeCl}$** 

Not attacked by  $\text{H}_2\text{O}$ , very sl sol in  $\text{HCl} + \text{Aq}$ , easily and completely sol with comp in  $\text{HNO}_3 + \text{Aq}$  (Schneider)

**Bismuth disulphide,  $\text{Bi}_2\text{S}_2 + 2\text{H}_2\text{O}$  (?)**Insol in  $\text{H}_2\text{O}$  Decomp by  $\text{HCl} + \text{Aq}$ **Bismuth trisulphide,  $\text{Bi}_2\text{S}_3$** Insol in  $\text{H}_2\text{O}$ 

1 l  $\text{H}_2\text{O}$  dissolves  $0.35 \times 10^{-6}$  mo of  $\text{Bi}_2\text{S}_3$  at  $18^\circ$  (Weigel, Z phys Ch 1907, 1 294)

Easily sol in moderately dil  $\text{HNO}_3 + \text{Aq}$ , and conc  $\text{HCl} + \text{Aq}$ , with separation of  $\text{S}$  as  $\text{a}_2\text{S}_2\text{O}_3$ , or  $\text{KCN} + \text{Aq}$ , insol in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett). Insol in potassium carbonate +  $\text{Aq}$  (Rosenblatt, Z anal 26 5). Insol in alkali hydroxides or alkali hydro-sulphides

Insol in  $2\text{N}-(\text{NH}_4)_2\text{S} + \text{Aq}$ 

0 0090 g  $\text{Bi}_2\text{S}_3$  is sol in 100 cc  $\text{N} \text{Na}_2\text{S}_2 + \text{Aq}$  at  $25^\circ$  (Knox, Chem Soc 09, 95 1764)

Somewhat sol in  $\text{Na}_2\text{S} + \text{Aq}$ , 1 cc of  $\text{N} \text{Na}_2\text{S} + \text{Aq}$  (sp gr 1 06) dissolve amt of  $\text{Bi}_2\text{S}_3$  corresponding to 0 031 g  $\text{Bi}_2\text{O}_3$  (Stillman, J Am Chem Soc 1896, 18 6)

Solubility in  $\text{Na}_2\text{S} + \text{N KOH} + \text{Aq}$  $25^\circ$ 

Conc of $\text{Na}_2\text{S}$ Mol/l	Conc of $\text{N KOH}$ Mol/l	g $\text{Bi}_2\text{S}_3$ in 100 cc solution
0 5	1 0	0 185
1 0	1 0	0 535

(Knox, Chem Soc 1909, 95 1 3)

Bismuth sulphide pptd from acid solution is not dissolved by subsequent treatment with  $\text{K}_2\text{S} + \text{Aq}$  (Stone, J Am Chem Soc 1896, 18 1091)

Sol in  $\text{K}_2\text{S} + \text{Aq}$  (Dittc, C R 95, 120 157)

Solubility in  $\text{K}_2\text{S} + \text{KOH} + \text{Aq}$  at  $5^\circ$ 

Conc of $\text{K}_2\text{S}$ Mol/l	Conc of $\text{KOH}$ Mol/l	g $\text{Bi}_2\text{S}_3$ in 100 cc solution
0 5	1 0	0 1240
1 0	1 0	0 1230
1 25	1 25	0 2354

(Knox, Chem Soc 1909, 95 63)

## Solubility in alkali sulphides + Aq at 25°

Alkali sulphide	Conc of alkali sulphide Mol / l	g Bi <sub>2</sub> S <sub>3</sub> in 100 cc of solution
Na <sub>2</sub> S	0.5	0.0040
	1.0	0.0238
	1.5	0.1023
K <sub>2</sub> S	0.5	0.0042
	1.0	0.0337
	1.25	0.0639

(Knox, Chem Soc 1909, **95** 1762)Decomp by FeCl<sub>3</sub> + Aq (Cammerer, C C **1891**, II 525)Insol in KCN + Aq (Hoffmann, A 1884, **223** 134)Min *Bismuthinite* Easily sol in HNO<sub>3</sub> + Aq**Bismuth cuprous sulphide**, Bi<sub>2</sub>S<sub>3</sub>, Cu<sub>2</sub>SInsol in H<sub>2</sub>O Sol with decomp in HNO<sub>3</sub> + Aq (Schneider, J pr (2) **40** 564)Min *Emplectonite***Bismuth potassium sulphide**, Bi<sub>2</sub>S<sub>3</sub>, K<sub>2</sub>S(Schneider, Pogg **136** 460)Insol in ethyl acetate (Naumann, B **1910**, **43** 314)Bi<sub>2</sub>S<sub>3</sub>.4K<sub>2</sub>S + 4H<sub>2</sub>O Decomp by H<sub>2</sub>O Very sol in K<sub>2</sub>S + Aq Efflorescent in dry air (Ditte, C R 1895, **120** 186)See also *Sulphobismuthite*, potassium**Bismuth silver sulphide**, Bi<sub>2</sub>S<sub>3</sub>, Ag<sub>2</sub>SInsol in cold HCl, or HNO<sub>3</sub> Sol in warm HNO<sub>3</sub> with separation of S, in boiling HCl with separation of H<sub>2</sub>SMin *Plenargyrite*, *Matildite*(Schneider, J pr 1890, (2) **41** 414)**Bismuth sodium sulphide**, Bi<sub>2</sub>S<sub>3</sub>, Na<sub>2</sub>S

(Schneider)

**Bismuth sulphide telluride**, Bi<sub>2</sub>S<sub>3</sub>, 2Bi<sub>2</sub>Te<sub>3</sub>Min *Tetradymite* Sol in HNO<sub>3</sub> with separation of SBi<sub>2</sub>S<sub>3</sub>.2Bi<sub>2</sub>Te<sub>3</sub>Min *Joselite* As above**Bismuth sulphobromide**, Bi<sub>2</sub>S<sub>3</sub>Bi<sub>2</sub>(Muir and Eakins, Chem Soc 1895, **67** 91)**Bismuth sulphochloride**, Bi<sub>2</sub>SClInsol in H<sub>2</sub>O or dil HCl + Aq Sol in conc HCl, or HNO<sub>3</sub> + Aq Decomp by alkalis + Aq (Schneider, Pogg **93** 464)**Bismuth sulphiodide**, Bi<sub>2</sub>SINot attacked by boiling H<sub>2</sub>O, and dil acids Decomp by hot conc HCl + Aq, and HNO<sub>3</sub> + Aq KOH + Aq dissolves out I (Schneider, Pogg **110** 114)**Bismuth telluride**, Bi<sub>2</sub>Te<sub>3</sub>Min *Tetradymite* Sol in HNO<sub>3</sub> + AqSee also *Bismuth sulphide telluride***Bismuthic acid**, HBiO<sub>3</sub>See *Bismuthic hydroxide***Potassium bismuthate**, KBiO<sub>3</sub>Sol in H<sub>2</sub>O (Arppe)KH(BiO<sub>3</sub>)<sub>2</sub> Insol in H<sub>2</sub>ONot decomp by boiling H<sub>2</sub>O (André, C R **113** 860)No salts of HBiO<sub>3</sub> can exist (Muir and Carnegie, Chem Soc **51** 77)**Bismuthicotungstic acid****Ammonium bismuthicotungstate**, 3(NH<sub>4</sub>)<sub>2</sub>O, 2Bi<sub>2</sub>O<sub>3</sub>, 11WO<sub>3</sub> + 10H<sub>2</sub>OA yellow oil which dries to a yellow glass (E F Smith, J Am Chem Soc 1903, **25** 1232)**Potassium bismuthicotungstate**, 3K<sub>2</sub>O, 2Bi<sub>2</sub>O<sub>3</sub>, 11WO<sub>3</sub> + 15H<sub>2</sub>OA yellow oil which dries to a pale yellow glass (E F Smith, J Am Chem Soc 1903, **25** 1233)**Strontium bismuthicotungstate**, 3SrO, 2Bi<sub>2</sub>O<sub>3</sub>, 11WO<sub>3</sub> + 11H<sub>2</sub>OA yellow wax, insol in pure H<sub>2</sub>O, but sol in H<sub>2</sub>O containing a few drops HNO<sub>3</sub> F Smith, J Am Chem Soc 1903, **25****Bismuthyl bromide**, BiOBrInsol in H<sub>2</sub>O, sol in moderately conc HBr + AqInsol in H<sub>2</sub>O (Herz, Z anorg 1903, **36** 348)Bi<sub>2</sub>O<sub>3</sub>Br<sub>2</sub> Insol in H<sub>2</sub>O, easily sol in conc HCl, or HNO<sub>3</sub> + Aq, less sol in dil HNO<sub>3</sub> + AqBi<sub>11</sub>O<sub>13</sub>Br<sub>7</sub> As the preceding comp (Muir)**Bismuthyl chloride**, BiOClInsol in H<sub>2</sub>O or dil acids Sol in conc HCl, or HNO<sub>3</sub> + AqInsol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, **20** 827)Insol in acetone (Naumann, B 1904, **37** 4329)+ H<sub>2</sub>O (Heintz, Pogg **63** 55)+ 3H<sub>2</sub>O (Phillips, Bi Arch (1) **39** 41)Bi<sub>7</sub>O<sub>5</sub>Cl<sub>3</sub> (Arppe)BiO<sub>2</sub>Cl<sub>3</sub> Insol in H<sub>2</sub>O, sol in hot HCl, or HNO<sub>3</sub> + Aq (Muir)**Bismuthyl fluoride**, BiOFInsol in H<sub>2</sub>O, sol in HCl, HBr, or HI + Aq (Gott and Muir, Chem Soc **33** 139)BiOF, 2HF Insol in H<sub>2</sub>O



**Bismuthyl iodide, BiOI**

Not decomp by  $H_2O$  or alkaline solutions  
Sol in  $HCl + Aq$  Decomp by  $HNO_3 + Aq$   
(Schneider, J pr 79 424)

Insol in  $KCl$ , or  $KI + Aq$   
 $3BiOI, 7Bi_2O_3$  Sol in dil  $HCl$ , decomp  
by  $HNO_3$ , insol in boiling  $H_2O$  and alkali  
(Blyth, C N 1896, 74 200)

$BiI_3, 5Bi_2O_3$  Ppt Sl sol in  $HC_2H_3O_2 + Aq$   
Not decomp by  $H_2O$  (Fletcher and  
Cooper, Pharm J (3) 13 254)

$4BiI_3, 5Bi_2O_3$  Easily sol in  $HCl + Aq$   
Decomp by  $HNO_3 + Aq$  Sl attacked by  
 $H_2SO_4$ , somewhat sol in  $H_2C_4H_6O_6$ , and  
 $KHC_4H_4O_6 + Aq$

Sol in  $(NH_4)_2S$ , and  $KOH + Aq$  (Storer's  
Dict)

**Bismuthyl sulphide,  $Bi_2O_3S$** 

(Hermann, J pr 75 452)  
 $Bi_2O_3S$  Insol in  $H_2O$  (Scherpenberg,  
C C 1889, II 641)

$Bi_4O_5S$

Min *Karehnite*

**Boracic acid**

See Boric acid

**Borax**

See Tetraborate, sodium

**Boric acid, anhydrous,  $B_2O_3$** 

See Boron trioxide

**Metaboric acid,  $HBO$** 

Sol in  $H_2O$   
Sl sol in hot glacial acetic acid (Holt,  
Chem Soc 1911, 100 (2) 720)

**Orthoboric acid,  $H_3BO_3$** 

Sol in 53 pt  $H_2O$  at  $10^\circ$

100 pt  $H_2O$  at  $100^\circ$

(Fierz)

Sol in 20 pt  $H_2O$  at  $18^\circ$  (All)

100 pt  $H_2O$  at  $100^\circ$  in 2 pt (Carr Dict)

1 pt crystallized acid dissolves in -

20 66 pts  $H_2O$  at  $19^\circ$

14 88 25

12 66 57

10 16 50

6 12 62

4 7 75

3 3 87

2 97 100

Or, 100 pts  $H_2O$  dissolve at -

19 5 9 pts  $H_3BO_3$

25 6 8

37 7 8

50 7 8

62 16 0

75 21 0

87 28 0

100 34 0

Or, sat aqueous solution contains at -

19 3 75%  $H_3BO_3$

25 6 27

37 5 7 32

50 8 96

62 5 14 04

75 17 44

87 5 21 95

100 25 17

(Brandes and Firnhaber, Arch Pharm 7 50)

1 litre  $H_2O$  dissolves at -

0 19 47 g  $H_3BO_3$

12 29 20

20 39 92

40 69 91

62 114 16

80 168 15

102 291 16

(Ditte, C R 85 1069)

1 l  $H_2O$  dissolves 0 901 mol  $H_3B$  at  $25^\circ$   
(Herz, Z anorg 1910, 66 359)

1 l  $H_2O$  dissolves 0 898 mol  $H_3B$  at  $25^\circ$   
Sp gr of the solution = 1 0168 (Miller, Z  
phys Ch 1907, 57 529)

1 l  $H_2O$  dissolves 0 887 mol  $H_3B$  at  $25^\circ$   
and 1 025 mol at  $30^\circ$  (Ageno and Valla,  
Ist Ven (VIII) 14 II, 331)

Solubility in  $H_2O$  at  $t^\circ$

t	g $H_3BO_3$ in 100 g of the solution
0	2 59
12 2	3 69
21	4 90
31	6 44
40	8 02
50	10 35
60	12 90
69 5	15 58
80	19 11
90	23 30
99 5	28 10
108	36 7
115	45 0
120	52 1

(Nasmi and Ageno, Z phys Ch 1909, 69 18)

Solubility curve for orthoboric acid in  
 $H_2O$  at various temp up to  $120^\circ$  (Nasmi  
and Ageno, Gazz ch 1911, 41 131)

Sp gr of  $H_3BO_3 + Aq$  at  $18^\circ$  1 014 (Nasmi A  
24 11)  
Sp gr of  $H_3BO_3 + Aq$  at  $100^\circ$  1 028 (Nasmi A  
11 90 1)

Sp gr of  $H_3BO_3 + Aq$  at  $1^\circ$

$H_3BO_3$	Sp gr	$H_2O$	Sp
1	1 0054	4	0147
2	1 0069	Sat sol	015
3	1 0106		

(Gerlach, Z anal 28 473)

Sp gr of  $\text{H}_3\text{BO}_3 + \text{Aq}$  at  $18^\circ$   
 $\% \text{H}_3\text{BO}_3$  0 776 1 92 2 88 3 612  
 Sp gr 1 0029 1 0073 1 0109 1 0131  
 (Bock, W Ann 1887, 30 638)

Volatile with steam  
 More sol in dil  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$   
 Sol in warm conc  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$

Solubility in $\text{HCl} + \text{Aq}$ at $25^\circ$	
Millimols $\text{HCl}$ in 10 ccm of the solution	Millimols $\text{H}_3\text{BO}_3$ in 10 ccm of the sat solution
7 0	9 01
13 7	7 69
	6 66

(Herz, Z anorg 1910, 66 359)

Solubility of $\text{H}_3\text{BO}_3$ in $\text{HCl} + \text{Aq}$ at $16^\circ$	
Normality of $\text{HCl}$	Normality of $\text{H}_3\text{BO}_3$
0	0 907
0 130	0 895
0 260	0 870
0 390	0 842
1 30	0 645
2 16	0 542
4 32	0 308
6 00	0 338
7 08	0 327
5 74	0 327
9 51	0 338

(Herz, Z anorg 1902, 33 354)

Solubility in $\text{HF} + \text{Aq}$ at $26^\circ$			
(1) Titer of $\text{HF}$	(2) Liter after saturation with $\text{H}_3\text{BO}_3$ at $26^\circ$	(3) Titer after addition of mannitol	(3)-(2) equals free boric acid
3 21n	1 61	2 36	0 75
2 80n	1 25(1 40?)	2 21	0 96(0 81?)

The values 0 75 and 0 81 represent the solubility of  $\text{H}_3\text{BO}_3$  in the concentrations of fluorboric acid resulting from the original concentration of  $\text{HF} + \text{Aq}$

(Abegg, Z anorg 1903, 35 145)

Solubility of $\text{H}_3\text{BO}_3$ in acids + $\text{Aq}$ at $26^\circ$		
Acid	Normality of the acid	Normality of $\text{H}_3\text{BO}_3$
$\text{H}_2\text{SO}_4$	0 548	0 746
	2 74	0 518
	5 48	0 312
	5 75	0 092
$\text{HNO}_3$	0 241	0 818
	1 206	0 676
	1 607	0 593
	2 411	0 567
	5 96	0 268
	7 38	0 238

(Herz, Z anorg 1903, 34 205)

Solubility in  $\text{KOH} + \text{Aq}$   
*See Borates, potassium*  
 Solubility in  $\text{NaOH} + \text{Aq}$   
*See Borates, sodium*

Solubility in  $\text{LiCl} + \text{Aq}$  at  $25^\circ$

Millimols $\text{LiCl}$ in 10 ccm of the solution	Millimols $\text{H}_3\text{BO}_3$ in 10 ccm of the sat solution
7 1	9 01
10 3	8 13
22 3	7 65
37 2	6 42
	5 02

(Herz, Z anorg 1910, 66 359)

Solubility in  $\text{KCl} + \text{Aq}$  at  $25^\circ$

Millimols $\text{KCl}$ in 10 ccm of the solution	Millimols $\text{H}_3\text{BO}_3$ in 10 ccm of the sat solution
1 9	9 01
7 9	9 20
15 6	9 44
30 6	9 80
	10 75

(Herz)

Solubility in  $\text{RbCl} + \text{Aq}$  at  $25^\circ$

Millimols $\text{RbCl}$ in 10 ccm of the solution	Millimols $\text{H}_3\text{BO}_3$ in 10 ccm of the sat solution
14 0	9 01
25 3	9 66
	10 60

(Herz)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $25^\circ$

Millimols $\text{NaCl}$ in 10 ccm of the solution	Millimols $\text{H}_3\text{BO}_3$ in 10 ccm of the sat solution
8 2	9 01
15 2	8 49
29 4	8 25
	8 20

(Herz)

Solubility in  $\text{H}_2\text{O}$  is increased by presence of  $\text{KCl}$ ,  $\text{KNO}_3$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{NaNO}_3$  and  $\text{Na}_2\text{SO}_4$

In general the solubility in  $\text{H}_2\text{O}$  is increased by the presence of both electrolytes and non-electrolytes (Bogdan, C C 1903, II 2)

Sol in borax +  $\text{Aq}$  (McLauchlan, Z anorg 1903, 37 371)

Sl sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

Unattacked and undissolved by liquid  $\text{NO}_2$  (Frankland, Chem Soc 1901, 79 1362)

Sol in 6 pts alcohol (Wittstein), 5 pts boiling alcohol (Wenzel) Only traces dissolve in anhydrous ether (Schiff) Sol in 100 pts ether (Hager's Comm) Sol in several essential oils

1 l  $\text{H}_2\text{O}$  sat with amyl alcohol dissolves 0 8952 mol  $\text{H}_3\text{BO}_3$  at  $25^\circ$  (Auerbach, Z anorg 1903, 37 357)

Solubility of  $\text{H}_3\text{BO}_3$  in amyl alcohol + Aq at  $t^\circ$ M = millimols  $\text{H}_3\text{BO}_3$  in 1 l of  $\text{H}_2\text{O}$ A = millimols  $\text{H}_3\text{BO}_3$  in 1 l of alcohol

$t^\circ$	M	A
15°	607 2	176 4
	589 3	177 4
	589 0	177 1
	586 0	173 4
	427 4	127 6
	425 8	127 0
	289 1	84 9
	894 0	264 0
	372 0	110 0
	371 8	110 8
25°	301 2	85 7
	180 8	54 0
	49 15	15 45
	51 04	15 45
	26 02	8 05
35°	146 3	44 27

(Müller, Z phys Ch 1907, 57 514)

Sp gr of amyl alcohol + Aq sat with  $\text{H}_3\text{BO}_3$ 

g water in 1 l of alcohol + Aq	d <sub>25°/4°</sub>
32 481	0 82229
35 465	0 82324
37 339	0 82321
42 479	0 82392
45 175	0 82447
45 636	0 82456
47 883	0 82454
51 461	0 82527
52 043	0 82585
59 270	0 82699
63 179	0 82739
64 254	0 82779
66 403	0 82701
66 624	0 82670
68 253	0 82856
69 211	0 82884
75 610	0 82999

(Muller)

Solubility of  $\text{H}_3\text{BO}_3$  in amyl alcohol and NaCl + Aq at 25°

Water phase		Amyl alcohol phase			
NaCl normality	mol $\text{H}_3\text{BO}_3$	Sp gr 25°/4°	1 l contains		
			mol $\text{H}_2\text{O}$	mol amyl alcohol	mol $\text{H}_3\text{BO}_3$
0 00	0 880	0 8296	4 10	8 39	0 340
0 945	0 866	0 8277	3 55	8 49	0 338
1 490	0 850	0 8268	3 27	8 54	0 359
1 865	0 844	0 8259	3 03	8 56	0 724
2 355	0 833	0 8254	2 86	8 59	0 850
2 845	0 827	0 8247	2 62	8 62	0 877
3 06	0 810	0 8241	2 39	8 66	0 891
3 48	0 810	0 8240	2 32	8 69	0 006
3 57	0 807	0 8236	2 15	8 70	0 066
4 01	0 801	0 8233	1 99	8 72	0 162
4 28	0 798	0 8229	1 78	8 75	0 210

(Muller)

Solubility in hydroxy-compounds + Aq at 25

Organic substance added	Mol of organic substance in 100 mol of the mixture	Mol of boric acid sol in 1 l of solution	Sp gr of the pure mixture	Sp gr of mixture sat with boric acid
Lactic acid	2 321	1 07	1 0252	1 441
	6 819	1 61	1 0722	1 386
	18 77	1 86	1 1405	1 635
	36 33	2 08	1 2023	1 254
Glycerine	24 64	1 208	1 1574	1 707
	46 75	2 132		1 260
	67 71	2 96	1 2370	1 526
	90 58	3 78	1 2531	1 710

Solubility in hydroxy-compounds, etc—*Continued*

Organic substance added	Mol of organic substance in 100 mol of the mixture	Mol of boric acid sol in 1 l of solution	Sp gr of the pure mixture	Sp gr of the mixture sat with boric acid
Mannitol	0 790	1 007		1 0425
	0 810	1 015	1 0244	1 0433
	0 945	1 029	1 0288	
	1 585	1 136	1 0475	
Dulcitol	0 065	0 8876	0 9995	1 0686
	0 130	0 9078	1 0018	1 0212
	0 260	0 9360	1 0060	1 0260

(Muller )

Solubility of  $H_3BO_3$  in alcohols+Aq at 25°  
M = Mol of alcohol in 100 mol of alcohol+Aq  
 $H_3BO_3$  = Mol of  $H_3BO_3$  in 1 l of the solution  
 $d_1$  = Sp gr of alcohol+Aq  
 $d_2$  = Sp gr of alcohol+Aq sat with  $H_3BO_3$

Alcohol added	M	$H_3BO_3$	$d_1$	$d_2$
Methyl alcohol	11 74	0 895		
	28 64	1 012		
	36 02	1 098		
	43 95	1 161		
	52 31	1 307		
	100	2 900	0 7924	0 8904
Ethyl alcohol	8 996	0 829		
	22 28	0 800		
	44 46	0 729		
	55 62	0 700		
	79 89	0 893		
	88 10	1 105		
	99 26	1 527	0 7860	0 8353
n-Propyl alcohol	23 66	0 6437	0 9043	0 9193
	53 63	0 4569	0 8231	0 8570
	83 65	0 5776	0 8133	0 8466
	100	0 961	0 8010	0 8297
i-Butyl alcohol	0 70	0 884	0 9923	1 0124
	2 15	0 857	0 9853	0 0038
	2 18	0 857	0 9855	0 0046
	71 4	0 323	0 8173	0 8351
	77 1	0 347	0 8133	0 8220
	85 6	0 4212	0 8081	0 8195
	100	0 6927	0 7984	0 8172
i-Amyl alcohol	0 448	0 883	0 9943	1 0132
	0 520	0 880	0 9936	1 0125
	0 525 <sup>1</sup>	0 880	0 9931	1 0123
	67 26	0 2584	0 8232	0 8295
	75 54	0 2722	0 8183	0 8253
	83 40	0 3190	0 8142	0 8223
	100	0 5703	0 8068	0 8220

<sup>1</sup> Water sat with alcohol<sup>2</sup> Alcohol sat with water

(Muller )

Easily sol in acetone (Krug and M'Elroy, J Anal Ch 6 184)

Solubility in acetone + Aq at 20°  
A = ccm acetone in 100 ccm acetone + Aq  
H<sub>3</sub>BO<sub>3</sub> = millimols H<sub>3</sub>BO<sub>3</sub> in 100 ccm of the solution

A	H <sub>3</sub> BO <sub>3</sub>
0	79 15
20	81 71
30	83 35
40	82 74
50	81 61
60	76 40
70	67 62
80	55 05
100	8 06

(Herz, Z anorg 1904, 41 319)

100 g pure anhydrous ether dissolve 0 00775 g H<sub>3</sub>BO<sub>3</sub>

100 g ether sat with H<sub>2</sub>O dissolve 0 2391 g H<sub>3</sub>BO<sub>3</sub>  
(J A Rose, Dissert 1902)

Sol in 10 pts glycine (Hager)

100 pts glycine (sp gr 1 26 at 15 5°) dissolve pts H<sub>3</sub>BO<sub>3</sub> at t°

t°	Pts H <sub>3</sub> BO <sub>3</sub>	t°	Pts H <sub>3</sub> BO <sub>3</sub>	t°	Pts H <sub>3</sub> BO <sub>3</sub>
0	20	40	35	80	61
10	24	50	44	90	67
20	28	60	50	100	72
30	33	70	56		

(Hooper Ph J Trans (3) 13 258)

Solubility of H<sub>3</sub>BO<sub>3</sub> in glycine + Aq at 25°  
G = g glycine in 100 g glycine + Aq  
H<sub>3</sub>BO<sub>3</sub> = Millimols H<sub>3</sub>BO<sub>3</sub> in 100 cc of the solution

G	H <sub>3</sub> BO <sub>3</sub>	Sp gr
0	90 1	1 0170
7 15	90 1	1 0379
20 44	90 6	1 0629
31 35	92 9	1 0897
46 93	97 0	1 1130
58 7	103 0	1 1328
69 2	140 2	1 1871
100	390 3	1 2719

(Herz, Z anorg 1903, 45 268)

Solubility of H<sub>3</sub>BO<sub>3</sub> in organic acids + Aq at 26

Acid	Normality of the acid	Normality of H <sub>3</sub> BO <sub>3</sub>
Acetic	0 570	0 887
	2 85	0 538
	5 70	0 268

Solubility of H<sub>3</sub>BO<sub>3</sub>, etc — Continue

Acid	Normality of the acid	Normality of H <sub>3</sub> BO <sub>3</sub>
Tartaric	0 955	0 890
	1 909	0 923
	2 51	0 962
	3 316	1 07

(Herz, Z anorg 1903, 34 206)

The solubility of H<sub>3</sub>BO<sub>3</sub> in H<sub>2</sub>O is increased by the presence of racemic acid

Millimols racemic acid in 10 ccm of the solvent	Millimols boric acid in 10 ccm of the solution
0	9 01
6 3	9 86
12 6	10 46
24 7	11 65

(Herz, Z anorg 1911, 70 71)

Solubility of H<sub>3</sub>BO<sub>3</sub> in H<sub>2</sub>O is increased by the presence of tartaric acid

Millimols tartaric acid in 10 ccm of the solvent	Millimols boric acid in 10 ccm of the solution
0	9 01
7 5	10 00
15	10 70
30	12 07

(Herz, Z anorg 1911, 70 71)

Solubility in oxalic acid + Aq at 25°

Millimols oxalic acid in 10 ccm of the solution	Millimols H <sub>3</sub> BO <sub>3</sub> in 10 ccm of the solution
	9 01
	9 95
2 97	10 80
5 95	11 98
13 77	

(Herz, Z anorg 1910, 66 93)

Solubility in H<sub>2</sub>O is increased by the presence of urea, acetone or propyl alcohol (Bogdan, C C 1903, II 2)

Rapidly sol in hot glacial acetic acid (Holt Chem Soc 1911, 100 (2) 720)

Sol in 250 pts benzene (Hager)

Solubility of H<sub>3</sub>BO<sub>3</sub> in mannite + Aq at t°

Solid phase H <sub>3</sub> BO <sub>3</sub>					
t°	Mm. mol in 1 l	t	Mm. mol in 1 l		
	Mannite	H <sub>3</sub> BO <sub>3</sub>		Mannite	H <sub>3</sub> BO <sub>3</sub>
25°	0	0 887	30	0	1 025
	0 1	0 951		0 1	1 056
	0 3	1 015		0 2	1 086
	0 4	1 039		0 3	1 118
	0 5	1 071		0 4	1 157
	0 6	1 102		0 5	1 193
	0 7	1 142		0 6	1 219
	0 8	1 173		0 7	1 258
	1 043	1 244			
	1 409	1 404			
	1 781	1 521			

Solid phase mannite		
t°	Mg mols in 1 l	
	Mannite	H <sub>3</sub> BO <sub>3</sub>
25°	1 075	0
"	1 1424	0 2646
"	1 259	0 463
"	1 265	0 559
"	1 354	0 794
"	1 409	0 927
"	1 536	1 243
"	1 781	1 521

(Ageno and Valla, Ist Ven (VIII) 14 331)

Distribution between H<sub>2</sub>O and amyl alcohol at 25°w = concentration of H<sub>3</sub>BO<sub>3</sub> in H<sub>2</sub>O layer expressed in millimolsa = concentration of H<sub>3</sub>BO<sub>3</sub> in alcohol layer expressed in millimols

w	a
265 8	76 6
196 5	59 5
159 6	47 5
126	37 1
87 9	33 2
75 2	22 7
64 6	19 76

(Abegg, Z anorg 1903, 35 130)

Partition of H<sub>3</sub>BO<sub>3</sub> between water and mixtures of amyl alcohol and CS<sub>2</sub>W = Millimols H<sub>3</sub>BO<sub>3</sub> in 10 ccm of the aqueous layerG = Millimols H<sub>3</sub>BO<sub>3</sub> in 10 ccm of the amyl alcohol—CS<sub>2</sub> layer

Composition of the solvent mixture	c	w	w, G
75% by vol amyl alcohol + 25% by vol CS <sub>2</sub>	0 145	0 624	4 31
	0 375	1 198	4 36
	0 429	1 844	4 30
	0 589	2 565	4 45
50% by vol amyl alcohol + 50% by vol CS <sub>2</sub>	0 145	0 756	5 47
	0 259	1 353	5 21
	0 364	1 946	5 34
	0 555	2 889	5 22
25% by vol amyl alcohol + 75% by vol CS <sub>2</sub>	0 085	0 699	8 24
	0 175	1 467	8 40
	0 264	2 165	8 12
	0 384	3 129	8 14

(Herz, Z Elektrochem 1910, 16 870)

Distribution between HF + Aq and amyl alcohol at 25°

c = HF concentration (millimols)

a = H<sub>3</sub>BO<sub>3</sub> concentration in alcohol layer (expressed in millimols)w = H<sub>3</sub>BO<sub>3</sub> concentration in water layer (expressed in millimols)

c	a	w
500	14 3	71 2
"	19 2	99 2
"	25 3	144 2
"	114 3	979 0
250	30 1	144 5
"	37 0	194 8
"	56 8	321 5
"	108 0	652 0
125	39 0	170 5
"	47 2	214 0
"	52 8	240 5
"	96 0	442 0
62 5	30 4	111 2
"	39 4	151 8
"	65 (68°)	272 8
"	90 0	362 2

(Abegg, Z anorg 1903, 35 131)

See also Boron trioxide

Pyroboric (tetraboric) acid, H<sub>2</sub>B<sub>4</sub>O<sub>7</sub>Sol in H<sub>2</sub>OSp gr of solutions of boric acid, calc as H<sub>2</sub>B<sub>4</sub>O<sub>7</sub>, containing—

6 3	1 27	1 91	2 54%
1 0034	1 0069	1 0106	1 0147 sp gr

Sat solution at 15° has sp gr 1 015 (Gerlach, Z anal 28 473)

Insol in hot glacial acetic acid (Holt, Chem Soc 1911, 100 (2) 720)

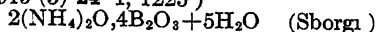
**Borates**

No borate is quite insol in H<sub>2</sub>O, the alkali borates are very sol. The less sol borates are easily decomp by H<sub>2</sub>O, the easily sol salts are also decomp, but less quickly. The less sol borates are easily sol in H<sub>3</sub>BO<sub>3</sub>, HNO<sub>3</sub>, etc. They are more sol in H<sub>2</sub>O containing tartaric acid or potassium tartrate than in pure H<sub>2</sub>O (Souberain). The normal borates of the alkaline earths are sol to no inconsiderable extent in H<sub>2</sub>O and more readily in hot, than in cold H<sub>2</sub>O (Berzelius, Pogg 34 568).

All borates are insol, or sl sol in alcohol

**Aluminum borate, 2Al<sub>2</sub>O<sub>3</sub>, B<sub>2</sub>O<sub>3</sub>**Min *Jeremicumite*+ 3H<sub>2</sub>O Ppt (Rose, Pogg 91 452)3Al<sub>2</sub>O<sub>3</sub>, B<sub>2</sub>O<sub>3</sub> *Crystallized* Insol in HNO<sub>3</sub> + Aq (Ebelmen, A ch (3) 33 62)3Al<sub>2</sub>O<sub>3</sub>, 2B<sub>2</sub>O<sub>3</sub> + 7H<sub>2</sub>O Ppt (Rose, l c)**Ammonium borate**The system (NH<sub>4</sub>)<sub>2</sub>B<sub>4</sub>O<sub>7</sub>, H<sub>2</sub>O at 60° has

been studied by Sborgi (Real Ac Linc 1915 (5) 24 I, 1225)



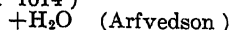
### Ammonium diborate

Difficultly sol in acetone (Naumann, B 1904, 37 4328)

**Ammonium tetraborate**,  $(\text{NH}_4)_2\text{B}_4\text{O}_7 + 4\text{H}_2\text{O}$ ,  
or perhaps  $\text{NH}_4\text{H}(\text{BO}_2)_2 + 1\frac{1}{2}\text{H}_2\text{O}$

Sol in 12 pts cold  $\text{H}_2\text{O}$ , decomp by heat (Rammelsberg, Pogg 90 21)

Sol in acetone (Eidmann, C C 1899, II 1014)



**Ammonium octoborate**,  $(\text{NH}_4)_2\text{B}_8\text{O}_{13} + 6\text{H}_2\text{O}$

Sol in 8 pts cold, decomp by boiling  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 90 21)



Min *Lardellerite* Sol in  $\text{H}_2\text{O}$  with decomp

**Ammonium dekaborate**,  $(\text{NH}_4)_2\text{B}_{10}\text{O}_{16} + 6\text{H}_2\text{O}$

Permanent Sol in  $\text{H}_2\text{O}$  (Rammelsberg)  $+ 8\text{H}_2\text{O}$  (Atterberg, Bull Soc (2) 22 350)

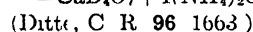
**Ammonium dodekaborate**,  $(\text{NH}_4)_2\text{B}_{12}\text{O}_{18} + 9\text{H}_2\text{O}$

Sol in hot  $\text{H}_2\text{O}$  (Bechi, Sill Am J (2) 17 129)

**Ammonium perborate**,  $\text{NH}_4\text{BO}_3$

See Perborate, ammonium

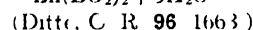
**Ammonium calcium borate**,  $(\text{NH}_4)_8\text{CaB}_4\text{O}_{11} = \text{CaB}_4\text{O}_7 + 4(\text{NH}_4)_2\text{O}$



**Ammonium magnesium borate**

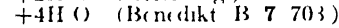
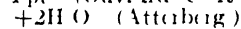
Sol in  $\text{H}_2\text{O}$ , decomp by boiling (Rammelsberg, Pogg 49 451)

**Ammonium zinc borate**,  $4(\text{NH}_4)_2\text{B}_4\text{O}_7 \cdot \text{Zn}(\text{BO}_2)_2 + 5\text{H}_2\text{O}$



**Barium borate**,  $\text{Ba}(\text{BO}_2)_2$

Ppt (Ouvrard C R 1906 142 283)



Sol in 3 300 pts 45% alcohol

7,500 " 50 "

25,000 " 60 "

55,000 " 75 "

(Berg, Z anal 16 25)

$+ 10\text{H}_2\text{O}$  Sl sol in cold, more readily in hot  $\text{H}_2\text{O}$ , especially in presence of ammonium salts (Berzelius, Pogg 34 568) Sol in sodium citrate + Aq (Spiller) Insol in wood spirit (Fehlimen)

$2\text{Ba}(\text{O})\text{B}(\text{O})_2$  Decomp by  $\text{H}_2\text{O}$  forming  $\text{Ba}(\text{O}) \cdot \text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$  (Ouvrard, C R 1906, 142 283)

$3\text{BaO} \cdot \text{B}_2\text{O}_3$  Easily sol in mineral acids Sl attacked by dil acetic acid (Ouvrard, C R 1901, 132 258)

$\text{BaB}_4\text{O}_7$  Slowly sol in warm dilute  $\text{HNO}_3$  + Aq (Ditte, C R 77 892)

$+ 5\text{H}_2\text{O}$  Sol in 100 pts cold, and more freely in hot  $\text{H}_2\text{O}$  When freshly pptd sol in cold  $\text{NH}_4\text{Cl}$  + Aq (Wackenroder, A 41 315),  $\text{NH}_4\text{NO}_3$  + Aq (Brett, Phil Mag (10 96), and  $\text{BaCl}_2$  + Aq (Rose)

$\text{BaB}_4\text{O}_{10} + 13\text{H}_2\text{O}$  (Laurent, A ch (67 215)

$\text{Ba}_2\text{B}_2\text{O}_5$  (Bloxam, Chem Soc 14 43)

$5\text{BaO} \cdot 2\text{B}_2\text{O}_3$

$\text{Ba}_2\text{B}_{10}\text{O}_{18} + 6\text{H}_2\text{O}$  Sol in 100 pts cold  $\text{H}_2\text{O}$  Easily sol in ammonium nitrate, or chloride, or barium chloride + Aq (Rose, Pogg 87 1)

$\text{Ba}_2\text{B}_6\text{O}_{11}$  Easily sol in warm dilute acids  $+ 6\text{H}_2\text{O}$

$+ 7\text{H}_2\text{O}$

$+ 15\text{H}_2\text{O}$  (Laurent, A ch (2) 67 2)

**Barium borate bromide**,  $3\text{BaO} \cdot 5\text{B}_2\text{O}_3 \cdot \text{HBr}$  (Ouvrard, C R 1906, 142 283)

**Barium borate chloride**,  $3\text{BaO} \cdot 5\text{B}_2\text{O}_3 \cdot \text{HCl}$  Unaffected by  $\text{H}_2\text{O}$  Sol in acids (Ouvrard, C R 1906, 142 283)

**Bismuth borate**,  $\text{BiBO}_3 + 2\text{H}_2\text{O}$

Ppt Sl sol in  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{S}$  Not decomp by  $\text{KOH}$  + Aq (Vanino, pr 1906, (2) 74 152)

**Cadmium borate**,  $\text{Cd}_3(\text{BO}_3)_2$

Insol in  $\text{H}_2\text{O}$ , easily sol in dil acids (Ouvrard, C R 1900, 130 174)

$\text{Cd}(\text{BO}_2)_2$  Difficultly sol in  $\text{H}_2\text{O}$  (Berzelius), insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl}$  + Aq (Ouvrard), easily sol in warm  $\text{NH}_4\text{Cl}$  + Aq (Rose)

(Guertler, Z anorg 1904, 40 242)

$3\text{CdO} \cdot 2\text{B}_2\text{O}_3 + 3\text{H}_2\text{O}$  Ppt Sl in  $\text{H}_2\text{O}$  (Rose, Pogg 88 299)

$\text{CdO} \cdot 2\text{B}_2\text{O}_3 + 2\text{H}_2\text{O}$  (Ditte, A ch 1883, (5) 30 255)

$\text{CdO} \cdot 4\text{B}_2\text{O}_3 + 10\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  decomp on heating (Ditte, A ch 1883, (5) 30 255)

**Cadmium borate bromide**,  $6\text{CdO} \cdot 3\text{B}_2\text{O}_3 \cdot \text{CdBr}_2$

Insol in  $\text{H}_2\text{O}$  and fuming  $\text{HCl}$  or  $\text{HBr}$  + Aq (Rousseau and Allure, C R 1894 116 72)

**Cadmium borate chloride**,  $6\text{CdO} \cdot 3\text{B}_2\text{O}_3 \cdot \text{CdCl}_2$

(Rousseau and Allure, C R 1894 116 72)

**Cadmium borate iodide**,  $6\text{CdO} \cdot 3\text{B}_2\text{O}_3 \cdot \text{CdI}_2$  (Allure, C R 1898 127 557)

**Cæsium borate**,  $\text{CsB}_3\text{O}_{10}$

Very sol in  $\text{H}_2\text{O}$ , less in alcohol (Reichle, Z anorg 4 116)

**Calcium borate,  $\text{Ca}(\text{BO}_2)_2$** 

Sl sol in  $\text{H}_2\text{O}$ , insol in alkali chlorides, or boiling conc acetic acid + Aq, sol in cold or hot solutions of ammonium salts, especially ammonium nitrate, in  $\text{CaCl}_2$  + Aq, and also easily sol in dilute mineral acids at  $50^\circ$  (Ditte, C R 80 490, 561)

+  $2\text{H}_2\text{O}$   
+  $4\text{H}_2\text{O}$ , two modifications of which one is very unstable (van't Hoff and Meyerhoffer, A 1906, 351 101)

+  $6\text{H}_2\text{O}$  When warmed in  $\text{H}_2\text{O}$  it goes over into  $\text{CaB}_2\text{O}_4 + 4\text{H}_2\text{O}$  (van't Hoff and Meyerhoffer)

Sol in  $\text{H}_2\text{O}$  without decomp, 1 l solution contains 2 g salt (Ditte, C R 96 1663)

$\text{CaB}_2\text{O}_7$  Decomp by  $\text{H}_2\text{O}$  (Blount, C N 54 208)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

+  $3\text{H}_2\text{O}$  (Ditte, C R 96 1663)

+  $4\text{H}_2\text{O}$  Min *Bechulte*

+  $6\text{H}_2\text{O}$  Min *Borocalcite* Sol in acids  
 $\text{CaB}_6\text{O}_{10} + 4\text{H}_2\text{O}$

+  $8\text{H}_2\text{O}$  Unstable On standing in the solution in which it is formed it changes into  $\text{CaB}_6\text{O}_{10} + 4\text{H}_2\text{O}$

+  $12\text{H}_2\text{O}$  Unstable Goes over into  $\text{CaB}_6\text{O}_{10} + 8\text{H}_2\text{O}$  (van't Hoff and Meyerhoffer, A 1906, 351 104)

$\text{CaB}_6\text{O}_{13} + 12\text{H}_2\text{O}$  (Ditte, C R 96 1663)  
 $2\text{CaO} \cdot \text{B}_2\text{O}_3$  Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Ouvrard, C R 1905, 141 353)

$\text{Ca}_2\text{B}_6\text{O}_{11}$  (Ditte, C R 77 785)

+  $3\text{H}_2\text{O}$  Min *Pandermite*, *Pricente* See  
 $4\text{CaO} \cdot 5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$

+  $5\text{H}_2\text{O}$  Min *Colemanite*

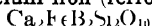
If all the Ca is in form of colemanite, the solution contains in 100 g, 4.8 g  $\text{H}_2\text{BO}_3$  and 0.1 g CaO (van't Hoff, B A B 1907, 653)

+  $7\text{H}_2\text{O}$   
+  $9\text{H}_2\text{O}$  (van't Hoff and Meyerhoffer, A 1906, 351 101)

$3\text{CaO} \cdot \text{B}_2\text{O}_3$  Easily sol in dil acids (Ouvrard, C R 1901, 132 258)

$3\text{CaO} \cdot 5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$  (van't Hoff, B A B 1906, II 568)

$4\text{CaO} \cdot 5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$  True composition of Pandermite (van't Hoff, B A B 1906, II 572)

**Calcium iron (ferrous) borate silicate,**

Min *Hommelite* Easily sol in  $\text{HCl}$  + Aq

**Calcium magnesium borate,  $\text{CaO}$ ,  $\text{MgO}$ ,  $3\text{B}_2\text{O}_3 + 6\text{H}_2\text{O}$** 

Min *Hydroboracite* Somewhat sol in  $\text{H}_2\text{O}$  Easily sol in warm  $\text{HCl}$  + Aq or  $\text{HNO}_3$  + Aq  
 $3\text{CaO}$ ,  $3\text{MgO}$ ,  $4\text{B}_2\text{O}_3$  (Ditte, C R 77 894)

**Calcium sodium borate,  $2\text{CaO}$ ,  $\text{Na}_2\text{O}$ ,  $5\text{B}_2\text{O}_3 + 8\text{H}_2\text{O}$** 

(van't Hoff, B A B 1907, 303)

$\text{Ca}_2\text{B}_{10}\text{O}_{18}$ ,  $\text{Na}_3\text{B}_3\text{O}_9 + 15$ , or  $24\text{H}_2\text{O}$

Min *Natroborocalcite*, *Ulexite* Decomp by boiling with  $\text{H}_2\text{O}$  Sol in acids

$\text{Ca}_2\text{Na}_4\text{B}_{12}\text{O}_{22} + 15\text{H}_2\text{O}$  Min *Franklan-dite* Sl sol in  $\text{H}_2\text{O}$ , easily sol in  $\text{HCl}$ , and  $\text{HNO}_3$  + Aq

**Calcium borate bromide,  $3\text{CaO}$ ,  $3\text{B}_2\text{O}_3$ ,  $\text{CaBr}_2$** 

Sl attacked by  $\text{H}_2\text{O}$  Very sol in dilute acetic acid (Ouvrard, C R 1905, 141 1023)

$3\text{CaO}$ ,  $5\text{B}_2\text{O}_3$ ,  $\text{CaBr}_2$  Hardly attacked by cold  $\text{H}_2\text{O}$  or very dil acetic acid Sol in strong acids, even when dilute (Ouvrard, C R 1905, 141 1023)

**Calcium borate chloride,  $\text{Ca}_2\text{B}_2\text{O}_6$ ,  $\text{CaCl}_2$** 

Decomp quickly by moist air or  $\text{H}_2\text{O}$ , slowly by absolute alcohol (Chatelier, C R 99 276)

$3\text{CaO}$ ,  $3\text{B}_2\text{O}_3$ ,  $\text{CaCl}_2$  (Ouvrard, C R 1905, 141 353)

$3\text{CaO}$ ,  $5\text{B}_2\text{O}_3$ ,  $\text{CaCl}_2$  Sl attacked by cold  $\text{H}_2\text{O}$  and dil acetic acid + Aq Strong acids dissolve even when very dilute (Ouvrard, C R 1905, 141 352)

**Calcium borate silicate,  $2\text{CaO}$ ,  $\text{B}_2\text{O}_3$ ,  $2\text{SiO}_2 + \text{H}_2\text{O}$** 

Min *Datolite* Sol in  $\text{HCl}$  + Aq with separation of gelatinous silica

+  $2\text{H}_2\text{O}$  Min *Botryolite*

$\text{CaO}$ ,  $\text{B}_2\text{O}_3$ ,  $\text{SiO}_2$  Min *Danburite* Very sl attacked by  $\text{HCl}$  + Aq before ignition

**Chromous borate**

Precipitate Sol in free acids, borax + Aq (Moberg)

**Chromic borate,  $7\text{Cr}_2\text{O}_3$ ,  $4\text{B}_2\text{O}_3$** 

Insol in  $\text{H}_2\text{O}$ , sol in excess of borax + Aq (Hebberling, C C 1870 122)

**Chromic magnesium borate,  $3\text{Cr}_2\text{O}_3$ ,  $6\text{MgO}$ ,  $2\text{B}_2\text{O}_3$** 

Not attacked by acids (Ebelmen, A ch (3) 33 52)

$2\text{Cr}_2\text{O}_3$ ,  $9\text{MgO}$ ,  $3\text{B}_2\text{O}_3$  (Mallard, C R 105 1260)

**Cobaltous borate,  $3\text{CoO}$ ,  $2\text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  (Rose, Pogg 88 299)

$3\text{CoO}$ ,  $\text{B}_2\text{O}_3$  (Mallard, C R 105 1260)

$2\text{CoO}$ ,  $\text{B}_2\text{O}_3$  (Ouvrard, C R 1900, 130 337)

**Cobaltous borate bromide,  $6\text{CoO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{CoBr}_2$** 

(Rousseau and Allanc, C R 1894, 119 73)

**Cobaltous borate chloride,  $6\text{CoO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{CoCl}$** 

(Rousseau and Allanc, C R 1894, 118 1257)

**Cobaltous borate iodide,  $6\text{CoO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{CoI}_2$**   
(Allanc, C R 1898, 127 557)**Cuprous borate,  $3\text{Cu}_2\text{O}$ ,  $2\text{B}_2\text{O}_3$** 

(Guertler, Z anorg 1904, 38 459)



**Cupric borate**

Composition depends on temperature and concentration of solutions Boiling  $H_2O$  dissolves out all the boric acid Sol in acids, slowly sol in hot conc  $NH_4Cl + Aq$

$Cu(BO_2)_2$  Insol in cold dil acids, even HF Slowly sol in hot conc HCl Not attacked by alkalies or alkali carbonates + Aq (Guertler, Z anorg 1904, **38** 456)

Insol in methyl acetate (Naumann, B 1909, **42** 3790)

**Cupric borate ammonia**,  $CuB_4O_7 \cdot 4NH_3 + 6H_2O$

Efflorescent Can be recrystallized from a little  $NH_4OH + Aq$  (Pasternack, A **151** 227)

**Didymium borate**,  $DiBO_3$ 

Insol in  $H_2O$  acidulated with HCl + Aq (Cleve, Bull Soc (2) **43** 363)

$Di_2(B_4O_7)_3$  Insol in  $H_2O$ , sol in acids (Friedrichs and Smith, A **191** 355)

**Glucinum borate, basic**,  $5GfO \cdot B_2O_3$ 

Insol in  $H_2O$ , sol in acids (Kruss and Moraht, B **23** 735)

**Iron (ferrous) borate**

Ppt  $H_2O$  dissolves out all the boric acid (Tunnersman)

**Iron (ferric) borate**,  $Fe_2(BO_2)_6 + 3H_2O$ 

Ppt Insol in  $H_2O$   
Min *Lagonite* Sol in acids  
 $2Fe_2O_3 \cdot 3B_2O_3$  (Mallard, C R **105** 1260)  
 $6Fe_2O_3 \cdot B_2O_3 + 6H_2O$  Ppt (Rose, Pogg **89** 473)

$9Fe_2O_3 \cdot B_2O_3 + 9H_2O$  Ppt (Rose)

**Iron (ferric) magnesium borate**,  $3Fe_2O_3 \cdot 6MgO \cdot 2B_2O_3$ 

Insol in  $H_2O$  Sol in conc HCl + Aq (Ebelmen, A ch (3) **33** 53)

$2Fe_2O_3 \cdot 9MgO \cdot 3B_2O_3$  (Mallard, C R **105** 1260)

**Iron (ferroferric) magnesium borate**,  $3MgO \cdot 1FeO \cdot FeO_2 \cdot B_2O_3$ 

Min *Ludwigite* Slowly sol in HCl + Aq when finely powdered

**Iron (ferrous) borate bromide**,  $6FeO \cdot 3B_2O_3 \cdot 1FeBr$ 

Slowly sol in hot  $HNO_3 + Aq$  (Rousseau and Allard, C R **116** 1445)

**Iron (ferrous) borate chloride**,  $6FeO \cdot 3B_2O_3 \cdot 1FeCl$ 

Slowly sol in hot  $HNO_3 + Aq$  (Rousseau and Allard, C R **116** 1195)

**Lanthanum borate**,  $2La_2O_3 \cdot B_2O_3$ 

(Nordenskjöld, Pogg. **114** 618)

$La_2(B_4O_7)_3$  Ppt (Smith)

Formula is  $La_2B_4O_{11} + cH_2O$  (Cleve, B **11** 910)

**Lead borate, basic**,

$2PbO \cdot B_2O_3 + 2H_2O$  Ppt  
 $4PbO \cdot 3B_2O_3 + 4H_2O$  Ppt  
+  $5H_2O$  Ppt  
 $6PbO \cdot 5B_2O_3 + 6H_2O$  Ppt  
 $8PbO \cdot 3B_2O_3 + 8H_2O$  Ppt  
 $9PbO \cdot 5B_2O_3 + 9H_2O$  Ppt (Rose, ogg **87** 470)

**Lead borate**,  $Pb(BO_2)_2 + H_2O$ 

Insol in  $H_2O$  Easily sol in dil HN  $_3$ , or boiling  $HC_2H_3O_2 + Aq$  Decomp by I  $SO_4$ , HCl, also by boiling KOH, or NaOH Aq  
Insol in alcohol (Herapath, Phil M (3) **34** 375)

Sol in  $NH_4Cl + Aq$ , sol in sat NaCl Aq'  
 $2PbO \cdot 3B_2O_3 + 4H_2O$  (Herapath)  
 $PbB_4O_7 + 4H_2O$  Slightly sol in pure  $H_2O$ , but insol in solutions of Na salts as Na  $B_4O_7 + Aq$  (Soubeiran)

**Lead borate chloride**,  $Pb(BO_2)_2 \cdot PbCl_2 + H_2O$ 

Insol in cold, very slowly decomp l hot  $H_2O$  into its constituents Easily sol i dil hot  $HNO_3 + Aq$ , insol in alcohol (Her path, Phil Mag (3) **34** 375)

**Lead borate nitrate**,  $Pb(BO_2)_2 \cdot Pb(NO_3)_2 + H_2O$ 

Insol in alcohol (Herapath)

**Lithium borate**,  $LiBO$ 

Solubility in $H_2O$				
100 g	$H_2O$ dissolve g	$LiBO$	at t°	
t°	g	$LiBO$	t°	g
0	0.7	30	4	
10	1.4	40	11	2
20	2.6	45	20	

(Le Chatcher, C R 1897, **124** 109)

Insol in acetone (Fidmann C C **1899**, II 1014, Naumann B 1904 **37** 4329)

Insol in methyl acetate (Naumann B 1909, **42** 3790)

Insol in ethyl acetate (Naumann B 1910, **43** 314)

+  $5H_2O$  (Le Chatcher Bull Soc 1899 (3) **21** 55)

+  $16H_2O$  Effloresces in the m slowly sol in cold  $H_2O$  rapidly in hot  $H_2O$  (Le Chatcher C R 1897, **124** 1092)

$Li_2H_2(BO_3)_4 + 14H_2O$  (Roeschle Z anorg **4** 166)

$Li_2B_4O_7$  Deliquescent easily sol i  $H_2O$  (Arfvedson A ch **10** 82)

Sol in acetone (Fidmann C C **1899**, II 1014)

Insol in acetone (Naumann B 1904, **37** 4329)

Insol in methyl acetate (Naumann B 1909 **42** 3790)

+  $5H_2O$  Insol in alcohol (Fidnger, Aich Ph (3) **8** 198)

$\text{Li}_2\text{O}$ ,  $3\text{B}_2\text{O}_3 + 6\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$ , insol in alcohol (Filsinger)  
 $\text{Li}_2\text{O}$ ,  $4\text{B}_2\text{O}_3$  Insol in  $\text{H}_2\text{O}$  (Le Chatelier, Bull Soc 1899, (3) 21 35)  
 $+10\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Filsinger)  
 "Acid lithium borate" is less sol than the tetraborate (Gmelin)  
 $\text{Li}_2\text{O}$ ,  $5\text{B}_2\text{O}_3 + 10\text{H}_2\text{O}$  (Dukelski, C A 1908 1089)

### Magnesium borate, $\text{Mg}(\text{BO}_2)_2$

(Ditte, C R 77 893)  
 $+3\text{H}_2\text{O}$  Min *Pinnite*  
 $+4\text{H}_2\text{O}$  (Laurent, A ch (2) 67 215)  
 $+8\text{H}_2\text{O}$  Insol in cold or hot  $\text{H}_2\text{O}$ , easily sol in  $\text{HCl} + \text{Aq}$  Decomp by conc  $\text{HCl} + \text{Aq}$  into  $\text{H}_3\text{BO}_3$  and  $\text{MgCl}_2$  (Wohler)  
 $\text{MgB}_4\text{O}_7 + 8\text{H}_2\text{O}$  (Popp, A Suppl 8 1)  
 $\text{MgO}$ ,  $3\text{B}_2\text{O}_3 + 8\text{H}_2\text{O}$  Very slowly sol in  $\text{H}_2\text{O}$  (Rose, A 84 221)  
 Sol in 75 pts cold  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 49 445)  
 $2\text{MgO}$ ,  $\text{B}_2\text{O}_3$  Insol in  $\text{H}_2\text{O}$ , but sol in  $\text{Na}_2\text{CO}_3 + \text{Aq}$  (Guertler, Z anorg 1904, 40 236)  
 $+ \text{H}_2\text{O}$  Very sl sol in  $1/10$  N  $\text{HCl} + \text{Aq}$  (van't Hoff, B A B 1907, 658)  
 Min *Ascharite*  
 $3\text{MgO}$ ,  $\text{B}_2\text{O}_3$  Insol in  $\text{H}_2\text{O}$ , easily sol in acids (Ebelmen, A 80 208)  
 Very sl sol in cold, but somewhat decomp by boiling  $\text{H}_2\text{O}$  (Rammelsberg)  
 $+9\text{H}_2\text{O}$  Somewhat sol in cold  $\text{H}_2\text{O}$  (Wohler, Pogg 28 525)  
 $3\text{MgO}$ ,  $2\text{B}_2\text{O}_3$  Sol in warm  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$  (Ditte, C R 77 893)  
 $\text{MgO}$ ,  $6\text{B}_2\text{O}_3 + 18\text{H}_2\text{O} = \text{Mg}(\text{BO}_2)_2$ ,  $10\text{HBO}_2 + 13\text{H}_2\text{O}$  (Rammelsberg, Pogg 49 445)  
 $3\text{MgO}$ ,  $4\text{B}_2\text{O}_3$  Sol in hot dil acids, insol in acetic acid (Ditte, C R 77 893)  
 $5\text{MgO}$ ,  $2\text{B}_2\text{O}_3 + 1\frac{1}{2}$ , and  $3\text{H}_2\text{O}$  Min *Szibuite*  
 Difficultly sol in  $\text{HCl} + \text{Aq}$   
 $9\text{MgO}$ ,  $\text{B}_2\text{O}_3$  (Mallard, C R 105 260)

### Magnesium manganous borate, $3\text{Mg}_2\text{B}_2\text{O}_5$ , $4\text{MnB}_2\text{O}_7 + 7\text{H}_2\text{O}$

Min *Susselite* Sol in  $\text{HCl} + \text{Aq}$

### Magnesium potassium borate, $\text{KMgB}_{11}\text{O}_{19} + 9\text{H}_2\text{O}$

Min *Kaliborite* Insol in  $\text{H}_2\text{O}$  (Feit, Ch Z 1899, 13 1188)  
 $2\text{MgO}$ ,  $2\text{K}_2\text{O}$ ,  $11\text{B}_2\text{O}_3 + 20\text{H}_2\text{O}$  (van't Hoff and Ichnsten, B A B 1904, 936)

### Magnesium sodium borate, $\text{MgB}_4\text{O}_7$ , $\text{Na}_4\text{B}_4\text{O}_7 + 30\text{H}_2\text{O}$

Efflorescent About as sol in cold  $\text{H}_2\text{O}$  as borax solution separates out a Mg borate on warming, which redissolves on cooling  
 Decomp by boiling  $\text{H}_2\text{O}$  (Rammelsberg)

### Magnesium strontium borate, $3\text{MgO}$ , $3\text{SrO}$ , $4\text{B}_2\text{O}_3$

Easily sol in dil acids (Ditte, C R 77 895)

### Magnesium borate bromide, $2\text{Mg}_2\text{B}_2\text{O}_5$ , $\text{MgBr}_2$ or $6\text{MgO}$ , $8\text{B}_2\text{O}_3$ , $\text{MgBr}_2$

(Rousseau and Allaire, C R 1894, 119, 71)

### Magnesium borate chloride, $2\text{Mg}_2\text{B}_2\text{O}_5$ , $\text{MgCl}_2$

Min *Boracite* Insol in  $\text{H}_2\text{O}$ , slowly sol in acids (Kraut)

*Stassfurthite* Easily sol in warm acids (Bischof)

### Magnesium borate iodide, $6\text{MgO}$ , $8\text{B}_2\text{O}_3$ , $\text{MgI}_2$

(Allaire, C R 1898, 127 556)

### Magnesium borate phosphate, $\text{Mg}(\text{BO}_2)_2$ , $2\text{MgHPO}_4 + 7\text{H}_2\text{O}$

Min *Lüneburgite*

### Magnesium borate sulphate, $2\text{Mg}_2\text{B}_2\text{O}_5$ , $3\text{MgSO}_4 + 12\text{H}_2\text{O}$

Min *Magnesium sulphoborate*

Sol in mineral acids when ground (Nau-pert, B 1893, 26 874)

### Manganous borate, $\text{MnB}_4\text{O}_7$ (?)

Insol in  $\text{H}_2\text{O}$  (Berzelius), very sl sol in  $\text{H}_2\text{O}$  (Thomas, Am Ch J 4 358), decomp by warm, slowly by cold  $\text{H}_2\text{O}$  Sol in  $\text{MgSO}_4 + \text{Aq}$  (Berzelius)

$+3\text{H}_2\text{O}$  (Endemann and Paisley, Zeit angew Ch 1903, 16 176)

$+5\text{H}_2\text{O}$  Ppt (Endemann and Paisley, Zeit angew Ch 1903, 16 176)  
 Very hygroscopic (Endemann, Ar J 1903, 29 72)

$3\text{MnO}$ ,  $\text{B}_2\text{O}_3$  (Mallard, C R 105 1260)  
 Not attacked by  $\text{H}_2\text{O}$  Very sol in acids

(Ouvrard, C R 1900, 130 336)

$3\text{MnO}$ ,  $2\text{B}_2\text{O}_3$  (Mallard)

$\text{MnH}_4(\text{BO}_3)$  Very sl sol in  $\text{H}_2\text{O}$

Solubility in 2%  $\text{Na}_2\text{SO}_4 + \text{Aq}$  At  $18^\circ$ , 0.77 g  $\text{MnH}_4(\text{BO}_3)_2$  are dissolved per litre, at  $40^\circ$ , 0.65 g, at  $60^\circ$ , 0.36 g, at  $80^\circ$ , 0.12 g

Solubility in 2%  $\text{NaCl} + \text{Aq}$  1 l solution dissolves 1.31 g salt at  $18^\circ$ , 0.6 g at  $59^\circ$  and 0.29 g at  $80^\circ$

Solubility in 2%  $\text{CaCl}_2 + \text{Aq}$  1 l  $\text{CaCl}_2 + \text{Aq}$  dissolves 2.91 g salt at  $17^\circ$ , 2.44 g at  $43^\circ$ , 2.25 g at  $61^\circ$ , and 1.35 g at  $80^\circ$  (Hartley and Ramuge, Chem Soc 63 129)

### Manganous borate bromide, $6\text{MnO}$ , $8\text{B}_2\text{O}_3$ , $\text{MnBr}$

(Rousseau and Allaire, C R 1894, 119 73)

### Manganous borate chloride, $6\text{MnO}$ , $8\text{B}_2\text{O}_3$ , $\text{MnCl}$

(Rousseau and Allaire, C R 1894, 118 1257)

### Molybdenum borate, $\text{MoO}$ , $2\text{B}_2\text{O}_3$ (?)

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{H}_3\text{BO}_3 + \text{Aq}$  (Berzelius)

**Molybdenum borate,  $\text{Mo}_2\text{O}_3, \text{B}_2\text{O}_3$** 

Precipitate Insol in  $\text{H}_2\text{O}$ , sl sol in a solution of boric acid (Berzelius)

See **Boromolybdic Acid**

**Nickel borate,  $\text{Ni}(\text{BO}_2)_2 + 2\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  Easily sol in acids Easily sol in warm  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rose, Pogg 88 299)

$2\text{NiO}, \text{B}_2\text{O}_3 + x\text{H}_2\text{O}$  Easily sol in acids (Rose)

$3\text{NiO}, 2\text{B}_2\text{O}_3 + 5\text{H}_2\text{O}$  Easily sol in acids (Rose)

$3\text{NiO}, \text{B}_2\text{O}_3$  Not attacked by  $\text{H}_2\text{O}$ , sol in acids (Ouvrard, C R 1900, 130 337)

**Nickel borate bromide,  $6\text{NiO}, 8\text{B}_2\text{O}_3, \text{NiBr}_2$**   
(Rousseau, C R 1894, 119 73)**Nickel borate chloride,  $6\text{NiO}, 8\text{B}_2\text{O}_3, \text{NiCl}_2$**   
(Rousseau, C R 1894, 118 1257)**Potassium borates**

Solubility of  $\text{B}_2\text{O}_3$  in  $\text{K}_2\text{O} + \text{Aq}$  at  $30^\circ$

Solution contains		Solid phase
% by wt $\text{K}_2\text{O}$	% by wt $\text{B}_2\text{O}_3$	
47 50		$\text{KOH}, 2\text{H}_2\text{O}$
46 45	0 72	"
46 36	0 91	$\text{K}_2\text{O}, \text{B}_2\text{O}_3, 2 5\text{H}_2\text{O}$
40 51	1 25	"
36 82	1 80	"
36 72	1 85	"
32 74	3 51	"
29 63	6 98	"
26 89	12 12	"
24 84	17 63	"
23 30	18 19	$\text{K}_2\text{O}, 2\text{B}_2\text{O}_3, 4\text{H}_2\text{O}$
16 21	13 10	"
11 78	9 82	"
9 18	8 00	"
6 22	9 13	"
7 79	13 20	"
7 73	13 37	$\text{K}_2\text{O}, 2\text{B}_2\text{O}_3, 4\text{H}_2\text{O} + \text{K}_2\text{O}, 5\text{B}_2\text{O}_3, 8\text{H}_2\text{O}$
7 81	13 28	"
7 67	13 19	"
7 71	13 21	$\text{K}_2\text{O}, 5\text{B}_2\text{O}_3, 8\text{H}_2\text{O}$
7 63	13 28	"
3 42	7 59	"
1 80	4 13	"
0 80	3 05	"
0 51	3 19	"
0 33	4 58	$\text{K}_2\text{O}, 5\text{B}_2\text{O}_3, 8\text{H}_2\text{O} + \text{B}(\text{OH})_3$
0 38	4 51	"
0 31	4 46	"
0 28	4 36	$\text{B}(\text{OH})_3$
	3 54	"

At  $30^\circ$  only the three potassium borates  $\text{K}_2\text{O}, \text{B}_2\text{O}_3 + 2 5\text{H}_2\text{O}$ ,  $\text{K}_2\text{O}, 2\text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$  and  $\text{K}_2\text{O}, 5\text{B}_2\text{O}_3 + 8\text{H}_2\text{O}$  exist in stable form (Dukelski, Z anorg 1906, 50 42)

**Potassium metaborate,  $\text{KBO}_2$** 

Sol in small amount of  $\text{H}_2\text{O}$  (Berzelius, Pogg 34 568)

$+1\frac{1}{2}\text{H}_2\text{O}$  Only stable hydrate (Dukelski, Z anorg 1906, 50 42)

$+1\frac{1}{2}\text{H}_2\text{O}$  (Atterberg, Bull Soc ( ) 22 350)

**Potassium tetraborate,  $\text{K}_2\text{B}_4\text{O}_7$** 

Very sol in  $\text{H}_2\text{O}$

$+4\text{H}_2\text{O}$  (Atterberg, Bull Soc ( ) 22 350)

Only stable hydrate (Dukelski, l c)

$+5\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$ , more so than

$\text{K}_2\text{B}_6\text{O}_{10}$  or  $\text{K}_2\text{B}_{12}\text{O}_{19}$

$+6\text{H}_2\text{O}$  (Atterberg, l c)

**Potassium hexaborate,  $\text{K}_2\text{B}_6\text{O}_{10} + 5$ , and  $8\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$

Does not exist (Dukelski, l c)

**Potassium dekaborate,  $\text{K}_2\text{B}_{10}\text{O}_{16} + 8\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Rammelsberg)

Only hydrate (Dukelski)

**Potassium dodekaborate,  $\text{K}_2\text{B}_{12}\text{O}_{18} + 10\text{H}_2\text{O}$** 

Sl sol in cold, very sol in hot  $\text{H}_2\text{O}$

(Laurent, A ch 67 215)

$= \text{K}_2\text{B}_{10}\text{O}_{16}$  (Rammelsberg)

Does not exist (Dukelski)

**Potassium borate fluoride,  $\text{KBO}_2, \text{KF}$** 

Sol in  $\text{H}_2\text{O}$  (Schiff and Sestini, 228 72)

$\text{KBO}_2, 2\text{KF}$  Sol in little, decomposes by much  $\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Schiff and Sestini, A 228 72)

**Rubidium borate,  $\text{RbB}_4\text{O}_7$** 

Anhydrous (Reischle, Z anorg 4 56)

$+6\text{H}_2\text{O}$  Not deliquescent or efflorescent Sol in  $\text{H}_2\text{O}$  (Reissig, A 127 33)

**Samarium borate,  $\text{SmBO}_3$** 

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$  (Cleve, Bull Soc (2) 43 1670)

**Scandium borate,  $\text{ScBO}_3$** 

Sol in dil acids (Crookes Phil Trans 1910, 210 A 364)

**Silver borate,  $\text{AgBO}_2$** 

Sl sol in  $\text{H}_2\text{O}$  By washing with  $\text{H}_2\text{O}$  the boric acid is dissolved out (Rose, Chem Centr bl 1853 205)

Sol with decom in  $\text{Na}_2\text{SO}_4 + \text{A}$  (Henschel), sol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  if pptd old 1 l  $\text{H}_2\text{O}$  dissolves ca  $6 \times 10^{-4}$  g atoms at  $25^\circ$  (Abegg and Cox, Z phys C 1903, 46 11)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

$3\text{AgO}, 4\text{B}_2\text{O}_3$  (Rose, l c)

## Sodium borates

Solubility of  $B_2O_3$  in  $Na_2O + Aq$  at  $30^\circ$ 

Solution contains		Solid phase
% by wt $Na_2O$	% by wt $B_2O_3$	
42 00		$NaOH, H_2O$
40 85	2 71	"
41 37	5 10	"
38 85	5 55	$Na_2O, B_2O_3, 4H_2O$
34 44	3 73	"
29 39	2 51	"
28 61	2 38	"
27 78	2 44	"
26 13	2 75	"
25 08	2 98	"
23 00	3 82	"
16 61	13 69	"
21 58	4 63	$Na_2O, B_2O_3, 4H_2O + Na_2O, B_2O_3, 8H_2O$
20 58	4 69	$Na_2O, B_2O_3, 8H_2O$
18 31	4 97	"
15 32	6 21	"
13 25	8 18	"
12 39	9 12	"
8 85	10 49	$Na_2O, 2B_2O_3, 10H_2O$
5 81	6 94	"
4 00	4 76	"
1 88	2 41	"
1 38	5 16	"
1 84	7 36	"
2 02	7 79	"
2 40	9 48	"
4 08	17 20	$Na_2O, 2B_2O_3, 10H_2O + Na_2O, 5B_2O_3, 10H_2O$
		$Na_2O, 5B_2O_3, 10H_2O$
3 79	15 84	"
3 47	13 30	"
2 26	12 14	"
1 99	11 84	$Na_2O, 5B_2O_3, 10H_2O + B(OH)_3$
		$B(OH)_3$
1 86	11 78	"
1 81	11 18	"
0 64	6 11	"
	3 54	"

At  $30^\circ$ , only the four sodium borates  $Na_2O, B_2O_3 + 4H_2O$ ,  $Na_2O, B_2O_3 + 8H_2O$ ,  $Na_2O, 2B_2O_3 + 10H_2O$ , and  $Na_2O, 5B_2O_3 + 10H_2O$  exist as stable phases

(Dukelski, Z anorg 1906, 50 46)

Sodium metaborate,  $NaBO_3$ 

Anhydrous Easily sol in  $H_2O$ , with evolution of heat

+  $H_2O$  Easily sol in  $H_2O$  (Benedikt)+  $2H_2O$  Easily sol in  $H_2O$  (Benedikt, B 7 703)+  $3H_2O$  Easily sol in  $H_2O$  (Berzelius)+  $4H_2O$  Slightly efflorescent Sol in hot, less sol in cold  $H_2O$  Melts at  $57^\circ$  in its crystal  $H_2O$  (Dukelski, Z anorg 50 42)+  $4\frac{1}{2}H_2O$  (Atterberg, Z anorg 1906, 48 370)+  $5\frac{1}{2}H_2O$  (Atterberg)

+  $8H_2O$  (Atterberg)  
+  $4H_2O$  and +  $8H_2O$  are the only hydrates formed (Dukelski)

System  $Na_2O, B_2O_3, H_2O$  at  $60^\circ$  investigated by Sborgi (Real Ac Linc 1915, (5) 24 I, 443)

Sodium tetraborate,  $Na_4B_4O_7$  (Borax)100 g  $H_2O$  dissolve at $5^\circ$  10° 21 5° 30° 37 5°

1 3 1 6 2 8 3 9 5 6 g anhydrous salt

 $45^\circ$   $50^\circ$   $54^\circ$   $55^\circ$   $56^\circ$   $57^\circ$ 

8 1 10 5 13 3 14 2 15 0 16 0 g anhydrous salt

(Horn and van Wagener, Am Ch J 1903, 30 347)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Sol in amyl alcohol in the presence of meta-arsenous acid and excess of  $H_3BO_3$  (Auerbach, Z anorg 1903, 37 358)+  $4H_2O$ +  $5H_2O$ 100 g  $H_2O$  dissolve at $65^\circ$   $70^\circ$   $80^\circ$   $90^\circ$   $100^\circ$ 

22 0 24 4 31 4 40 8 52 3 g anhydrous salt

(Horn and van Wagener, Am Ch J 1903, 30 347)

+  $6H_2O$  Grows opaque in the air (Bechi, Sill Am J (2) 17 129)+  $10H_2O$  Only stable hydrate (Dukelski, Z anorg 50 30) Efflorescent on surface in dry air Not efflorescent when free from $Na_2CO_3$  (Sims)

Sol in 12 pts cold and 2 pts hot  $H_2O$  Sat cold  $Na_2B_4O_7 + Aq$  contains 9 23% and sat hot  $Na_2B_4O_7 + Aq$  contains 33 33%  $Na_2B_4O_7$  (Gmelin)

Sol in 20 pts cold and 6 pts boiling  $H_2O$  (Wallemus)Sol in 15 pts  $H_2O$  at  $18.7^\circ$  (Abt)100 pts  $H_2O$  at  $1.5^\circ$  dissolve 5 pts at  $60^\circ$  40 pts at  $100^\circ$  166 pts  $Na_2B_4O_7 + 10H_2O$  (Ure's Dictionary)

100 pts sat  $Na_2B_4O_7 + Aq$  at  $105.5^\circ$  contain 52 5 pts  $Na_2B_4O_7$  or 100 pts  $H_2O$  dissolve 110 54 pts  $Na_2B_4O_7$  or 1 pt  $Na_2B_4O_7$  is sol in 0.9047 pt  $H_2O$  at  $105.5^\circ$  (Griffith Quar J Sci 18 90)

Solubility in 100 pts  $H_2O$  at  $t^\circ$ 

t	Pts $Na_2B_4O_7$	Pts $Na_2B_4O_7 + 10H_2O$	t	Pts $Na_2B_4O_7$	Pts $Na_2B_4O_7 + 10H_2O$
0	1 49	2 83	60	18 09	40 43
10	2 42	4 65	70	24 22	57 85
20	4 05	7 88	80	31 17	76 19
30	6 00	11 90	90	40 14	116 66
40	8 79	17 90	100	55 16	201 43
50	12 93	27 41			

(Poggiale, A ch (3) 8 46)

100 pts  $H_2O$  dissolve 1 4 pts  $Na_2B_4O_7$  at  $0^\circ$ , and 55 3 pts at  $100^\circ$  (Mulder)

$Na_2B_4O_7 + Aq$  sat at  $15^\circ$  has sp gr = 1.0199, and contains 3.926 pts  $Na_2B_4O_7$  to 100 pts  $H_2O$  (Michel and Krafft, A ch (3) 41 471)

$\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  sat at  $17^\circ$  has sp gr = 1.0208 (Stolba, J pr 97 503)

Sp gr of  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  at  $15^\circ$

$\frac{\%}{100} \text{Na}_2\text{B}_4\text{O}_7$	$\frac{\%}{100} \text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$	Sp gr	$\frac{\%}{100} \text{Na}_2\text{B}_4\text{O}_7$	$\frac{\%}{100} \text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$	Sp gr
1	0.52	1.0049	4	2.11	1.0199
2	1.06	1.0099	5	2.64	1.0249
3	1.59	1.0149	6	3.17	1.0299

(Gerlach, Z anal 28 473)

Sp gr of  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  sat at  $15^\circ = 1.032$  (Gerlach)

Sat  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  boils at  $105.5^\circ$ , and contains 110.5 pts  $\text{Na}_2\text{B}_4\text{O}_7$  to 100 pts  $\text{H}_2\text{O}$  (Griffith)

Sat  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  forms a crust at  $103^\circ$ , and contains 60.14 pts  $\text{Na}_2\text{B}_4\text{O}_7$  to 100 pts  $\text{H}_2\text{O}$ , highest temp observed,  $104.3^\circ$  (Gerlach, Z anal 26 427)

B-pt of  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  containing pts  $\text{Na}_2\text{B}_4\text{O}_7$  to 100 pts  $\text{H}_2\text{O}$

B pt	Pts $\text{Na}_2\text{B}_4\text{O}_7$	B pt	Pts $\text{Na}_2\text{B}_4\text{O}_7$
100.5	8.64	103.0	61.2
101.0	17.2	103.5	75.4
101.5	26.5	104.0	90.8
102.0	37.5	104.5	109.0
102.5	48.5	104.6	112.3

(Gerlach, Z anal 26 452)

M-pt of  $\text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$  is  $75.5^\circ$  (Tilden, Chem Soc 45 407)

Insol in alcohol

100 g alcohol (0.941 sp gr) dissolve 2.45 g at  $15.5^\circ$  (U S P)

Sol in alcoholic solution of  $\text{NaCH}_3\text{CO}_2$  (Stromeyer)

Sol in 14.7 pts glycerine of 1.225 sp gr (Vogel)

Sol in 1 pt glycerine (Schultze, Arch Pharm (3) 6 149)

100 g glycerine dissolve 60.3 g at  $15.5^\circ$  (U S P)

Min Thermal

**Sodium borate,  $\text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$**

Sol in 5-6 pts cold  $\text{H}_2\text{O}$  (Bolley A 68 122) Perhaps sodium hydrogen tetraborate  $\text{Na}_2\text{HB}_4\text{O}_7 + 4\frac{1}{2}\text{H}_2\text{O}$

$\text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Atterberg, Z anorg 48 370)

Stable (Dukelski, Z anorg 50 42)

+  $11\text{H}_2\text{O}$  (Lament, C R 29 5)

**Sodium borate fluoride,  $\text{Na}_2\text{B}_4\text{O}_7 + 3\text{NaF} + 4\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$

Bischoff (B 7 112) considers this salt to be a mixture

$\text{Na}_2\text{B}_4\text{O}_7, 12\text{NaF} + 22\text{H}_2\text{O}$  Can be separated into its constituents by  $\text{H}_2\text{O}$  (Berzelius, Berz J B 23 96)

**Strontium borate,  $\text{Sr}(\text{BO}_2)_2$**

(Ditte, C R 77 788)

Easily hydrated by  $\text{H}_2\text{O}$  forming  $\text{Sr}(\text{BO}_2)_2 + 2\text{H}_2\text{O}$  Very sol in dil acetic acid (Ouvrard, C R 1906, 142 282)

Insol in acetone (Naumann, B 14, 37 4329)

+  $2\text{H}_2\text{O}$  (Ouvrard, l c)

+  $4\text{H}_2\text{O}$  (Ouvrard, l c)

+  $5\text{H}_2\text{O}$  1 l  $\text{H}_2\text{O}$  dissolves 2.3 g at  $10^\circ$

(Ditte, A ch 1883 (5) 30 253)

$\text{SrB}_2\text{O}_7$  Insol in  $\text{H}_2\text{O}$ , sol in dil acids

(Guerlier, Z anorg, 1904, 40 243)

+  $4\text{H}_2\text{O}$  Sol in 130 pts boiling  $\text{H}_2\text{O}$ , 100 pts  $\text{H}_2\text{O}$  at  $100^\circ$  dissolve 7.7 pts (Ure, Dict)

Easily sol in cold  $\text{NH}_4$  salts +  $\text{Aq}$ , sol in cold  $\text{HNO}_3 + \text{Aq}$

$2\text{SrO} \cdot \text{B}_2\text{O}_3$  Easily decomp by  $\text{H}_2\text{O}$  forming  $\text{B}_2\text{O}_3$ ,  $\text{SrO}$ ,  $4\text{H}_2\text{O}$  Very sol in acids (Ouvrard, C R 1906, 142 282)

$3\text{SrO} \cdot \text{B}_2\text{O}_3$  Less easily attacked by  $\text{H}_2\text{O}$  than Ca comp Very sol in mineral acids Sl attacked by dil acetic acid (Ouvrard, C R 1901, 132 258)

$\text{SrB}_2\text{O}_7$  Very sl sol in  $\text{H}_2\text{O}$ , sol in acids (Laurent)

$\text{SrB}_2\text{O}_7 + 7\text{H}_2\text{O}$  Ppt (Lament)

+  $12\text{H}_2\text{O}$  (Ditte)

$\text{Sr}_2\text{B}_4\text{O}_{13}$  Sol in cold mineral acids and acetic acid (Ditte, C R 77 785)

$2\text{SrO} \cdot 3\text{B}_2\text{O}_3$  Easily sol in acids (Ditte, l c)

**Strontium borate bromide,  $3\text{SrO} \cdot 5\text{B}_2\text{O}_3 \cdot \text{SrBr}_2$**

As the chloride (Ouvrard, C R 1906, 142 283)

**Strontium borate chloride,  $3\text{SrO} \cdot 5\text{B}_2\text{O}_3 \cdot \text{SrCl}_2$**

Sl attacked by cold  $\text{H}_2\text{O}$  not attacked by dilute acetic acid (Ouvrard, C R 1906 142 282)

**Thallous borate,  $\text{TlBO}_2 + \frac{1}{2}\text{H}_2\text{O}$**

Decomp in the air (Buchta J 1913 (2) 88 784)

$\text{TlBO}_2$  (Buchta J)

$\text{Tl}_2\text{B}_4\text{O}_7$  Ppt Sol in boiling  $\text{H}_2\text{O}$  insol in cold dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Crookes)

+  $2\text{H}_2\text{O}$  (Buchta J pr 191 (2) 88 774)

$\text{Tl}_2\text{B}_4\text{O}_{10} + 3\text{H}_2\text{O}$  (Buchta J)

$\text{Tl}_2\text{B}_4\text{O}_{11} + 4\text{H}_2\text{O}$  (Buchta J)

$\text{Tl}_2\text{B}_{10}\text{O}_{16} + 5\text{H}_2\text{O}$  (Buchta J)

$\text{Tl}_2\text{B}_{10}\text{O}_{17} + 7\text{H}_2\text{O}$  (Buchta J)

**Thorium borate (?)**

Precipitate Insol in  $\text{H}_2\text{O}$  and  $\text{LiBO}_2 + \text{Aq}$  (Berzelius)

**Tin (stannous) borate (?)**

Ppt (Wenzel)

**Divanadyl borate**

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{H}_3\text{BO}_3 + \text{Aq}$  (Berzelius)

**Ytterbium borate,  $\text{YbBO}_3$** 

Insol in conc  $\text{HCl}$ , sol in  $\text{HF}$  (Cleve, Z anorg 1902, **32** 148)

**Yttrium borate**

Precipitate (Berlin, Pogg **43** 105)

**Zinc borate,  $3\text{ZnO}, 2\text{B}_2\text{O}_3$** 

(Mallard, C R **105** 1260)

Decomp by  $\text{H}_2\text{O}$ , very sol in dil acids (Ouvrard, C R 1900, **130** 336)

$\text{ZnO}, 2\text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with decomp (Ditte, A ch 1883, (5) **30** 256)

$3\text{ZnO}, 4\text{B}_2\text{O}_3 + \text{H}_2\text{O}$  Ppt (Holdermann, Arch Pharm 1904, **242** 567)

$\text{ZnO}, 4\text{B}_2\text{O}_3 + 10\text{H}_2\text{O}$  (Ditte, A ch 1883, (5) **30** 256)

$9\text{ZnO}, 4\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$  Sl sol in  $\text{H}_3\text{BO}_3 + \text{Aq}$  (Rose, Pogg **88** 299)

$3\text{ZnO}, \text{B}_2\text{O}_3$  Insol in mineral acids (le Chatelier, C R **113** 1034)

**Zinc borate ammonia,  $\text{ZnB}_4\text{O}_7, 4\text{NH}_3 + 6\text{H}_2\text{O}$** 

Easily sol in  $\text{NH}_4\text{OH}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$  (Buchner, A **151** 234)

**Zinc borate bromide,  $6\text{ZnO}, 8\text{B}_2\text{O}_3, \text{ZnBr}_2$** 

(Rousseau and Allaire, C R **116** 1446)

**Zinc borate chloride,  $6\text{ZnO}, 8\text{B}_2\text{O}_3, \text{ZnCl}_2$** 

Insol in  $\text{HCl}$  (Rousseau, C R 1894, **118** 1256)

**Zinc borate iodide,  $6\text{ZnO}, 8\text{B}_2\text{O}_3, \text{ZnI}_2$** 

(Allaire, C R 1898, **127** 556)

**Zirconium borate, (?)**

Insol in  $\text{H}_2\text{O}$

**Perboric acid**

See Perboric Acid

**Boric phosphoric acid**

See Phosphoboric acid

**Boric tungstic acid**

See Borotungstic acid

**Boric acid sulphur trioxide**

See Borosulphuric acid

**Borimide,  $\text{B}(\text{NH})_3$** 

Decomp by  $\text{H}_2\text{O}$ , insol in all indifferent solvents, sol in liquid  $\text{NH}_3 + \text{S}$  to form a dark blue solution (Stock, B 1901, **34** 3044)

**Borimide hydrochloride,  $\text{B}_2(\text{NH})_3, 3\text{HCl}$** 

Decomp by  $\text{H}_2\text{O}$ , insol in all ordinary organic solvents (Stock, B 1901, **34** 3045)

**Borofluorhydric acid,  $\text{HBF}_4$** 

See Fluoboric acid

**Borofluorides**

See Fluoborides

**Boromolybdic acid**

Sol in  $\text{H}_2\text{O}$  Decomp by alcohol (Berzelius)

**Boron, B**

(a) *Amorphous* Somewhat sol in pure  $\text{H}_2\text{O}$ , when not ignited Salts and acids separate it out of aqueous solution Upon evaporation of  $\text{H}_2\text{O}$  solution a crust is formed, which is only partially sol in  $\text{H}_2\text{O}$  (Berzelius, Pogg **2** 113) Decomp by hot  $\text{H}_2\text{SO}_4$  and cold moderately conc  $\text{HNO}_3 + \text{Aq}$  Strongly ignited amorphous B is much less easily attacked by reagents than freshly pptd, and is insol in  $\text{H}_2\text{O}$  (Berzelius) Insol in caustic alkalis +  $\text{Aq}$ , also in alcohol and ether

Above boron was very impure (Moissan, C R **114** 392)

Pure B is not attacked by acids, but has a strong reducing action on  $\text{KMnO}_4 + \text{Aq}$ ,  $\text{FeCl}_3 + \text{Aq}$ , etc (Moissan, C R **114** 617)

Does not melt at  $1500^\circ$  Readily sol in conc acids, as  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{H}_3\text{PO}_4$ , very sl sol in hydric acids, decomp  $\text{H}_2\text{O}$  at red heat (Moissan, A ch 1895, (7) **6** 313-14)

Insol in liquid  $\text{NH}_3$  (Gore, A ch 1898, **20** 827)

(b) *Crystallized* 1 Insol in  $\text{H}_2\text{O}$ ,  $\text{KOH} + \text{Aq}$  Very slightly and slowly by boiling conc  $\text{H}_2\text{SO}_4$  Gradually so by conc  $\text{HNO}_3$  Formula is  $\text{Al}_2\text{B}_{10}$  (Hampe, A **183** 75)

2 Very slightly attacked by conc  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ , slowly but completely sol in conc  $\text{HNO}_3$ , insol in  $\text{KOH} + \text{Aq}$  Formula is  $\text{C}_2\text{Al}_3\text{B}_{10}$  (Hampe)

$\text{C}_2\text{Al}_3\text{B}_{10}$  (*crystalline*) Insol in a solution of  $\text{CrO}_3$  in  $\text{H}_2\text{SO}_4$  Insol in hot conc  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$  Sol in hot conc  $\text{HNO}_3$  (Biltz, B 1910, **43** 303)

**Boron tribromide,  $\text{BBr}_3$** 

Sol in  $\text{H}_2\text{O}$  or alcohol with decomp (Nickles, C R **60** 800)

**Boron phosphorus bromide,  $\text{BBr}_3, \text{PBr}_3$** 

Decomp by  $\text{H}_2\text{O}$

Sol in  $\text{CS}_2$  and  $\text{CHCl}_3$  Decomp by alcohol, ether, etc (Turle, C R **116** 1521)

$\text{BBr}_3, \text{PBr}_3$  Sl sol in cold, easily in hot  $\text{CS}_2$  (Turle)

**Boron bromide ammonia,  $\text{BBr}_3, 4\text{NH}_3$** 

Decomp by  $\text{H}_2\text{O}$  and alkalis (Besson, C R **114** 542)

**Boron bromide phosphine,  $\text{BBr}_3, \text{PH}_3$** 

Violently decomp by  $\text{H}_2\text{O}$  (Besson, C R **113** 78)

**Boron bromide phosphorus trichloride,  $2\text{BBr}_3\text{,PCl}_3$** 

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{BBr}_3$ ,  $\text{PCl}_3$ ,  $\text{CS}_2$ , and  $\text{CHCl}_3$  Insol in petroleum ether (Tarble, C R 1901, 132 84)

**Boron bromide phosphorus pentachloride,  $2\text{BBr}_3\text{,PCl}_5$** 

Sol in  $\text{BBr}_3$  and  $\text{CS}_2$ , decomp by  $\text{H}_2\text{O}$ , insol in light petroleum (Tarble, C R 1901, 132 85)

**Boron bromide phosphorus diiodide,  $2\text{BBr}_3\text{,P}_2\text{I}_4$** 

Sol in  $\text{BBr}_3$ ,  $\text{CS}_2$ ,  $\text{CHCl}_3$ , insol in light petroleum, decomp by  $\text{H}_2\text{O}$  (Tarble, C R 1901, 132 205)

**Boron bromide phosphoryl chloride,  $\text{BBr}_3\text{,POCl}_3$** 

Very easily decomp (Oddo and Tealdi, Gazz ch it 1903, 33 (2) 431)

**Boron bromoiodide,  $\text{BBr}_2\text{I}$** 

Decomp violently by  $\text{H}_2\text{O}$  (Besson, C R 112 100)

$\text{BBI}$  (Besson, C R 112 100)

**Boron bromosulphide,  $\text{B}_2\text{S}_3\text{,BBr}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Stock, B 1901, 34 3040)

**Boron carbide,  $\text{B}_6\text{C}$** 

Very stable, insol in  $\text{HF}$  and in  $\text{HNO}_3$ , sol in  $\text{KOH}$  at red heat (Moissan, Bull Soc 1894, (3) 11 1101)

Insol in acids, sol in fused alkali (Moissan, C R 1894, 118 559)

$\text{BC}$  or  $\text{B C}$  Insol in all the usual solvents (Mullhauser, Z anorg 5 92)

**Boron trichloride,  $\text{BCl}_3$** 

Rapidly absorbed by  $\text{H}_2\text{O}$  and alcohol with decomposition

**Boron nitrosyl chloride,  $\text{BCl}_3\text{,NOCl}$** 

Decomp violently by  $\text{H}_2\text{O}$  (Geuther, J pr (2) 8 511)

**Boron phosphoryl chloride,  $\text{BCl}_3\text{,POCl}_3$** 

Decomp immediately by  $\text{H}_2\text{O}$  (Gustavson, Zeit Chem 1870 521)

**Boron chloride ammonia,  $2\text{BCl}_3\text{,3NH}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Berzelius, Pogg 2 147)

**Boron chloride phosphine,  $\text{BCl}_3\text{,PH}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Besson, C R 110 516)

**Boron chlorosulphide,  $\text{B}_2\text{S}_3\text{,BCl}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Stock, B 1901, 34 3040)

**Boron trifluoride,  $\text{BF}_3$** 

$\text{H}_2\text{O}$  absorbs 700 vols  $\text{BF}_3$  gas to form a

liquid of 1.77 sp gr On boiling,  $\frac{1}{5}$  of t  $\text{BF}_3$  is given off, and a residue boiling at  $16^\circ$  to  $200^\circ$ , with composition  $\text{BF}_3 + 2\text{H}_2\text{O}$  or  $\text{H}_2\text{O}_2 + 3\text{HF}$ , is left (J Davy, A ch 86 178)

1 ccm  $\text{H}_2\text{O}$  absorbs at  $0^\circ$  and 762 mm pressure 1.057 ccm  $\text{BF}_3$

1 vol conc  $\text{H}_2\text{SO}_4$  of 1.85 sp gr absorbs 50 vols  $\text{BF}_3$

Absorbed by alcohol with decomp

Cold oil of turpentine absorbs 6 % of  $\text{BF}_3$

**Boron fluoride ammonia,  $\text{BF}_3\text{,NH}_3$ ,  $\text{BF}_3\text{,2NH}_3$ , and  $\text{BF}_3\text{,3NH}_3$** 

Decomp by  $\text{H}_2\text{O}$

**Boron fluoride cyanhydric acid,  $\text{BF}_3\text{,HCN}$** 

Very unstable (Paton, C R 113 5)

**Boron fluoride phosphine,  $2\text{BF}_3\text{,PH}_3$** 

Very unstable at ordinary temp Decomp by  $\text{H}_2\text{O}$  (Besson, C R 110 80)

**Boron hydride,  $\text{BH}_3$** 

Not obtained free from  $\text{H}_2\text{Si}$  Sol in  $\text{H}_2\text{O}$  (Jones, Chem Soc 35 41)

See **Cyclotriborene**

$\text{B}_4\text{H}_{10}$  B-pt  $16-17^\circ$  at 760 mm

Very unstable Takes fire spontaneously in the air

Decomp by  $\text{H}_2\text{O}$ , dil  $\text{HCl}$ , and oxidized by conc  $\text{HNO}_3$  with explosive violence

Absorbed by  $\text{NaOH} + \text{Aq}$

Decomp by alcohol Sol in dry benzene (Stock, B 1912, 45 3562)

$\text{B}_6\text{H}_{12}$  B-pt  $100^\circ$  at atmospheric pressure

Decomp by  $\text{H}_2\text{O}$  With aqueous solutions, hydrogen is evolved (Stock, B 1913, 45 3565)

$\text{B}_3\text{H}$  Insol in  $\text{HCl}$  Sol in aqueous  $\text{NaOH} + \text{Aq}$  (Winkler, B 1890, 23 778)

$\text{B}_{10}\text{H}_{14}$  M-pt  $99.5^\circ$ , not attacked by cold or boiling  $\text{H}_2\text{O}$  Sol in dil  $\text{NaOH} + \text{Aq}$  Sol in alcohol, ether, benzene, in  $\text{CS}_2$  (Stock, B 1913, 46 3360)

**Boron iodide,  $\text{BI}_3$** 

Very hygroscopic, and instantly decomp by  $\text{H}_2\text{O}$  or alcohol Very sol in  $\text{CS}_2$ ,  $\text{CCl}_4$ , less sol in  $\text{PCl}_3$ ,  $\text{AsCl}_3$ , and in many organic liquids (Moissan, C R 112 717)

**Boron iodide ammonia,  $\text{BI}_3\text{,5NH}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Besson, C R 112 512)

**Boron iodophosphide,  $\text{BI}_3\text{P}$** 

Very hygroscopic, decomp by  $\text{H}_2\text{O}$  Not attacked by cold conc  $\text{H}_2\text{SO}_4$ , even if ming, but on heating decomposition takes place Very sol in  $\text{CS}_2$  Insol in benzene,  $\text{PCl}_3$ , or  $\text{CCl}_4$  (Moissan, C R 113 624)

$\text{BIP}$  Less hygroscopic than  $\text{BI}_3$ , but otherwise the properties are similar (Moissan)

**Boron nitride, BN**

Insol in  $H_2O$ , conc  $HNO_3$ , conc  $HCl$ +  
Aq, or conc solutions of alkalis

Decomp by hot conc  $H_2SO_4$  or  $HF$   
(Wohler, A 74 70)

**Boron trioxide,  $B_2O_3$** 

Deliquescent Sol in  $H_2O$  with a large in-  
crease in temp (Ditte, C R 85 1069)

1 pt dissolves—

at	18 75°	in	47 01 pts	$H_2O$
"	25°	"	27 75 "	"
"	37 5°	"	18 73 "	"
"	50°	"	15 13 "	"
"	62 5°	"	9 29 "	"
"	75°	"	7 28 "	"
"	87 5°	"	5 58 "	"
"	100°	"	4 74 "	"

Or 100 pts  $H_2O$  dissolve—

at	18 75°	2 13 pts	$B_2O_3$
"	25°	3 60 "	"
"	37 5°	4 24 "	"
"	50°	6 61 "	"
"	62 5°	10 76 "	"
"	75°	13 73 "	"
"	87 5°	17 92 "	"
"	100°	21 09 "	"

(Brandes and Firnhaber, Arch Pharm 7 50)

1 litre  $H_2O$  dissolves—

at	0°	11 00 g	$B_2O_3$
"	12°	16 50 "	"
"	20°	22 49 "	"
"	40°	39 50 "	"
"	62°	64 50 "	"
"	80°	95 00 "	"
"	102°	164 50 "	"

(Ditte, C R 85 1069)

Sat H O solution boils at 100° (Brandes  
and Firnhaber)

Sat H O solution boils at 103 3° (Grif-  
fiths, Quar J Sci 18 90)

Sol in acetic acid, hot conc  $HCl$ +Aq,  
 $HNO_3$ , and  $H_2SO_4$ . From the three latter it  
separates on cooling or dilution with H O

Solubility in  $Na_2O$ +Aq at 30

See Borates, sodium

Solubility in  $K_2O$ +Aq at 30°

See Borates, potassium

Insol in hot glacial acetic acid (Holt,  
Chem Soc 1911, 100 (2) 720)

Insol in alcohol (Graham)

Sol in alcohol (Berzelius, Ebdmen)

Sol in oils

See also Boric acid

**Boron trioxide potassium fluoride,  $B_2O_3, 2KF$** 

Gradually sol in  $H_2O$  Decomp by much  
 $H_2O$  Insol in alcohol (Schiff and Sestini,  
A 228 82)

**Boron oxychloride,  $BOCl$** 

(Gustavson, Zeit Chem 1870 521)

$BOCl_3$  Slowly decomp by  $H_2O$  (Coun-  
cler, J pr (2) 18 399)

Oxychlorides of either the above formulæ  
do not exist, the true formula for boron oxy-  
chloride is  $B_2O_{11}Cl_2$  (Lorenz, A 247 226)

**Boron phosphide,  $BP$** 

Insol in  $H_2O$  Sol in conc boiling alkalis  
+Aq with decomp Decomp by  $HNO_3$ +Aq  
(Besson, C R 113 78)

Insol in  $PCl_3$ ,  $AsCl_3$ ,  $SbCl_3$ ,  $CCl_4$ , and in  
fact in all known solvents

Not attacked by boiling  $H_2O$ , conc  $HCl$ , or  
 $HI$ +Aq Sol in conc  $HNO_3$  with decomp  
on heating Not attacked by cold  $H_2SO_4$   
(Moissan, C R 113 726)

$B_2P_3$  Not attacked by boiling conc  $HNO_3$   
+Aq Insol in all solvents (Moissan)

**Boron phosphoriodide**

See Boron iodophosphide

**Boron selenide,  $B_2Se_3$** 

Violently decomp by  $H_2O$  (Sabatier, C  
R 112 1000)

**Boron trisulphide,  $B_2S_3$** 

Decomp with violence with  $H_2O$  Com-  
bines with alcohol and ether (Fremy, A ch  
(3) 38 312)

Insol in most solvents, but sl sol in  $PCl_3$   
without decomp, more sol in  $SCl_2$ , but does  
not crystallize from the solution (Moissan,  
C R 115 203)

**Boron trisulphide ammonia,  $B_2S_3, 6NH_3$** 

Ppt (Stock, B 1901, 34 3042)

**Boron pentasulphide,  $B_2S_5$** 

Decomp by  $H_2O$  and alcohol (Moissan,  
C R 115 271)

**Borosulphuric acid,  $BOHSO_4+SO_3$** 

Decomp by H O (Schultz-Sellac, B 4  
12)

$B(HSO_4)_3$  Very deliquescent Easily sol  
in fuming  $H_2SO_4$  (D'Arcy, Chem Soc 55  
155)

$SO_3(O BO)_2$  Hygroscopic Deliquescent  
Sol in H O with decomp Decomp by cold  
alcohols (Pictet, Bull Soc 1908, (4) 3 1121)

$(SO_3)_2B_2O_3$  Hygroscopic Deliquescent  
Sol in  $H_2O$  with decomp Decomp by cold  
alcohols (Pictet, Bull Soc 1908, (4) 3 1121)

**Boronotungstic acid,  $H_4B_2W_9O_{32}+22H_2O=9WO_3, B_2O_3, 2H_2O+22H_2O$** 

Sol in less than  $\frac{1}{10}$  pt  $H_2O$ , and as easily  
sol in alcohol and ether Sp gr of aqueous  
solution is somewhat under 3 (Klein, A ch  
(5) 28 370)

**Aluminum boronotungstate,  $Al_4(B_2W_9O_{32})_3+65H_2O$** 

Extremely sol in  $H_2O$  (Klein)

**Ammonium —,  $(NH_4)_4B_2W_9O_{32}+18H_2O$** 

Quickly effloresces (Klein)



**Barium boronotungstate**,  $\text{Ba}_2\text{B}_2\text{W}_9\text{O}_{32} + 19\text{H}_2\text{O}$

Sol in 4 pts cold, and less than  $\frac{1}{2}$  pt hot  $\text{H}_2\text{O}$  (Klein)

**Cadmium** —,  $\text{Cd}_2\text{B}_2\text{W}_9\text{O}_{32} + 18\text{H}_2\text{O}$

Deliquescent

100 pts of salt dissolve in less than 8 pts  $\text{H}_2\text{O}$  at  $19^\circ$  Sp gr of solution is 3.28 (Klein)

Sp gr of sat solution at  $15.6^\circ/4^\circ = 3.2887$ , at  $16.2^\circ/4^\circ = 3.2868$  (Kahlbaum, Z anorg 1902, 29 229)

**Calcium** —,  $\text{Ca}_2\text{B}_2\text{W}_9\text{O}_{32} + 15\text{H}_2\text{O}$

Sol in  $\frac{1}{10}$  pt  $\text{H}_2\text{O}$  Solution has sp gr = 3.10 (Klein)

**Cerium** —,  $\text{Ce}_4(\text{B}_2\text{W}_9\text{O}_{32})_3 + 57\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , sp gr of solution is over 3

**Chromium** —,  $\text{Cr}_4(\text{B}_2\text{W}_9\text{O}_{32})_3 + 74\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , sp gr of solution is 2.80 (Klein)

**Cobalt** —,  $\text{Co}_2\text{B}_2\text{W}_9\text{O}_{32} + 18\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , sp gr of solution sat at  $19^\circ = 3.36$  (Klein)

100 pts  $\text{H}_2\text{O}$  dissolve 306.8 pts anhydrous salt at  $16.2^\circ$ , 288 pts at  $18.5^\circ$ , 299.7 pts at  $19.6^\circ$ , 286 pts at  $21^\circ$

Sp gr of solution sat at  $19.2^\circ/4^\circ = 3.1369$  (Kahlbaum, Z anorg 1902, 29 218)

**Copper** —,  $\text{Cu}_2\text{B}_2\text{W}_9\text{O}_{32} + 19\text{H}_2\text{O}$

25 pts  $\text{H}_2\text{O}$  dissolve 100 pts salt Sp gr of solution = 2.6 (Klein)

**Lead** —,  $\text{Pb}_2\text{B}_2\text{W}_9\text{O}_{32} + 11\text{H}_2\text{O}$

Sl sol in cold easily sol in hot  $\text{H}_2\text{O}$  (Klein)

**Lithium** —, (?)

Very sol in  $\text{H}_2\text{O}$  Sp gr of solution is about 3

**Magnesium** —,  $\text{Mg}_2\text{B}_2\text{W}_9\text{O}_{32} + 22\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Klein)

**Manganese** —,  $\text{Mn}_2\text{B}_2\text{W}_9\text{O}_{32} + 17\text{H}_2\text{O}$

100 pts dissolve in 15 pts  $\text{H}_2\text{O}$  Sp gr of solution at  $19^\circ = 3.15$  (Klein)

**Mercurous** —,  $\text{Hg}_2\text{B}_2\text{W}_9\text{O}_{32} + 9\text{H}_2\text{O} + 14\text{H}_2\text{O} (?)$

Precipitate

Insol in  $\text{H}_2\text{O}$  (Klein)

Sol in 20,000 pts dil cold and 1000 pts boiling  $\text{HNO}_3$  + Aq of 1.2 sp gr

**Nickel** —,  $\text{Ni}_2\text{B}_2\text{W}_9\text{O}_{32} + 18\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Sp gr of sat solution at  $19^\circ = 3.32$

100 pts  $\text{H}_2\text{O}$  dissolve 261.6 pts at  $21.2^\circ$  Sp gr  $15.7^\circ/4^\circ$  of solution = 2.2959 (Kahlbaum, Z anorg 1902, 29 218)

**Potassium boronotungstate**,  $\text{K}_2\text{B}_2\text{W}_9\text{O}_{32} + 13\text{H}_2\text{O}$

5 pts salt dissolve in 8 pts  $\text{H}_2\text{O}$  at  $9^\circ$  to form a solution of 1.38 sp gr The saturation at  $100^\circ$  has sp gr of over 2 (Klein)

**Silver** —,  $\text{Ag}_4\text{B}_2\text{W}_9\text{O}_{32} + 14\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$

**Sodium** —,  $\text{Na}_2\text{B}_2\text{W}_9\text{O}_{32} + 23\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Solution sat at  $1^\circ$  contains 84 pts salt to 16 pts  $\text{H}_2\text{O}$  (Klein)

$\text{Na}_4\text{B}_2\text{W}_9\text{O}_{32} + 12\text{H}_2\text{O}$  Sol in less than  $\frac{1}{3}$  pt  $\text{H}_2\text{O}$

**Thallium** —,  $\text{Tl}_2\text{B}_2\text{W}_9\text{O}_{32} + 5\text{H}_2\text{O}$

Sl sol in hot  $\text{H}_2\text{O}$  and nearly insol in cold  $\text{H}_2\text{O}$  (Klein)

**Uranyl** —,  $(\text{UO}_2)_3(\text{B}_2\text{W}_9\text{O}_{32})_2 + 30\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Klein)

Sp gr of solution = 3.1

**Zinc** —,  $\text{Zn}_2\text{B}_2\text{W}_9\text{O}_{32} + 2\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Sp gr of solution is 3.15 (Klein)

### Borodecitungstic acid

**Barium borodecitungstate**,  $\text{Ba}_2\text{B}_2\text{W}_{11}\text{O}_{48} + 20\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Klein, C R 99 35)

**Borodecitungstic acid**,  $\text{H}_5\text{B}_2\text{W}_{11}\text{O}_{48} = 4\text{H}_2\text{O}, \text{B}_2\text{O}_3, 12\text{WO}_3$

Known only in solution, which decomposes into boronotungstic acid and tungstic acid, when evaporated to a certain concentration (Klein, C R 99 35)

**Barium potassium borodecitungstate**,  $3\text{BaO}, \text{K}_2\text{O}, \text{B}_2\text{O}_3, 12\text{WO}_3 + 28\text{H}_2\text{O}$

**Potassium** —,  $\text{K}_8\text{B}_2\text{W}_{11}\text{O}_{48} + 21\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Klein)

$2\text{K}_2\text{O}, 12\text{WO}_3, \text{B}_2\text{O}_3 + 18\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Klein)

**Borotetradecitungstic acid**,  $\text{H}_7\text{B}_2\text{W}_{14}\text{O}_{64} = 6\text{H}_2\text{O}, \text{B}_2\text{O}_3, 14\text{WO}_3$

Has not been obtained in the free state (Klein, A ch (5) 28 353)

**Barium borotetradecitungstate**,  $\text{Ba}_4\text{B}_2\text{W}_{14}\text{O}_{68} = 3\text{BaO}, \text{B}_2\text{O}_3, 14\text{WO}_3 + 5\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Klein)

**Barium sodium** —,  $3\frac{1}{2}\text{BaO}, 1\frac{1}{2}\text{Na}_2\text{O}, 5\text{H}_2\text{O}, \text{B}_2\text{O}_3, 14\text{WO}_3 + 29\text{H}_2\text{O}$

**Potassium** —,  $3\text{K}_2\text{O}, \text{H}_2\text{O}, \text{B}_2\text{O}_3, 14\text{WO}_3 + 22\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Klein)

**Silver** —,  $\text{Ag}_2\text{H}_2\text{B}_2\text{W}_{14}\text{O}_{68} + 7\text{H}_2\text{O}$

Nearly insol in cold  $\text{H}_2\text{O}$  (Klein)

**Sodium** —,  $\text{Na}_4\text{H}_8\text{B}_2\text{W}_{14}\text{O}_{68} + 29\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Klein)

**Sodium strontium boroguanthetungstate**,  $3\frac{1}{2}\text{SrO}$ ,  $1\frac{1}{2}\text{Na}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $14\text{WO}_3+29\text{H}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$  (Klein)

**Boroundevigntungstic acid**

**Barium boroundevigntungstic acid**,  $4\text{BaO}$ ,  $\text{B}_2\text{O}_3$ ,  $19\text{WO}_3+30\text{H}_2\text{O}$   
Can be cryst from  $\text{H}_2\text{O}$  (Ebenhusen, Dissert 1905)

**Boroguanthetungstic acid**,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3+66\text{H}_2\text{O}$   
Deliquescent Somewhat more sol in  $\text{H}_2\text{O}$  than  $\text{B}_2\text{O}_3$ ,  $28\text{WO}_3+62\text{H}_2\text{O}$  Also more stable (Copaux, C R 1908, 147 975)

**Barium boroguanthetungstic acid**,  $5\text{BaO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3+54\text{H}_2\text{O}$   
100 pts  $\text{H}_2\text{O}$  dissolve 50 pts salt (Copaux, A ch 1909, (8) 17 217)  
 $6\text{BaO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3+58\text{H}_2\text{O}$  (Copaux, l c)

**Cadmium** —,  $5\text{CdO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3+51\text{H}_2\text{O}$   
Extremely sol in  $\text{H}_2\text{O}$  (Copaux, l c)

**Calcium** —,  $5\text{CaO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3+44\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  (Copaux, l c)

**Lithium** —,  $15\text{Li}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3+38\text{H}_2\text{O}$   
(Copaux, l c)

**Magnesium** —,  $5\text{MgO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3+42\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  (Copaux, l c)

**Mercurous** —,  $9\text{Hg}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3+25\text{H}_2\text{O}$   
(Copaux, l c)

**Potassium** —,  $5\text{K}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3+36\text{H}_2\text{O}$   
(Copaux, l c)

**Sodium** —,  $5\text{Na}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3+5\text{H}_2\text{O}$   
As  $\text{NH}_4$  salt (Copaux, l c)

**Boroguanthetungstic acid**

**Potassium boroguanthetungstic acid**,  $5\text{K}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $25\text{WO}_3+34\text{H}_2\text{O}$  (Ebenhusen, Dissert 1905)

**Boroduodetungstic acid**,  $\text{B}_2\text{O}_3$ ,  $28\text{WO}_3+62\text{H}_2\text{O}$   
Decomp in boiling aqueous solution (Copaux, C R 1908, 147 975)

**Potassium boroduodetungstic acid**,  $6\text{K}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $28\text{WO}_3+42\text{H}_2\text{O}$   
Decomp by boiling alkalis (Copaux, A ch 1909 (8) 17 217)

**Borovanadic acid**  
Sol in  $\text{H}_2\text{O}$  Easily decomp (Guyard, Bull Soc (2) 25 354)

**Metabromantimonic acid**,  $\text{HSbBr}_6+3\text{H}_2\text{O}$   
Very hygroscopic Loses  $\text{Br}_2$  in the air  
Decomp by  $\text{H}_2\text{O}$  with separation of antimonic acid (Weinland, B 1903, 36 256)

**Ammonium metabromantimonate**,  $\text{NH}_4\text{SbBr}_6+\text{H}_2\text{O}$   
Loses  $\text{Br}_2$  in the air Decomp by  $\text{H}_2\text{O}$  (Weinland, l c)

**Iron (ferric) metabromantimonate**,  $\text{Fe}(\text{SbBr}_6)_3+14\text{H}_2\text{O}$   
Very hygroscopic Decomp by  $\text{H}_2\text{O}$  (Weinland, l c)

**Lithium metabromantimonate**,  $\text{LiSbBr}_6+4\text{H}_2\text{O}$   
Very hygroscopic Loses  $\text{Br}_2$  in the air  
Decomp by  $\text{H}_2\text{O}$  (Weinland, l c)

**Nickel metabromantimonate**,  $\text{Ni}(\text{SbBr}_6)_2+12\text{H}_2\text{O}$   
Hygroscopic Decomp by  $\text{H}_2\text{O}$  (Weinland, l c)

**Potassium metabromantimonate**,  $\text{KSbBr}_6+\text{H}_2\text{O}$   
Loses  $\text{Br}_2$  in the air Decomp by  $\text{H}_2\text{O}$  (Weinland, l c)

**Bromarsenous acid**  
See Arsenyl bromide

**Bromauric acid**,  $\text{HAuBr}_4+3\text{H}_2\text{O}$   
(Lengfeld, Am Ch J 1901, 26 329)  
 $+5\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Thomser pr (2) 13 337)  
 $+6\text{H}_2\text{O}$  Sol in ether and  $\text{CHCl}_3$  without decomp (Lengfeld, Am Ch J 1901, 26 329)

**Ammonium bromaurate**,  $\text{NH}_4\text{AuBr}_4$   
Ppt (Gutbier, Z anorg 1914, 85 358)

**Barium bromaurate**  
Not deliquescent Sol in  $\text{H}_2\text{O}$  (v Bonsdorff, Pogg 17 261)

**Cæsium bromaurate**,  $\text{CsAuBr}_4$   
Sl sol in  $\text{H}_2\text{O}$  or alcohol Insol in ether (Wells and Wheeler, Sill Am J 144 157)  
Ppt (Gutbier, Z anorg 1914, 85 360)

**Cerium bromaurate**,  $\text{CeAuBr}_6+8\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Jolin, Bull Soc (2) 21 533)

**Didymium bromaurate**,  $\text{DyAuBr}_6+9\text{H}_2\text{O}$   
Very deliquescent Sol in  $\text{H}_2\text{O}$  (Cleve)

**Lanthanum bromaurate**,  $\text{LaAuBr}_6+9\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Cleve)

**Magnesium bromaurate**  
Deliquescent in moist air (v Bonsdorff)

**Manganese bromaurate**  
Deliquescent (v Bonsdorff)

**Potassium bromaurate, KAuBr<sub>4</sub>**

Sl sol in H<sub>2</sub>O. More sol in cold alcohol than in H<sub>2</sub>O (v Bonsdorff).  
 +2H<sub>2</sub>O. Sol in 5.12 pts H<sub>2</sub>O at 15°, 1.56 pts at 40°, and 0.48 pt at 67°. Decomp by ether. Sl sol in KBr + Aq (Schottlander, A 217 314).  
 +5H<sub>2</sub>O. Efflorescent (v Bonsdorff).

**Rubidium bromaurate, RbAuBr<sub>4</sub>**

As caesium bromaurate  
 Ppt (Gutbier, Z anorg 1914, 85 359)

**Samarium bromaurate, SmAuBr<sub>6</sub> + 10H<sub>2</sub>O**

Very deliquescent (Cleve, Bull Soc (2) 43 165)

**Sodium bromaurate, NaAuBr<sub>4</sub>**

Slowly sol in H<sub>2</sub>O (v Bonsdorff)

**Zinc bromaurate, Zn(AuBr<sub>4</sub>)<sub>2</sub>**

Very deliquescent (v Bonsdorff)

**Bromauricyanhydric acid**

Not known in free state

**Barium bromauricyanide, Ba[Au(CN)<sub>2</sub>Br<sub>2</sub>]<sub>2</sub> + 10H<sub>2</sub>O**

Very sol in hot or cold H<sub>2</sub>O, also in alcohol (Lindbom, Lund Univ Arsk 12 No 6)

**Cadmium bromauricyanide, Cd[Au(CN)<sub>2</sub>Br<sub>2</sub>]<sub>2</sub> + 6H<sub>2</sub>O**

Very sol in hot or cold H<sub>2</sub>O, but solution is unstable (Lindbom)

**Calcium bromauricyanide, Ca[Au(CN)<sub>2</sub>Br<sub>2</sub>]<sub>2</sub> + 10H<sub>2</sub>O**

Extremely sol in H<sub>2</sub>O and alcohol (Lindbom)

**Cobalt bromauricyanide, Co[Au(CN)<sub>2</sub>Br<sub>2</sub>]<sub>2</sub> + 9H<sub>2</sub>O**

Moderately sol in H<sub>2</sub>O. Less sol than other bromauricyanides (Lindbom)

**Potassium bromauricyanide, KAu(CN)<sub>2</sub>Br<sub>2</sub> + 3H<sub>2</sub>O**

Sol in H<sub>2</sub>O and alcohol

**Sodium bromauricyanide, NaAu(CN)<sub>2</sub>Br<sub>2</sub> + 2H<sub>2</sub>O**

Very sol in H<sub>2</sub>O or alcohol

**Strontium bromauricyanide, Sr[Au(CN)<sub>2</sub>Br]<sub>2</sub> + 2H<sub>2</sub>O**

Very sol in H<sub>2</sub>O or alcohol

**Zinc bromauricyanide, Zn[Au(CN)<sub>2</sub>Br]<sub>2</sub> + 8H<sub>2</sub>O**

Easily sol in cold or hot H<sub>2</sub>O

**Bromhydric acid, HBr**

Very sol in H<sub>2</sub>O

The most concentrated HBr + Aq has a sp gr of 1.78, and contains 82.02% HBr (Champion and Pellat, C R 70 620). This, or a weak acid on heating leaves a residue which

distils unchanged at 125–125.5° under 765 mm pressure, and contains 48.17% HBr (Topsoe), at 126° under 758 mm pressure, and contains 46.83% HBr (Bineau), and has sp gr = 1.486 at 20° (Bineau), sp gr = 1.3 at 20° (Champion and Pellat), sp gr = 1.1 at 20° (Topsoe).

According to Roscoe (A 116 214) an acid of constant composition, obtained by boiling a stronger or a weaker acid, if distilled under 752–76° mm pressure, contains 47.38–47.6% HBr, and boils at 126° at 760 mm pressure, but the composition is dependent on the pressure, as, for example, under 1952 mm pressure, the residue boils at 153°, and contains 46.3% HBr (Roscoe).

By conducting dry air through HBr + Aq an acid is obtained containing 51.65% HBr at 16°, and 49.35% HBr if at 100° (Roscoe).  
 1 vol H<sub>2</sub>O dissolves 600 vols HBr at 10° (Berthelot, C R 76 679).

1 pt H<sub>2</sub>O at t° and 760 mm pressure dissolves pts HBr

t°	Pts HBr	t°	Pts HBr	t°	Pts HBr
−25	2 550	−5	2 280	+50	715
−20	2 473	0	2 212	+75	505
−15	2 390	+10	2 103	+100	300
−10	2 335	+25	1 930		

(Roozeboom, R t c 4 107)

Absorption by 1 pt H<sub>2</sub>O at t° and p pressure in mm

t° = −25°

p	1 ts HBr	p	1 ts HBr
760	2 550	100	0.96
300	2 263	1	7.5
140	2 120	0.5	10

t° = −20°

p	Pts HBr	p	1 ts HBr
760	2 473	130	0.96
375	2 267	20	5.50
180	2 119		

t° = −15

p	1 ts HBr	p	1 ts HBr
760	2 390	175	0.96
470	2 266	102	9.80
250	2 119		

t° = −11.3°

p	1 ts HBr	p	1 ts HBr
760	2 350	310	115
570	2 265	216	0.55

$t^{\circ} = -5^{\circ}$ 

p	Pts HBr	p	Pts HBr
760	2 280	430	2 117
730	2 264	298	2 055

 $t^{\circ} = 0^{\circ}$ 

p	Pts HBr	p	Pts HBr
760	2 212	380	2 054
540	2 116	5	1 085

(Roozeboom, R t c 4 107)

Sp gr of HBr+Ag

Sp gr	% HBr	Temp	Sp gr	% HBr	Temp
1 055	7 67	14°	1 335	36 67	13°
1 075	10 19	14°	1 349	37 86	13°
1 089	11 94	14°	1 368	39 13	13°
1 097	12 96	14°	1 419	43 12	13°
1 118	15 37	14°	1 431	43 99	13°
1 131	16 92	14°	1 438	44 62	13°
1 164	20 65	14°	1 451	45 45	14°
1 200	24 35	13°	1 460	46 09	13°
1 232	27 62	13°	1 485	47 87	14°
1 253	29 68	13°	1 490	48 17	14°
1 302	33 84	13°			

(Topsoe, B 3 404)

Sp gr of HBr+Ag at 14°

% HBr	Sp gr	% HBr	Sp gr	% HBr	Sp gr
1	1 007	18	1 140	35	1 314
2	1 014	19	1 149	36	1 326
3	1 021	20	1 158	37	1 338
4	1 028	21	1 167	38	1 351
5	1 035	22	1 176	39	1 363
6	1 043	23	1 186	40	1 376
7	1 050	24	1 196	41	1 389
8	1 058	25	1 206	42	1 403
9	1 065	26	1 215	43	1 417
10	1 073	27	1 225	44	1 431
11	1 081	28	1 235	45	1 445
12	1 089	29	1 246	46	1 459
13	1 097	30	1 257	47	1 473
14	1 106	31	1 268	48	1 487
15	1 114	32	1 279	49	1 502
16	1 122	33	1 290		
17	1 131	34	1 302		

(Topsoe calculated by Gailich, Z anal 27 116)

Sp gr of HBr+Ag at 15°

% HBr	Sp gr	HBr	Sp gr	% HBr	Sp gr
5	1 038	25	1 204	45	1 435
10	1 077	30	1 252	50	1 515
15	1 177	35	1 305		
20	1 159	40	1 365		

Only a 'moderate degree of accuracy' is claimed for this table (Wright, C N 23 242)

Sp gr of HBr+Ag at 15°

% HBr	Sp gr	% HBr	Sp gr	% HBr	Sp gr
1	1 0082	18	1 145	35	1 314
2	1 0155	19	1 154	36	1 326
3	1 0230	20	1 163	37	1 338
4	1 0305	21	1 172	38	1 350
5	1 038	22	1 181	39	1 362
6	1 046	23	1 190	40	1 375
7	1 053	24	1 200	41	1 388
8	1 061	25	1 209	42	1 401
9	1 069	26	1 219	43	1 415
10	1 077	27	1 229	44	1 429
11	1 085	28	1 239	45	1 444
12	1 093	29	1 249	46	1 459
13	1 102	30	1 260	47	1 474
14	1 110	31	1 270	48	1 490
15	1 119	32	1 281	49	1 496
16	1 127	33	1 292	50	1 513
17	1 136	34	1 303		

(Biel, C C 1882 148)

Absorbed by alcohol with formation of  $C_2H_5Br$

The composition of the hydrates formed by HBr at different dilutions is calculated from determinations of the lowering of the fr pt produced by HBr and of the conductivity and sp gr of HBr+Ag (Jones, Am Ch J 1905, 34 326)

+H<sub>2</sub>O (Roozeboom, R t c 5 363)+2H<sub>2</sub>O (Berthelot, A ch (5) 14 369)

(Pickering Chem Soc 1894, 64 (2) 232)

Mpt -11° (Pickering, l c)

+3H<sub>2</sub>O Mpt -48° (Pickering)+4H<sub>2</sub>O Mpt -55° (Pickering)+5H<sub>2</sub>O (Pickering)

**Bromhydric cyanhydric acid, 3HBr, 2HCN**

Decomp by H<sub>2</sub>O and alcohol

Insol in ether (Gautier, A ch (4) 17 141)

**Bromic acid, HBrO<sub>3</sub>**

Known only in aqueous solution

Solution evaporated on water bath decomposes when it contains 4.26% HBrO<sub>3</sub>. In vacuo, in acid containing 50.59% HBrO<sub>3</sub>, corresponding to formula HBrO<sub>3</sub>+7H<sub>2</sub>O can be obtained

Not decomp by dil HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub>+Ag. Conc H<sub>2</sub>SO<sub>4</sub> decomposes

Alcohol and ether are quickly oxidized by HBrO<sub>3</sub>

**Bromates**

Most of the bromates are very sol in H<sub>2</sub>O, a few are sl sol, but none are insol, the least sol being AgBrO<sub>3</sub> and Hg (BrO<sub>3</sub>)<sub>2</sub>

**Aluminum bromate, Al(BrO<sub>3</sub>)<sub>3</sub>**

Deliquescent (Rammelsberg, Pogg 55 63)

+9H<sub>2</sub>O Mpt 62° Less hygroscopic

than  $\text{Al}(\text{ClO}_3)_2$  (Dobrosserdow, C C 1907 I, 1723)

### Ammonium bromate, $\text{NH}_4\text{BrO}_3$

Decomposes spontaneously, sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 52 85)

### Barium bromate, $\text{Ba}(\text{BrO}_3)_2$

Solubility of  $\text{Ba}(\text{BrO}_3)_2$  in  $\text{H}_2\text{O}$  100 g sat  $\text{Ba}(\text{BrO}_3)_2 + \text{Aq}$  at  $t^\circ$  contain g anhydrous  $\text{Ba}(\text{BrO}_3)_2$

$t^\circ$	grams $\text{Ba}(\text{BrO}_3)_2$	$t^\circ$	Grams $\text{Ba}(\text{BrO}_3)_2$
Eutectic point			
$-0.034^\circ \pm 0.002^\circ$	0.280	$50^\circ$	1.72
$0^\circ$	0.286	$60^\circ$	2.271
$+10^\circ$	0.439	$70^\circ$	2.922
$20^\circ$	0.652	$80^\circ$	3.521
$25^\circ$	0.788	$90^\circ$	4.26
$30^\circ$	0.95	$98.7^\circ$	5.256
$40^\circ$	1.31	$99.65^\circ$	5.39

\*99.65° is bpt at 740 mm = 100.39° at 760 mm

(Anschutz, Z phys Ch 1906, 56 240)

100 g sat  $\text{Ba}(\text{BrO}_3)_2 + \text{Aq}$  contain 0.793 g  $\text{Ba}(\text{BrO}_3)_2$  at  $25^\circ$  Sp gr of the solution at  $25^\circ/4^\circ = 1.0038$  (Harkins J Am Chem Soc 1911, 33 1815)

Solubility of  $\text{Ba}(\text{BrO}_3)_2$  in salts + Aq at  $25^\circ$  C = concentration of salt in salt + Aq in milliequivalents per l

$d_1 = \text{Sp gr at } 25^\circ/4^\circ \text{ of salt + Aq}$

$S = \text{solubility of } \text{Ba}(\text{BrO}_3)_2 \text{ in salt + Aq expressed in milliequivalents per l}$

$d_2 = \text{sp gr at } 25^\circ/4^\circ \text{ of } \text{Ba}(\text{BrO}_3)_2 + \text{salt} + \text{Aq}$

Salt	C	$d_1$	S	d
None			40.18	1.0038
$\text{KNO}_3$	25.018	0.9985	43.86	1.0059
	50.032	1.0030	47.03	1.0081
	99.970	1.0033	52.13	1.0120
$\text{Ba}(\text{NO}_3)_2$	25.018	1.0003	36.77	1.0059
	50.039	1.0025	34.74	1.0083
	99.97	1.0073	32.63	1.0132
	199.95	1.0183	30.95	1.0233
$\text{KBrO}_3$	24.988	1.0001	26.53	1.0046
	49.971	1.0031	17.37	1.0062
	99.85	1.0093	8.76	1.0109
$\text{Mg}(\text{NO}_3)_2$	100.0		52.57	1.0114

(Harkins, J Am Chem Soc 1911 33 1815)

+  $\text{H}_2\text{O}$  Sol in 130 pts cold, and 24 pts boiling  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 52 81)

Decomp by  $\text{H}_2\text{SO}_4$ , or  $\text{HCl} + \text{Aq}$

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

### Bismuth bromate

Known only in solution, which decom on evaporation (Rammelsberg, Pogg 55 )

### Cadmium bromate, $\text{Cd}(\text{BrO}_3)_2 + \text{H}_2\text{O}$

Sol in 0.8 pt cold  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 55 74)

+  $2\text{H}_2\text{O}$  (Topsoe, J B 1872, 164)

### Cadmium bromate ammonia, $\text{Cd}(\text{BrO}_3)_2 \cdot 3\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 55 74)

$\text{Cd}(\text{BrO}_3)_2 \cdot 4\text{NH}_3$  Ppt (Ephraim B 1915, 48 51)

### Calcium bromate, $\text{Ca}(\text{BrO}_3)_2 + \text{H}_2\text{O}$

Sol in 1.1 pts cold  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 52 98)

### Cerous bromate, $\text{Ce}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 55 63)

Mpt  $49^\circ$ , very sol in  $\text{H}_2\text{O}$  with decomp (James, J Am Chem Soc 1909, 31 91)

### Cobaltous bromate, $\text{Co}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$

Sol in 2.2 pts cold  $\text{H}_2\text{O}$ , sol in  $\text{N}_2\text{O}_5 + \text{Aq}$  (Rammelsberg, Pogg 55 71)

### Cupric bromate, basic, $6\text{CuO} \cdot \text{Br}_2\text{O}_7 + 1 \cdot \text{H}_2\text{O}$

Ppt (Rammelsberg, Pogg 55 78)

### Cupric bromate, $\text{Cu}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 52 92)

### Cupric bromate ammonia, $\text{Cu}(\text{BrO}_3)_2 \cdot \text{NH}_3$

Completely sol in a little  $\text{H}_2\text{O}$ , but decomp by dilution

Insol in alcohol (Rammelsberg, Pogg 52 92)

### Didymium bromate, $\text{Dy}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Maignac)

### Dysprosium bromate, $\text{Dy}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$

Mpt  $75^\circ$  Easily sol in  $\text{H}_2\text{O}$  Difficultly sol in alcohol (Luntzsch, B 1911 44 275)

### Erbium bromate, $\text{Er}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$

Very sol in alcohol and  $\text{H}_2\text{O}$

### Glucinum bromate

Deliquescent

### Iron (ferrous) bromate, $\text{Fe}(\text{BrO}_3)_2$

Sol in  $\text{H}_2\text{O}$ , but solution decom very easily

### Iron (ferric) bromate, $\text{Fe}(\text{BrO}_3)_3$

Partially sol in  $\text{H}_2\text{O}$  with separation of a more basic salt Sol in  $\text{HBrO}_4 + \text{Aq}$  (Rammelsberg Pogg 55 68)

### Lanthanum bromate, $\text{La}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$

Sol in  $3\frac{1}{2}$  pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Maignac, Ann Min (5) 15 274)

Mpt  $37.5^\circ$  in its water of crystallization 416 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $25^\circ$  (James, J Am Chem Soc 1909, 31 13)

**Lead bromate, basic**,  $3\text{PbO}$ ,  $\text{Pb}(\text{BrO}_3)_2 + 2\text{H}_2\text{O}$

Ppt (Stromholm, Z anorg 1904, **38** 441)

**Lead bromate**,  $\text{Pb}(\text{BrO}_3)_2$

Sl sol in  $\text{H}_2\text{O}$  13.37 x  $10^{-1}\text{g}$  are contained in 1 liter of sat solution at  $20^\circ$  (Bottger, Z phys Ch 1903, **46** 603)

+  $\text{H}_2\text{O}$  Sol in 75 pts cold  $\text{H}_2\text{O}$  (Rammelsberg, Pogg **52** 96)

**Lithium bromate**,  $\text{LiBrO}_3$

Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg A **55** 63)

Not deliquescent (Potililtzin, B **23** 545 R)

Sp gr of solution sat at  $18^\circ = 1.833$ , and contains 60.4%  $\text{LiBrO}_3$  (Mylius, B 1897, **30** 1718)

+  $\text{H}_2\text{O}$  Not deliquescent (Potililtzin)

**Magnesium bromate**,  $\text{Mg}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$

Efflorescent Sol in 1.4 pts cold  $\text{H}_2\text{O}$  at  $15^\circ$  Melts in its water of crystallization when heated (Rammelsberg, Pogg **52** 89)

**Mercurous bromate, basic**,  $2\text{Hg}_2\text{O}$ ,  $\text{Br}_2\text{O}_5$

Insol in warm  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg, Pogg **55** 79)

**Mercurous bromate**,  $\text{Hg}_2(\text{BrO}_3)_2$

Decomp by  $\text{H}_2\text{O}$  into basic salt Difficultly sol in  $\text{HNO}_3 + \text{Aq}$ , easily sol in  $\text{HCl} + \text{Aq}$  (Rammelsberg)

**Mercuric bromate, basic**,  $2\text{HgO}$ ,  $\text{Br}_2\text{O}_5 + \text{H}_2\text{O}$

Slowly decomp by cold, quickly by hot  $\text{H}_2\text{O}$  into oxide and an acid salt

Easily sol in dil acids (Topsoe, W A B **66**, **2** 2)

**Mercuric bromate**,  $\text{HgBrO}_3 + 2\text{H}_2\text{O}$

Sol in 650 pts cold, and 64 pts boiling  $\text{H}_2\text{O}$  Sl sol in  $\text{HNO}_3 + \text{Aq}$  Easily sol in  $\text{HCl} + \text{Aq}$  (Rammelsberg, Pogg **55** 79)

**Mercuric bromate ammonia**

Sol with decomp in  $\text{HCl} + \text{Aq}$  (Storer's Dict)

**Neodymium bromate**,  $\text{Nd}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$

Mpt  $66.7^\circ$  146 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $25^\circ$  (James, J Am Chem Soc 1909, **31** 915)

**Nickel bromate**,  $\text{Ni}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$

Sol in 3.58 pts cold  $\text{H}_2\text{O}$  (Rammelsberg, Pogg **55** 69)

**Nickel bromate ammonia**,  $\text{Ni}(\text{BrO}_3)_2, 2\text{NH}_3$

Sol in  $\text{H}_2\text{O}$ , with decomposition of the major portion Insol in alcohol (Rammelsberg, l c)

$\text{Ni}(\text{BrO}_3)_2, 6\text{NH}_3$  Ppt (Ephraim, B 1915, **48** 50)

**Potassium bromate**,  $\text{KBrO}_3$

100 pts  $\text{H}_2\text{O}$  dissolve 6.58 pts  $\text{KBrO}_3$  at  $15^\circ$  (Rammelsberg) 100 pts  $\text{H}_2\text{O}$  dissolve 5.83 pts  $\text{KBrO}_3$  at  $17.1^\circ$  (Pohl W A B **6**

595), at  $0^\circ$ , 3.11 pts, at  $20^\circ$ , 6.92 pts, at  $40^\circ$ , 13.24 pts, at  $60^\circ$ , 22.76 pts, at  $80^\circ$ , 33.90 pts, at  $100^\circ$  49.75 pts  $\text{KBrO}_3$  Sat solution boils at  $104^\circ$  (Kremers, Pogg **97** 5)

1 l  $\text{H}_2\text{O}$  at  $25^\circ$  dissolves 0.4715 moles  $\text{KBrO}_3$  (Geffcken, Z phys Ch 1904, **49** 296)

1 l  $\text{H}_2\text{O}$  dissolves 0.478 mol  $\text{KBrO}_3$  at  $25^\circ$  (Rothmund, Z phys Ch 1909, **69** 539)

Sp gr of  $\text{KBrO}_3 + \text{Aq}$  at  $19.5^\circ$

% $\text{KBrO}_3$	1	2	3	4	5
Sp gr	1.009	1.016	1.024	1.031	1.039

% $\text{KBrO}_3$	6	7	8	9	10
Sp gr	1.046	1.054	1.062	1.070	1.079

(Gerlach, Z anal **8** 290)

Solubility of  $\text{KBrO}_3$  in salts +  $\text{Aq}$  at  $25^\circ$

Salt	Moles of $\text{KBrO}_3$ sol in 1 liter of				
	5-N solution	N solution	2-N solution	3-N solution	4-N solution
$\text{NaNO}_3$	0.5745	0.6497	0.7680	0.9026	1.031
$\text{NaCl}$	0.5220	0.5616	0.6042	0.6244	0.640

(Geffcken, Z phys Ch 1904, **49** 296)

Easily sol in liquid  $\text{HF}$  (Franklin, Z anorg 1905, **46** 2)

Sl sol in alcohol (Rammelsberg)

Insol in absolute alcohol

Solubility in organic compds +  $\text{Aq}$  at  $25^\circ$

Solvent	Mol $\text{KBrO}_3$ sol in 1 litre
Water	0.478
0.5-N Methyl alcohol	0.444
" Ethyl alcohol	0.421
" Propyl alcohol	0.409
" Tert amyl alcohol	0.383
" Acetone	0.425
" Ether	0.395
" Formaldehyde	0.397
" Glycol	0.448
" Glycerine	0.451
" Mannitol	0.451
" Glucose	0.463
" Sucrose	0.431
" Urea	0.477
" Dimethyl pyrone	0.478
" Ammonia	0.445
" Diethylamine	0.384
" Pyridine	0.415
" Piperidine	0.396
" Urethane	0.433
" Formamide	0.473
" Acetamide	0.445
" Glycocol	0.501
" Acetic acid	0.456
" Phenol	0.426
" Methylal	0.405
" Methyl acetate	0.420

(Rothmund, Z phys Ch 1909, **69** 539)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

**Praseodymium bromate**,  $\text{Pr}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$

Mpt 56.5° 190 pts are sol in 100 pts  $\text{H}_2\text{O}$  at 25° (James, J Am Chem Soc 1909, 31 914)

**Samarium bromate**,  $\text{Sm}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$

Mpt 75° 114 pts are sol in 100 pts  $\text{H}_2\text{O}$  at 25° Very sl sol in alcohol (James, J Am Chem Soc 1909, 31 915)

**Scandium bromate**

(Crookes, Roy Soc Proc 1908, 80, A, 518)

**Silver bromate**,  $\text{AgBrO}_3$

1 pt  $\text{H}_2\text{O}$  dissolves 0.00810 pt  $\text{AgBrO}_3$  at 24.5° (Noyes, Z phys Ch 6 246)

Sol in 595.3 pts  $\text{H}_2\text{O}$  at 25°

Sol in 320.4 pts  $\text{HNO}_3 + \text{Aq}$  (sp gr 1.21) at 25°

Sol in 2.2 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (sp gr 0.96) at 25° (Longi, Gazz ch it 13 87)

1 l  $\text{H}_2\text{O}$  dissolves 1.71 g  $\text{AgBrO}_3$  at 27° (Whitby, Z anorg 1910, 67 108)

Sl sol in  $\text{H}_2\text{O}$  1.59 x  $10^{-4}$  g are contained in 1 liter of sat solution at 20° (Bottger, Z phys Ch 1903, 46 603)

Insol in  $\text{HNO}_3$  (Lowig) Easily sol in

ate ammonia,  $\text{AgBrO}_3, 2\text{NH}_3$

in air or by  $\text{H}_2\text{O}$  (Rammelsberg 52 94)

**bromate**,  $\text{NaBrO}_3$

100 pts  $\text{H}_2\text{O}$  at 15° (Rammelsberg)

100 pts  $\text{H}_2\text{O}$  dissolve at—

0° 20° 40° 60° 80° 100°

27.54 34.48 50.25 62.57 75.75 90.9 pts  $\text{NaBrO}_3$  (Kremers, Pogg 94 271)

Easily forms supersaturated solutions

Sat solution boils at 109° (Kremers)

$\text{NaBrO}_3 + \text{Aq}$  containing 10.10%  $\text{NaBrO}_3$  has sp gr 20°/20° = 1.0818

$\text{NaBrO}_3 + \text{Aq}$  containing 11.09%  $\text{NaBrO}_3$  has sp gr 20°/20° = 1.0900

(Le Blanc and Rohland, Z phys Ch 1896 19 278)

Sp gr of  $\text{NaBrO}_3 + \text{Aq}$  at 19.5°

% $\text{NaBrO}_3$	5	10	15
Sp gr	1.041	1.083	1.129

% $\text{NaBrO}_3$	20	25	30
Sp gr	1.178	1.231	1.289

(Kremers, Pogg 97 5, calculated by Gerlach, Z anal 8 290)

Moderately sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

**Sodium bromate bromide**,  $3\text{NaBrO}_3, 2\text{NaBr} + 3\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  or alcohol (Fritzsche)

**Strontium bromate**,  $\text{Sr}(\text{BrO}_3)_2 + \text{H}_2\text{O}$

Sol in 3 pts  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 52 84), less sol in  $\text{H}_2\text{O}$  than  $\text{SrBr}_2 + 6\text{H}_2\text{O}$  (Lowig)

**Thallous bromate**,  $\text{TlBrO}_3$

Sl sol in hot  $\text{H}_2\text{O}$ , easily sol in  $\text{HNO}_3 + \text{Aq}$  (Oettinger)

Easily sol in  $\text{H}_2\text{O}$  and dil acids (Ditte, A ch (6) 21 145)

**Terbium bromate**,  $\text{Tb}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$

Not deliquescent (Potratz, C N 1905, 92, 3)

**Thallous bromate**,  $\text{TlBrO}_3$

1 l  $\text{H}_2\text{O}$  at 39.75° dissolves 2.216 x  $10^{-6}$  mol (Noyes and Abbott, Z phys Ch 1895, 16 130)

Sl sol in  $\text{H}_2\text{O}$  3.46 x  $10^{-1}$  gram are contained in 1 liter of sat solution at 20° (Bottger, Z phys Ch 1903, 46 603)

**Thallic bromate**,  $\text{Tl}(\text{BrO}_3)_3 + 3\text{H}_2\text{O}$

Very hygroscopic Easily decomp by  $\text{H}_2\text{O}$  (Gewecke, Z anorg 1912, 75 275)

**Thulium bromate**,  $\text{Tm}_2(\text{BrO}_3)_6 + 18\text{H}_2\text{O}$

Pptd from sat aqueous solution by 95% alcohol

$\text{NH}_4\text{OH}$  is the best precipitant (Juncs, J Am Chem Soc 1911, 33 1342)

**Tin (stannous) bromate** (?)

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$

**Uranyl bromate**,  $4\text{UO}_3, 3\text{Bi}_2\text{O}_3 + 16\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Yttrium bromate**,  $\text{Y}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$

More easily sol in  $\text{H}_2\text{O}$  than  $\text{Y}(\text{IO}_3)_3$  Sl sol in alcohol Insol in ether (Clayton)

Mpt 74° 168 pts are sol in 100 pts  $\text{H}_2\text{O}$  at 25°

Sl sol in alcohol (Juncs, J Am Chem Soc 1909, 31 916)

**Zinc bromate**,  $\text{Zn}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$

Sol in 1 pt cold  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 52 90)

**Zinc bromate ammonia**,  $\text{Zn}(\text{BrO}_3)_2 \cdot 2\text{NH}_3 + 3\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  and alcohol Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Rammelsberg, Pogg 52 90)

$\text{Zn}(\text{BrO}_3)_2, 4\text{NH}_3$  Ppt (Lippmann, B 1915, 48 51)

**Perbromic acid**

See **Perbromic acid**

**Bromides**

Most bromides are sol in  $H_2O$ , many in alcohol, and some in ether

$AgBr$  and  $Hg_2Br_2$  are insol in  $H_2O$  or acids,  $PbBr_2$  and  $TlBr$  are sl sol therein  $Cu_2Br_2$  is insol in  $H_2O$ , sol in acids

*See under each element*

**Bromine, Br.**

1 pt Br dissolves at  $15^\circ$  in 33 pts  $H_2O$  (Lowig, Pogg **14** 485)

1 pt Br dissolves at  $15^\circ$  in 31 pts  $H_2O$  (Dancer, Chem Soc **15** 477)

**Solubility of Br in 100 pts  $H_2O$  at  $t^\circ$** 

t	Pts Br	$t^\circ$	Pts Br	$t^\circ$	Pts Br
5	3 600	15	3 226	25	3 167
10	3 327	20	3 208	30	3 126

(Dancer, *l c*)

A sat aqueous solution of Br contains 4.05% Br at  $0^\circ$ , 3.80% Br at  $3^\circ$ , 3.33% Br at  $10^\circ$  (Roozeboom, R t c **3** 29, 59, 73, 84)

1 l  $H_2O$  dissolves 34 g Br at  $25^\circ$  (Jakowkin, Z phys Ch **1896**, **20** 25)

1 pt is sol in 30 pts  $H_2O$  (Dietze, Chem Soc **1899**, **76** (2) 150)

100 pts  $H_2O$  dissolve at  
 $0^\circ$  10 34° 19 96° 30 17° 40 03° 49 85°  
 4 167 3 740 3 578 3 437 3 446 3 522  
 pts bromine

Liquid bromine as such is insol in  $H_2O$ , only the vapor dissolves (Winkler, Ch Z **1899**, **23** 688)

1 l  $H_2O$  dissolves 33.95 g  $Br_2$  at  $25^\circ$  (McLauchlan, Z phys Ch **1903**, **44** 617)

**Solubility of bromine vapor in  $H_2O$  at  $t^\circ$   
 $\alpha$  = coefficient of absorption**

t	$\alpha$	t	$\alpha$
0	60.5	42	8.6
2	54.1	44	7.9
4	48.3	46	7.4
6	43.3	48	6.9
8	38.9	50	6.5
10	35.1	52	6.1
12	31.5	54	5.8
14	28.4	56	5.4
16	25.7	58	5.1
18	23.4	60	4.9
20	21.3	62	4.6
22	19.4	64	4.4
24	17.7	66	4.2
26	16.3	68	4.0
28	15.0	70	3.8
30	13.8	72	3.6
32	12.7	74	3.4
34	11.7	76	3.3
36	10.9	78	3.1
38	10.1	80	3.0
40	9.4		

(Winkler, Ch Z **1899**, **23** 688)

**Solubility of bromine vapor  
(Mean of many determinations)**

Temp	Pressure	Absorption coefficient
0 0	56-13mm	60 53
9 94°	89-16	35 22
20 46	138-9	20 87
30 38	179-12	13 65
40 31	229-26	9 22
50 25	274-53	6 50
60 04	314-46	4 84
69 98	154-54	3 82
80 22	396-74	2 94

**Solubility of liquid bromine  
(The mean of many determinations)**

Temp	$0^\circ$	10 34°	19 96	30 17°	40 03°	49 85°
Pts $H_2O$ that dissolve 1 pt $Br_2$	24 0	26 74	27 94	29 10	29 02	28 38

Much less  $Br_2$  is sol in ice cold  $H_2O$  in the presence of bromine hydrate

**Solubility in presence of bromine hydrate  
(The mean of many determinations)**

Temp	$0^\circ$	5 $12^\circ$
Pts $H_2O$ that dissolve 1 pt $Br_2$	42 39	26 26

(Winkler, Ch Z **1899**, **23** 688-689)

Solubility of  $Br_2$  in  $H_2O$  at  $25^\circ = 0.21$  mols in 1 l (Bray, J Am Chem Soc **1910**, **32** 398)

Sp gr of  $Br_2 + Aq$  containing pts Br in 1000 pts solution

Pts Br	Sp gr	Pts Br	Sp gr
10 72	1 00901	18 74-19 06	1 01491
10 68	1 00931	19 52-20 09	1 01585
12 05	1 00995	20 89-21 55	1 01807
12 21	1 01223	31 02-31 69	1 02367

(Stessor, N Edin Phil J **7** 287)

Sp gr of  $Br + Aq$  at  $32.5^\circ$

% Br by weight	Sp gr
0 7214	0 999814
1 1172	1 002520
1 6448	1 006100
1 9956	1 008870
2 5960	1 013200

(Joseph, Chem Soc **1915**, **107** 3)

Sol in conc  $HCl$ ,  $HBr$ , conc solutions of bromides, and in liquid  $SO$  (Sestini, Zeit Chem **1868** 718)

Much more sol in  $HCl + Aq$  than in  $H_2O$   
 100 cem  $HCl + Aq$  of 1.153 sp gr dissolve 36.4 g Br at  $12^\circ$

More sol in  $BrCl_3$  and  $BaCl_2 + Aq$  than in  $H_2O$  (Berthelot, C R **100** 761)



Bromine is not more sol in KBr+*Aq* than in  $H_2O$  (?) (Balard)

KBr+*Aq* containing 1 pt KBr to 6 pts  $H_2O$  takes up as much Br as it already contains, when this solution is heated the dissolved Br is separated 1 pt KBr+1 pt  $H_2O$  takes up twice as much Br as it already contains, much heat being evolved This solution loses Br on exposure to the air or when heated (Lowig)

#### Solubility of $Br_2$ in KBr+*Aq*

g Mols KBr per l	g at Br dissolved per l at 18°	g at Br dissolved per l at 26°
0 00	0 4448	0 4282
0 01	0 4634	0 4490
0 02	0 4823	0 4671
0 03	0 5049	0 4925
0 04	0 5243	0 5101
0 05	0 5431	0 5301
0 06	0 5668	0 5530
0 07	0 5895	0 5636
0 08	0 6059	0 5920
0 09	0 6301	0 5981
0 1	0 6533	0 6488
0 2	0 8718	0 8591
0 3	1 0549	1 0787
0 4	1 3124	1 2704
0 5	1 5436	1 4731
0 6	1 7712	1 6717
0 7	2 0006	1 9197
	2 2354	2 1029
	2 4851	2 3349

The above figures indicate that below a concentration of 0.1 g mol KBr per l just enough Br is dissolved to form  $KBr_3$ , while above that concentration somewhat larger amounts of Br are dissolved, which is greater at the lower temp

(Worley, Chem Soc 1905, 87 1109)

#### Solubility of $Br_2$ in NaBr+*Aq* at 25°

g NaBr per l	g atoms $Br_2$ per l	Sp gr
92 6	2 479	1 213
160 5	4 345	1 372
205 8	6 195	1 515
255 8	8 575	1 678
319 7	13 65	1 997
359 0	16 04	2 137
	19 23	2 327
408 3	20 85	2 420

(Bell, J Am Chem Soc 1912, 34 14)

#### Solubility in salts+*Aq* Solubility in 1 liter $K_2SO_4$ +*Aq* at 25°

$K_2SO_4$ + <i>Aq</i>	g Bromine
1-N	25 14
$\frac{1}{2}$ -N	29 44
$\frac{1}{4}$ -N	31 46
$\frac{1}{8}$ -N	32 70
$\frac{1}{16}$ -N	33 10

(Jakowkin, Z phys Ch 1896, 20, 26)

#### Solubility in 1 liter $Na_2SO_4$ +*Aq* at 25°

$Na_2SO_4$ + <i>Aq</i>	g Bromine
1-N	25 07
$\frac{1}{2}$ -N	29 20
$\frac{1}{4}$ -N	31 33
$\frac{1}{8}$ -N	32 94
$\frac{1}{16}$ -N	33 26

(Jakowkin, l c)

#### Solubility in 1 liter $NaNO_3$ +*Aq* at 25°

$NaNO_3$ + <i>Aq</i>	g Bromine
1-N	28 80
$\frac{1}{2}$ -N	31 35
$\frac{1}{4}$ -N	32 62
$\frac{1}{8}$ -N	33 33
$\frac{1}{16}$ -N	33 74

(Jakowkin, l c)

#### Solubility in salts+*Aq* at 25°

Salt+ <i>Aq</i>	g $Br_2$ sol in 1 liter
$\frac{1}{2}$ -N $Na_2SO_4$	23 90
$\frac{1}{2}$ -N $K_2SO_4$	24 80
$\frac{1}{2}$ -N $(NH_4)_2SO_4$	77 7
N $NaNO_3$	28 00
N $KNO_3$	28 95
N $NH_4NO_3$	55 15
N $NaCl$	55 90
N $KCl$	57 40
N $NH_4Cl$	82 2

(McLauchlan, Z phys Ch 1903, 44 617)

#### Solubility in $HgBr_2$ +*Aq* at 25°

10 ccm of the solution contain —

Millimols $Br_2$	Millimols $Hg$
2 125	0
2 204	0 0560
2 216	0 0793
2 226	0 1284
2 231	0 2120

(Hetz and Paul, Z inorg 1914 85 215)

1 l N  $NH_4C_2H_3O_2$ +*Aq* dissolves 340.5 g  $Br_2$  at 25° (McLauchlan Z phys Ch 1903, 44 617)

Miscible in all proportions with liquid  $NO$  (Frankland, Chem Soc 1901, 79 1361)

More sol in alcohol than in  $H_2O$ , miscible with ether,  $CS_2$ ,  $CHCl_3$  (Sestini, Zeit Chem 1868 718)

Somewhat soluble in glycerine (Pelouze)  
Sol in benzene (Munsfeld), insol in benzene (Moride, A ch (3) 39 452) Sol in warm chloral, bromal and iodol (Lowig, Pogg 14 485) Sol in  $SCl$  (Solly) and  $SBr$  Sol in conc  $HCl$ + $H_2O$ +*Aq* (Balard) Sol in aqueous solution of potassium, sodium, or calcium acetates (Chouss)

Solubility in CS<sub>2</sub>100 g of the sat solution contain at  
-95° -110 5° -116°45 4 39 0 36 9 g Br<sub>2</sub>

(Arcetowski, Z anorg 1896, 11 274)

Cryst from CS<sub>2</sub> at -90° in fine needles  
(Arcetowski, Z anorg 1895, 10 25)Sp gr of Br<sub>2</sub>+CCl<sub>4</sub> at 32 5°% Br<sub>2</sub> by weight

Sp gr

1 5449 1 58014

1 6454 1 58080

1 7990 1 58168

2 6676 1 58812

3 5833 1 59526

(Joseph, Chem Soc 1915, 107 3)

Sp gr of Br<sub>2</sub>+nitrobenzene at 32 5°% Br<sub>2</sub> by weight

Sp gr

1 5643 1 20225

3 2323 1 21449

4 6462 1 22518

6 1826 1 23603

(Joseph, Chem Soc 1915, 107 3)

Very sol in benzonitrile (Naumann, B  
1914, 47 1369)Sol in acetone (Eidmann, C C 1899,  
II, 1014, Naumann, B 1904, 37 4328)Partition of Br<sub>2</sub> between water and other  
solventsW=millimols Bromine in 10 ccm of the  
aqueous layerG=millimols Bromine in 10 ccm of the  
other layer

Other solvent	G	W	G/W
CCl <sub>4</sub>	1 949	0 0853	22 73
	7 008	0 3085	22 71
	12 171	0 5300	23 13
	39 880	1 3132	30 32
	54 574	1 5560	35 01

75% by vol CCl<sub>4</sub>  
+25% by vol CS<sub>2</sub>

	3 567	0 0985	37 06
	7 304	0 1910	38 15
	10 833	0 2900	37 36
	13 922	0 3720	37 42
	17 230	0 4580	37 62
	25 637	0 6580	38 96
	40 625	0 9940	40 88
	54 035	1 2080	44 73

50% by vol CCl<sub>4</sub>+  
50% by vol CS<sub>2</sub>

	3 592	0 0784	45 82
	6 820	0 1487	46 85
	10 148	0 2206	46 01
	13 866	0 3065	45 24
	16 616	0 3688	45 05
	42 975	0 8086	53 15
	55 965	0 9960	56 19

25% by vol CCl<sub>4</sub>  
+75% by vol CS<sub>2</sub>

	5 753	0 0884	65 05
	10 902	0 1682	64 82
	26 724	0 4970	65 65
	41 314	0 6331	65 26
	55 526	0 8520	65 17

Partition of Br<sub>2</sub>, etc —*Continued*

Other solvent	G	W	G/W
CS <sub>2</sub>	7 750	0 1015	76 35
	10 600	0 1387	76 44
	14 696	0 1910	76 98
	17 999	0 2352	76 54
	26 345	0 3467	75 99
	40 625	0 5194	78 21
	57 038	0 7160	79 66

(Herz, Z Elektrochem, 1910, 16 871)

Partition coefficient for bromine between CS<sub>2</sub>  
and H<sub>2</sub>O at 25°C

A = concentration of the water layer

C = concentration of the CS<sub>2</sub> layer

A	C	N=C/A
7 545	691 9	91 71
4 109	338 6	82 41
2 660	217 4	81 72
2 544	207 7	81 66
1 740	140 38	80 67
1 2878	103 7	80 51
0 8073	64 44	79 83
0 5046	39 64	78 38

Partition coefficient for bromine between  
CHBr<sub>3</sub> and H<sub>2</sub>O at 25°C

A = concentration of the water layer

C = concentration of the CHBr<sub>3</sub> layer

A	C	N=C/A
5 424	373 6	68 88
3 838	264 7	68 80
2 368	161 5	68 19
1 348	90 17	66 90
0 766	50 49	65 84
0 366	23 62	64 85

Partition coefficient for bromine between CCl<sub>4</sub>  
and H<sub>2</sub>O at 25°C

A = concentration of the water layer

C = concentration of the CCl<sub>4</sub> layer

A	C	N=C/A
14 42	545 2	37 82
10 80	372 2	34 44
7 901	252 8	32 01
7 163	225 8	31 52
6 803	218 5	32 12
5 651	172 6	30 54
3 216	94 84	29 48
2 054	58 36	28 41
1 266	35 92	28 37
0 7711	21 53	27 92
0 5761	15 72	27 26
0 4476	12 09	27 02
0 3803	10 27	27 00
0 2478	6 691	27 00

(Jakowkin, Z phys Ch 1895, 18 588)

Partition of bromine between  $\text{CCl}_4$  and salts + Aq

A = concentration of Br in  $\text{H}_2\text{O}$  layer  
C = concentration of Br in  $\text{CCl}_4$  layer

Partition of  $\text{Br}_2$  between  $\text{CCl}_4$  and  $\text{NaNO}_3$  + Aq at  $25^\circ$

$\text{NaNO}_3$ + Aq	A	C
1-N	7 905	316 7
$\frac{1}{2}$ -N	8 763	319 5
$\frac{1}{4}$ -N	9 033	315 7
$\frac{1}{8}$ -N	9 200	316 7
$\frac{1}{16}$ -N	9 399	319 3

(Jakowkin, Z phys Ch 1896, 20, 25)

Partition of  $\text{Br}_2$  between  $\text{CCl}_4$  and  $\text{K}_2\text{SO}_4$  + Aq at  $25^\circ$

$\text{K SO}_4$ + Aq	A	C
1-N	5 982	255 4
$\frac{1}{2}$ -N	6 843	253 4
$\frac{1}{4}$ -N	7 354	252 8
$\frac{1}{8}$ -N	7 585	250 3
$\frac{1}{16}$ -N	7 498	242 3

(Jakowkin, l c)

Partition of  $\text{Br}_2$  between  $\text{CCl}_4$  and  $\text{Na}_2\text{SO}_4$  + Aq at  $25^\circ$

$\text{Na SO}_4$ + Aq	A	C
	5 934	254 6
	6 838	253 4
	7 402	254 4
N	7 609	252 8
$\frac{1}{16}$ -N	7 713	251 2

(Jakowkin, l c)

Crystallizes at  $4^\circ$  with  $10\text{H}_2\text{O}$

**Bromine chloride,  $\text{BrCl}$**

Sol in  $\text{H}_2\text{O}$ ,  $\text{CS}_2$ , ether, etc

**Bromine fluoride,  $\text{BrF}_3$**

Fumes in the air Decomps by  $\text{H}_2\text{O}$  (Lebeau, C R 1905, 141 1019)

**Bromine oxides**

No oxides of bromine are known in the free state See hypobromous, bromic, and perbromic acids

**Bromuric acid**

**Ammonium bromurate,  $(\text{NH}_4)_2\text{IrBr}_6$**

Less sol in cold  $\text{H}_2\text{O}$  than the K salt (Birnbau, Zeit Chem 1865 22)

Very sol in cold  $\text{H}_2\text{O}$  (Gutbier, B 1909, 42 3910)

**Cæsium bromurate,  $\text{Cs}_2\text{IrBr}_6$**

Sol in  $\text{H}_2\text{O}$  (Gutbier, B 1909, 42 3911)

**Potassium bromurate,  $\text{K}_2\text{IrBr}_6$**

Moderately sol in cold, more easily in hot  $\text{H}_2\text{O}$

Insol in alcohol or ether  
Sol in cold  $\text{H}_2\text{O}$  and in  $\text{HBr}$  + Aq (Gutbier, B 1909, 42 3910)

**Rubidium bromurate,  $\text{Rb}_2\text{IrBr}_6$**

Very sol in cold  $\text{H}_2\text{O}$  Sol in hot dil  $\text{HBr}$  + Aq (Gutbier, B 1909, 42 3911)

**Sodium bromurate**

Deliquescent Easily sol in  $\text{H}_2\text{O}$ , alcohol, or ether

**Bromurous acid,  $\text{H}_6\text{Ir}_2\text{Br}_{12} + 6\text{H}_2\text{O}$**

Easily sol in  $\text{H}_2\text{O}$ , alcohol, or ether (Birnbau, 1864)

**Ammonium bromurate,  $(\text{NH}_4)_6\text{Ir}_2\text{Br}_{12} + \text{H}_2\text{O}$**

Difficultly sol in  $\text{H}_2\text{O}$  (Birnbau)

**Potassium bromurate,  $\text{K}_6\text{Ir}_2\text{Br}_{12} + 6\text{H}_2\text{O}$**

Efflorescent Sol in  $\text{H}_2\text{O}$

**Silver bromurate,  $\text{Ag}_6\text{Ir}_2\text{Br}_{12}$**

Ppt Insol in  $\text{H}_2\text{O}$  or acids

**Sodium bromurate,  $\text{Na}_6\text{Ir}_2\text{Br}_{12} + 24\text{H}_2\text{O}$**

Efflorescent Very sol in  $\text{H}_2\text{O}$

**Bromocarbonatoplatin diamine carbonate,  $\text{CO}_3[\text{Pt}(\text{N}_2\text{H}_5)_2]_2(\text{CO}_3)_2 + 4\text{H}_2\text{O}$**

Ppt

**Bromocarbonatoplatin diamine carbonate**

**bromoplatin diamine nitrate,**

$\text{CO}_3[\text{Pt}(\text{N}_2\text{H}_5)_2]_2(\text{CO}_3)_2$ , 2Bt Pt(N  $\text{H}_6$ )  
 $(\text{NO}_3)_2$

**Bromochloroplatin diamine chloride,**

$\text{Br Cl Pt}(\text{N H}_6)_2\text{Cl}$

Very sl sol in  $\text{H}_2\text{O}$  (Cl v c)

— chlorobromide,  $\text{Br Cl Pt N H}_6\text{Cl}$   
 $\text{Cl N H}_6\text{Br}$

Very sl sol in  $\text{H}_2\text{O}$

**Bromochloroplatinic acid**

**Potassium bromochloroplatinate,  $\text{K PtCl Br}$**

(Pitkin, J Am Chem Soc 2 408)

Mixture (Herty J Am Chem Soc 1896, 18 136)

$\text{K}_2\text{PtCl}_4\text{Br}_2$  Sl sol in cold  $\text{H}_2\text{O}$  much more sol in hot  $\text{H}_2\text{O}$  (Pitkin)

Mixture (Herty)

$\text{K}_2\text{PtCl}_3\text{Br}_3$  As above

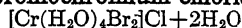
$\text{K PtCl}_2\text{Br}_4$  (Pigeon, A ch 1894, (7) 2 488)

$\text{K PtCl Br}$  (Pitkin)

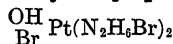
**Bromochromic acid**

**Potassium bromochromate,  $\text{KCrO}_4\text{Br}$**

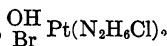
Decomp by  $\text{H}_2\text{O}$  (Heintze, J pr (2) 4 225)

**Dibromochromium chloride,**

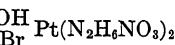
Ppt Nearly insol in fuming HCl (Bjerrum, B 1907, 40 2918)

**Bromohydroxyloplatin diamine bromide,**

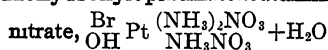
Very sl sol in  $\text{H}_2\text{O}$  (Cleve)

**— chloride,**

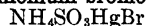
Sol in  $\text{H}_2\text{O}$  (Cleve)

**— nitrate,**

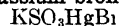
Very sl sol in cold, moderately sol in hot  $\text{H}_2\text{O}$  (Cleve)

**Bromohydroxyloplatin monodiamine**

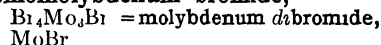
Easily sol in  $\text{H}_2\text{O}$  (Cleve)

**Bromomercurosulphurous acid****Ammonium bromomercurosulphate,**

Sol in  $\text{H}_2\text{O}$  (Barth, Z phys Ch 9 215)

**Potassium bromomercurosulphate,**

As above (B)

**Bromomolybdenum bromide,**

Insol in  $\text{H}_2\text{O}$  or acids, or even in boiling aqua regia. Easily sol in dilute, decomp by conc alkalis + Aq (Blomstrand, J pr 82 436)

**Bromomolybdenum chloride,  $\text{Br}_4\text{Mo}_3\text{Cl} + 3\text{H}_2\text{O}$** 

Insol in acids (Blomstrand)

**Bromomolybdenum chromate,  $\text{Br}_4\text{Mo}_3\text{CrO}_4 + 2\text{H}_2\text{O}$** 

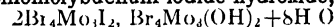
Insol in dil acids. Sol in hot conc HCl + Aq. Insol in alkali chromates + Aq (Atterberg)

**Bromomolybdenum fluoride,  $\text{Br}_4\text{Mo}_3\text{F} + 3\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Atterberg)

**Bromomolybdenum hydroxide,  $\text{Br}_4\text{Mo}_3(\text{OH})$** 

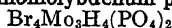
Completely sol in alkalis if not heated over  $90^\circ$  (Atterberg)

**Bromomolybdenum iodide hydroxide,**

Precipitate (Blomstrand, J pr 77 92)

**Bromomolybdenum molybdate,  $\text{Br}_4\text{Mo}_3\text{MoO}_4$** 

Precipitate (Atterberg)

**Bromomolybdenum phosphate,**

Precipitate Insol in  $\text{H}_2\text{O}$  (Atterberg)

**Bromomolybdenum sulphate,  $\text{Br}_4\text{Mo}_3\text{SO}_4 + 3\text{H}_2\text{O}$** 

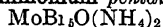
Precipitate Sl sol in boiling  $\text{H}_2\text{SO}_4$  (Atterberg)

**Dibromomolybdous acid,  $\text{MoOBr}_2(\text{OH}) + 1\frac{1}{2}\text{H}_2\text{O}$** 

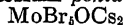
Sol in  $\text{H}_2\text{O}$  Very hygroscopic (Weinland, Z anorg 1905, 44 86)

**Tetrabromomolybdous acid,  $\text{MoBr}_4(\text{OH}) + 2\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  Hygroscopic (Weinland, l c)

**Diammonium pentabromomolybdate,**

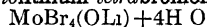
Hygroscopic Sol in  $\text{H}_2\text{O}$  (Weinland, l c)

**Dicæsium pentabromomolybdate,**

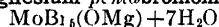
Hygroscopic Sol in  $\text{H}_2\text{O}$  (Weinland, l c)

**Calcium tetrabromomolybdate,  $(\text{MoBr}_4\text{O})_2\text{Ca} + 7\text{H}_2\text{O}$** 

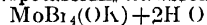
Hygroscopic Sol in  $\text{H}_2\text{O}$  (Weinland, l c)

**Monolithium tetrabromomolybdate,**

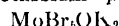
Hygroscopic Sol in  $\text{H}_2\text{O}$  (Weinland, l c)

**Magnesium pentabromomolybdate,**

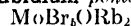
Hygroscopic Sol in  $\text{H}_2\text{O}$  (Weinland, l c)

**Monopotassium tetrabromomolybdate,**

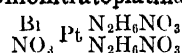
Hygroscopic Sol in  $\text{H}_2\text{O}$  (Weinland, l c)

**Dipotassium pentabromomolybdate,**

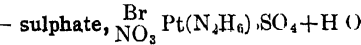
Hygroscopic Sol in  $\text{H}_2\text{O}$  (Weinland, l c)

**Rubidium pentabromomolybdate,**

Hygroscopic Sol in  $\text{H}_2\text{O}$  (Weinland, l c)

**Bromonitratoplatin diamine nitrate,**

Decomp by  $\text{H}_2\text{O}$  (Cleve)

**— sulphate,**

Sl sol in  $\text{H}_2\text{O}$

Partition of bromine between  $\text{CCl}_4$  and salts + Aq

A = concentration of  $\text{Br}$  in  $\text{H}_2\text{O}$  layer  
C = concentration of  $\text{Br}$  in  $\text{CCl}_4$  layer

Partition of  $\text{Br}_2$  between  $\text{CCl}_4$  and  $\text{NaNO}_3$  + Aq at  $25^\circ$

$\text{NaNO}_3$ + Aq	A	C
1-N	7 905	316 7
$1/2$ -N	8 763	319 5
$1/4$ -N	9 033	315 7
$1/8$ -N	9 200	316 7
$1/16$ -N	9 399	319 3

(Jakowkin, *Z phys Ch* 1896, 20, 25)

Partition of  $\text{Br}_2$  between  $\text{CCl}_4$  and  $\text{K}_2\text{SO}_4$  + Aq at  $25^\circ$

$\text{K}_2\text{SO}_4$ + Aq	A	C
1-N	5 982	255 4
$1/2$ -N	6 843	253 4
$1/4$ -N	7 354	252 8
$1/8$ -N	7 585	250 3
$1/16$ -N	7 498	242 3

(Jakowkin, *l c*)

Partition of  $\text{Br}_2$  between  $\text{CCl}_4$  and  $\text{Na}_2\text{SO}_4$  + Aq at  $25^\circ$

$\text{Na}_2\text{SO}_4$ + Aq	A	C
1-N	5 934	254 6
$1/2$ -N	6 838	253 4
$1/4$ -N	7 402	254 4
$1/8$ -N	7 609	252 8
$1/16$ -N	7 713	251 2

(Jakowkin, *l c*)

Crystallizes at  $4^\circ$  with  $10\text{H}_2\text{O}$

**Bromine chloride,  $\text{BrCl}$**

Sol in  $\text{H}_2\text{O}$ ,  $\text{CS}_2$ , ether, etc

**Bromine fluoride,  $\text{BrF}_3$**

Fumes in the air. Decomp by  $\text{H}_2\text{O}$  (Leibner *C R* 1905, 141 1019)

**Bromine oxides**

No oxides of bromine are known in the free state. See hypobromous, bromic, and perbromic acids

**Bromuric acid**

**Ammonium bromurate,  $(\text{NH}_4)_2\text{IrBr}_6$**

Less sol in cold  $\text{H}_2\text{O}$  than the  $\text{K}$  salt (Birnbau, *Zeit Chem* 1865 22)

Very sol in cold  $\text{H}_2\text{O}$  (Gutbier, *B* 1909, 42 3910)

**Cæsium bromurate,  $\text{Cs}_2\text{IrBr}_6$**

Sol in  $\text{H}_2\text{O}$  (Gutbier, *B* 1909, 42 3911)

**Potassium bromurate,  $\text{K}_2\text{IrBr}_6$**

Moderately sol in cold, more easily in hot  $\text{H}_2\text{O}$

Insol in alcohol or ether  
Sol in cold  $\text{H}_2\text{O}$  and in  $\text{HBr}$  + Aq (Ctibier, *B* 1909, 42 3910)

**Rubidium bromurate,  $\text{Rb}_2\text{IrBr}_6$**

Very sol in cold  $\text{H}_2\text{O}$  Sol in hot  $\text{H}_2\text{O}$   
 $\text{HBr}$  + Aq (Gutbier, *B* 1909, 42 3911)

**Sodium bromurate**

Deliquescent Easily sol in  $\text{H}_2\text{O}$ , alcohol, or ether

**Bromuric acid,  $\text{H}_2\text{IrBr}_6 + 6\text{H}_2\text{O}$**

Easily sol in  $\text{H}_2\text{O}$ , alcohol, or ether (Birnbau, 1864)

**Ammonium bromurate,  $(\text{NH}_4)_2\text{IrBr}_6 + \text{H}_2\text{O}$**

Difficultly sol in  $\text{H}_2\text{O}$  (Birnbau)

**Potassium bromurate,  $\text{K}_2\text{IrBr}_6 + 6\text{H}_2\text{O}$**

Efflorescent Sol in  $\text{H}_2\text{O}$

**Silver bromurate,  $\text{Ag}_2\text{IrBr}_6$**

Ppt Insol in  $\text{H}_2\text{O}$  or acids

**Sodium bromurate,  $\text{Na}_2\text{IrBr}_6 + 24\text{H}_2\text{O}$**

Efflorescent Very sol in  $\text{H}_2\text{O}$

**Bromocarbonatoplatindiamine carbonate,  $\text{CO}_3[\text{Pt}(\text{N}_2\text{H}_4)_2]_2(\text{CO}_3)_2 + 4\text{H}_2\text{O}$**

Ppt

**Bromocarbonatoplatindiamine carbonate bromoplatindiamine nitrate,**

$\text{CO}_3[\text{Pt}(\text{N}_2\text{H}_4)_2]_2(\text{CO}_3)_2, 2\text{Br}_2\text{Pt}(\text{NH}_4)_2(\text{NO}_3)_2$

**Bromochloroplatindiamine chloride,**

$\text{Br Pt}(\text{NH}_4)_2\text{Cl}$

Very sl sol in  $\text{H}_2\text{O}$  (Clay)

— chlorobromide,  $\text{Br Pt}(\text{NH}_4)_2\text{Cl}$

Very sl sol in  $\text{H}_2\text{O}$

**Bromochloroplatinic acid**

**Potassium bromochloroplatinate,  $\text{K PtClBr}_4$**

(Pitkin *J Am Chem Soc* 2 408)

Mixture (Herty *J Am Chem Soc* 1906, 18 136)

$\text{K}_2\text{PtCl}_4\text{Br}_2$  Sl sol in cold  $\text{H}_2\text{O}$  and more sol in hot  $\text{H}_2\text{O}$  (Pitkin)

Mixture (Herty)

$\text{K PtCl}_3\text{Br}_2$  As above

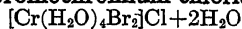
$\text{K PtClBr}_4$  (Pigou, *Ch* 1894, (2 488)

$\text{K PtClBr}_4$  (Pitkin)

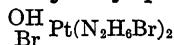
**Bromochromic acid**

**Potassium bromochromate,  $\text{KCrO}_4\text{Br}$**

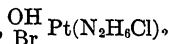
Decomp by  $\text{H}_2\text{O}$  (Hantzsch, *J pr* (1) 4 225)

**Dibromochromium chloride,**

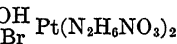
Ppt Nearly insol in fuming HCl (Bjerrum, B 1907, 40 2918)

**Bromohydroxyloplatin<sup>diamine</sup> bromide,**

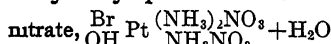
Very sl sol in H<sub>2</sub>O (Cleve)

**— chloride,**

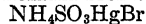
Sol in H<sub>2</sub>O (Cleve)

**— nitrate,**

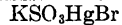
Very sl sol in cold, moderately sol in hot H<sub>2</sub>O (Cleve)

**Bromohydroxyloplatin<sup>monodiamine</sup>**

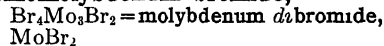
Easily sol in H<sub>2</sub>O (Cleve)

**Bromomercurosulphurous acid****Ammonium bromomercurosulphite,**

Sol in H<sub>2</sub>O (Barth, Z phys Ch 9 215)

**Potassium bromomercurosulphite,**

As above (B)

**Bromomolybdenum bromide,**

Insol in H<sub>2</sub>O or acids, or even in boiling aqua regia Easily sol in dilute, decomp by conc alkalis + Aq (Blomstrand, J pr 82 436)

**Bromomolybdenum chloride, Br<sub>4</sub>Mo<sub>3</sub>Cl<sub>2</sub> + 3H O**

Insol in acids (Blomstrand)

**Bromomolybdenum chromate, B<sub>14</sub>Mo<sub>3</sub>CrO<sub>4</sub> + 2H O**

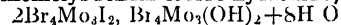
Insol in dil acids Sol in hot conc HCl + Aq Insol in alk di chromates + Aq (Atterberg)

**Bromomolybdenum fluoride, B<sub>14</sub>Mo<sub>3</sub>F<sub>2</sub> + 3H<sub>2</sub>O**

Insol in H<sub>2</sub>O (Atterberg)

**Bromomolybdenum hydroxide, B<sub>14</sub>Mo<sub>3</sub>(OH)<sub>2</sub>**

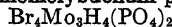
Completely sol in alkalis if not heated over 90° (Atterberg)

**Bromomolybdenum iodide hydroxide,**

Precipitate (Blomstrand, J pr 77 92)

**Bromomolybdenum molybdate, Br<sub>4</sub>Mo<sub>3</sub>MoO<sub>4</sub>**

Precipitate (Atterberg)

**Bromomolybdenum phosphate,**

Precipitate Insol in H<sub>2</sub>O (Atterberg)

**Bromomolybdenum sulphate, Br<sub>4</sub>Mo<sub>3</sub>SO<sub>4</sub> + 3H<sub>2</sub>O**

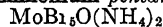
Precipitate Sl sol in boiling H<sub>2</sub>SO<sub>4</sub> (Atterberg)

**Dibromomolybdous acid, MoOBr (OH) + 1½H<sub>2</sub>O**

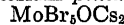
Sol in H<sub>2</sub>O Very hygroscopic (Weinland, Z anorg 1905, 44 86)

**Tetrabromomolybdous acid, MoBr<sub>4</sub>(OH) + 2H<sub>2</sub>O**

Sol in H<sub>2</sub>O Hygroscopic (Weinland, l c)

**Diammonium pentabromomolybdate,**

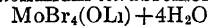
Hygroscopic Sol in H<sub>2</sub>O (Weinland, l c)

**Dicæsium pentabromomolybdate,**

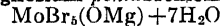
Hygroscopic Sol in H O (Weinland, l c)

**Calcium tetrabromomolybdate, (MoBr<sub>4</sub>O)<sub>2</sub>Ca + 7H<sub>2</sub>O**

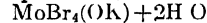
Hygroscopic Sol in H<sub>2</sub>O (Weinland, l c)

**Monolithium tetrabromomolybdate,**

Hygroscopic Sol in H<sub>2</sub>O (Weinland, l c)

**Magnesium pentabromomolybdate,**

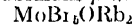
Hygroscopic Sol in H O (Weinland, l c)

**Monopotassium tetrabromomolybdate,**

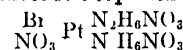
Hygroscopic Sol in H O (Weinland, l c)

**Dipotassium pentabromomolybdate,**

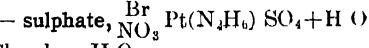
Hygroscopic Sol in H O (Weinland, l c)

**Dirubidium pentabromomolybdate,**

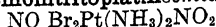
Hygroscopic Sol in H O (Weinland, l c)

**Bromonitratoplatin<sup>diamine</sup> nitrate,**

Decomp by H O (Cleve)

**— sulphate,**

Sl sol in H<sub>2</sub>O

**Bromonitritoplatin*semidiamine* nitrite,**

Sl sol in  $\text{H}_2\text{O}$  (Blomstrand)

**Bromonitrous acid****Platinum silver bromonitrite,  $\text{PtAg}_2\text{Br}_2(\text{NO}_2)_4$** 

Ppt (Miolati, Gazz ch it 1900, **30** 588)

**Bromopalladic acid****Ammonium bromopalladate,  $(\text{NH}_4)_2\text{PdBr}_6$** 

Difficultly sol in cold  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$  and by hot conc  $\text{H}_2\text{SO}_4$  (Gutbier, B 1905, **38** 1907)

**Cæsium bromopalladate,  $\text{Cs}_2\text{PdBr}_6$** 

Difficultly sol in cold  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$  or by hot conc  $\text{H}_2\text{SO}_4$  (Gutbier, l c)

**Potassium bromopalladate,  $\text{K}_2\text{PdBr}_6$** 

Difficultly sol in cold  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$  or by hot conc  $\text{H}_2\text{SO}_4$  (Gutbier, l c)

**Rubidium bromopalladate,  $\text{Rb}_2\text{PdBr}_6$** 

Insol in cold  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$  or by hot conc  $\text{H}_2\text{SO}_4$  (Gutbier, l c)

**Bromopalladious acid****Ammonium bromopalladite,  $(\text{NH}_4)_2\text{PdBr}_4$** 

Very stable Sol in  $\text{H}_2\text{O}$  (Smith, Z anorg 1894, **6** 381)

Very sol in cold  $\text{H}_2\text{O}$

Can be cryst from a very small amount of hot  $\text{H}_2\text{O}$  (Gutbier, B 1905, **38** 2387)

**Barium bromopalladite**

Not deliquescent Sol in  $\text{H}_2\text{O}$  (v Bonsdorff)

**Cæsium bromopalladite,  $\text{Cs}_2\text{PdBr}_4$** 

Very sol in  $\text{H}_2\text{O}$  (Gutbier, B 1905, **38** 2388)

**Manganese bromopalladite,  $\text{MnPdBr}_4$** 

Sol in  $\text{H}_2\text{O}$  and alcohol (v Bonsdorff)  
+  $7\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Smith, Z anorg 1894, **6** 382)

**Potassium bromopalladite,  $\text{K}_2\text{PdBr}_4$** 

Easily sol in  $\text{H}_2\text{O}$  (Joannis, C R **95** 295)

Very stable Sol in  $\text{H}_2\text{O}$  (Smith, Z anorg 1894, **6** 381)  
+  $2\text{H}_2\text{O}$  Unstable in the air (Smith, l c)

**Rubidium bromopalladite,  $\text{Rb}_2\text{PdBr}_4$** 

Can be cryst from a very small amount of hot  $\text{H}_2\text{O}$  (Gutbier, B 1905, **38** 2388)

**Sodium bromopalladite,  $\text{Na}_2\text{PdBr}_4 + 4\frac{1}{2}\text{H}_2\text{O}$** 

Very deliquescent Sol in  $\text{H}_2\text{O}$  (Smith, l c)

**Strontium bromopalladite,  $\text{SrPdBr}_4 + 6\text{H}_2\text{O}$** 

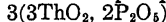
Stable in the air Very sol in  $\text{H}_2\text{O}$  (Smit, l c)

**Zinc bromopalladite**

Sol in  $\text{H}_2\text{O}$  (v Bonsdorff)

**Bromophosphatoplatin*diamine* phosphate,  $\text{BrPt}(\text{N}_2\text{H}_5)_2 + 2\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  (Cleve)

**Bromophosphoric acid****Thorium bromophosphate,  $\text{ThBr}_4$** 

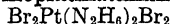
Insol in most acids and in fused alk carbonates Decomp by long boiling w conc  $\text{H}_2\text{SO}_4$  (Colani, C R 1909, **149** 20)

**Bromoplatinamine bromide,**

Sl sol in  $\text{H}_2\text{C}$  (Cleve, Sv V A H **10**, 31)

— nitrite,  $\text{Br}_2\text{Pt}(\text{NH}_3\text{NO}_2)_2$

Very sl sol in  $\text{H}_2\text{O}$  (Cleve)

**Bromoplatin*diamine* bromide,**

Only sl sol in hot  $\text{H}_2\text{O}$  (Cleve)

— chloride,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{Cl}_2$

Very sl sol in  $\text{H}_2\text{O}$  (Cleve)

— dichromate,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{Cr}_2\text{O}_7$

Sl sol in  $\text{H}_2\text{O}$

— nitrate,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_5\text{NO}_3)_2$

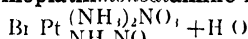
Sl sol in cold, rather easily sol in hot  $\text{H}_2\text{O}$  (Cleve)

— phosphate,  $\text{Br}_2\text{Pt}[\text{N}_2\text{H}_5\text{PO}_2(\text{OH})] + 2\text{H}_2\text{O}$

Rather easily sol in hot  $\text{H}_2\text{O}$  (Cleve)

— sulphate,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{SO}_4$

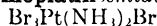
Very sl sol in  $\text{H}_2\text{O}$

**Bromoplatin*monodiamine* nitrate,**

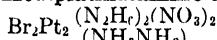
Easily sol in  $\text{H}_2\text{O}$

— sulphate,  $\text{Br}_2\text{Pt}(\text{NH}_3)_2\text{SO}_4 + \text{H}_2\text{O}$

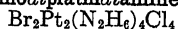
Moderately sol in  $\text{H}_2\text{O}$  (Cleve)

**Bromoplatin*semidiamine* bromide,**

Sl sol in cold  $\text{H}_2\text{O}$  (Cleve)

**Bromodiplatin*diamine* anhydronitrate**

Sol in  $\text{HNO}_3 + \text{Aq}$

**Bromodiplatinum diamine chloride,**

Ppt (Cleve)

— **nitrate**,  $\text{Br}_2\text{Pt}_2(\text{N}_2\text{H}_4)_4(\text{NO}_3)_4 + 2\text{H}_2\text{O}$ Moderately sol in hot  $\text{H}_2\text{O}$ — **sulphate**,  $\text{Br}_2\text{Pt}_2(\text{N}_2\text{H}_4)_4(\text{SO}_4)_2 + 2\text{H}_2\text{O}$ 

Ppt (Cleve)

**Bromoplatinic acid**,  $\text{H}_2\text{PtBr}_6 + 9\text{H}_2\text{O}$ Very deliquescent, and sol in  $\text{H}_2\text{O}$ , alcohol, ether, chloroform, or acetic acid (Topsoe, J B 1868 273)**Ammonium bromoplatinate**,  $(\text{NH}_4)_2\text{PtBr}_6$ Sol in 200 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Topsoe)100 pts  $(\text{NH}_4)_2\text{PtBr}_6 + \text{Aq}$  sat at  $20^\circ$  contain 0.59 pt dry salt (Halberstadt, B 17 2965)**Barium bromoplatinate**,  $\text{BaPtBr}_6 + 10\text{H}_2\text{O}$ Sl deliquescent Very sol in  $\text{H}_2\text{O}$ **Cæsium bromoplatinate**,  $\text{Cs}_2\text{PtBr}_6$ Sl sol in dil  $\text{HBr} + \text{Aq}$  (Obermaier, Dissert)**Calcium bromoplatinate**,  $\text{CaPtBr}_6 + 12\text{H}_2\text{O}$ Sl deliquescent Very sol in  $\text{H}_2\text{O}$ **Cobalt bromoplatinate**,  $\text{CoPtBr}_6 + 12\text{H}_2\text{O}$ 

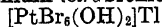
Deliquescent

**Copper bromoplatinate**,  $\text{CuPtBr}_6 + 8\text{H}_2\text{O}$ Very deliquescent, sol in  $\text{H}_2\text{O}$ **Lead bromoplatinate**,  $\text{PbPtBr}_6$ Easily sol in  $\text{H}_2\text{O}$ , but decomp by large amount**Lead tetrabromoplatinate**,  $[\text{PtBr}_4(\text{OH})_2]\text{Pb} \cdot \text{PbOH}$ Insol in  $\text{H}_2\text{O}$  (Miolati, C C 1900, II 810)**Magnesium bromoplatinate**,  $\text{MgPtBr}_6 + 12\text{H}_2\text{O}$ 

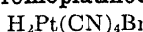
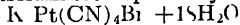
Not deliquescent

**Manganese bromoplatinate**,  $\text{MnPtBr}_6 + 6\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$   
+  $12\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ **Mercuric tetrabromoplatinate**,  $[\text{PtBr}_4(\text{OH})_2]\text{Hg}$ Insol in  $\text{H}_2\text{O}$  (Miolati, C C 1900, II 810)**Nickel bromoplatinate**,  $\text{NiPtBr}_6 + 12\text{H}_2\text{O}$ 

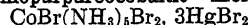
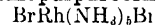
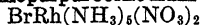
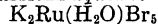
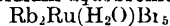
Deliquescent

**Potassium bromoplatinate**,  $\text{K}_2\text{PtBr}_6$ Sl sol in  $\text{H}_2\text{O}$  Insol in alcohol (v Bonadorff, Pogg 19 344)Sol in 10 pts boiling  $\text{H}_2\text{O}$  (Pitkin, C N 41 218)100 pts  $\text{K}_2\text{PtBr}_6 + \text{Aq}$  sat at  $20^\circ$  contain 2.02 pts dry salt (Halberstadt, B 17 2962)**Praseodymium bromoplatinate**,  $\text{PrBr}_3 \cdot \text{PtBr}_3 + 10\text{H}_2\text{O}$ Deliquescent, very sol in  $\text{H}_2\text{O}$ , sol in  $\text{HBr}$  (Von Schule, Z anorg 1898, 18 353)**Rubidium bromoplatinate**,  $\text{Rb}_2\text{PtBr}_6$ Sl sol in dil  $\text{HBr} + \text{Aq}$  (Obermaier Dissert)**Silver bromoplatinate**,  $\text{Ag}_2\text{PtBr}_6$ Insol in  $\text{H}_2\text{O}$  (Miolati, C C 1900, II 810)**Silver tetrabromoplatinate**,  $[\text{PtBr}_4(\text{OH})_2]\text{Ag}_2$ Ppt, insol in  $\text{H}_2\text{O}$  (Miolati, l c)**Sodium bromoplatinate**,  $\text{Na}_2\text{PtBr}_6 + 6\text{H}_2\text{O}$ Easily sol in  $\text{H}_2\text{O}$  and alcohol**Strontium bromoplatinate**,  $\text{SrPtBr}_6 + 10\text{H}_2\text{O}$ Sl deliquescent Very sol in  $\text{H}_2\text{O}$ **Thallium tetrabromoplatinate**,Insol in  $\text{H}_2\text{O}$  (Miolati, C C 1900, II 810)**Ytterbium bromoplatinate**,  $\text{YbBr}_3 \cdot 3\text{H}_2\text{PtBr}_6 + 30\text{H}_2\text{O}$ 

Ppt (Cleve, Z anorg 1902, 32 138)

**Zinc bromoplatinate**,  $\text{ZnPtBr}_6 + 12\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$ **Bromoplatinocyanhydric acid**,See **Perbromoplatinocyanhydric acid****Potassium bromoplatinocyanide**,  $5\text{K}_2\text{Pt}(\text{CN})_4$ Sol in  $\text{H}_2\text{O}$ **Bromoplatinous acid****Potassium bromoplatinite**,  $\text{K}_2\text{PtBr}_4 + 2\text{H}_2\text{O}$ Extremely sol in  $\text{H}_2\text{O}$  (Billmann und Anderson B 1903, 36 1566)**Bromopurpleochromium bromide**,Less sol in  $\text{H}_2\text{O}$  than chloropurpleochromium chloride (Jorgensen, J pr (2) 25 53)— **bromoplatinate**,  $\text{BrCr}(\text{NH}_3)_4\text{PtBr}_6$  (Jorgensen, l c)— **chloride**,  $\text{BrCr}(\text{NH}_3)_4\text{Cl}_2$ More sol in  $\text{H}_2\text{O}$  than the bromide (Jorgensen, l c)



**Bromopurpleochromium chromate,**Precipitate (Jorgensen, *l c*)**— nitrate,  $\text{BrCr}(\text{NH}_3)_5(\text{NO}_3)_2$** More sol than bromide and less than chloride (Jorgensen, *l c*)**Bromopurpleocobaltic bromide,**Sol in 530 pts  $\text{H}_2\text{O}$  at  $16^\circ$  Insol in alcohol,  $\text{NH}_4\text{Br}$ ,  $\text{KBr}$ , or  $\text{HBr} + \text{Aq}$  More sol in hot  $\text{H}_2\text{O}$  containing a little  $\text{HBr}$  (Jorgensen, *J pr* (2) **19** 49)**Bromopurpleocobaltic mercuric bromide,**More sol in  $\text{H}_2\text{O}$  than the corresponding  $\text{HgCl}_2$  salt (J)**— bromoplatinate**Very sl sol in cold  $\text{H}_2\text{O}$  (J)**— chloride,  $\text{CoBr}(\text{NH}_3)_5\text{Cl}_2$** Difficultly sol in cold  $\text{H}_2\text{O}$ , but much more easily than the bromide Insol in dil  $\text{HCl} + \text{Aq}$ , and in alcohol**— mercuric chloride,  $\text{CoBr}(\text{NH}_3)_5\text{Cl}$** Sl sol in  $\text{H}_2\text{O}$ **— chloroplatinate**Nearly or quite insol in  $\text{H}_2\text{O}$  (J)**— chromate,  $\text{CoBr}(\text{NH}_3)_5\text{CrO}_4$** Nearly insol in  $\text{H}_2\text{O}$ **— dithionate,  $\text{CoBr}(\text{NH}_3)_5\text{S}_2\text{O}_6$** Nearly insol in  $\text{H}_2\text{O}$ **— fluosilicate,  $\text{CoBr}(\text{NH}_3)_5\text{SiF}_6$** Very sl sol in cold  $\text{H}_2\text{O}$ , insol in alcohol**— nitrate,  $\text{CoBr}(\text{NH}_3)_5(\text{NO}_3)_2$** More sol in  $\text{H}_2\text{O}$  than the bromide, but less than the chloride Wholly insol in dil  $\text{HNO}_3 + \text{Aq}$  or alcohol**— oxalate,  $\text{CoBr}(\text{NH}_3)_5\text{C}_2\text{O}_4$** Nearly insol in  $\text{H}_2\text{O}$ **— sulphate,  $\text{CoBr}(\text{NH}_3)_5\text{SO}_4$** Can be crystallized from very dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Insol in alcohol  
 $+ 6\text{H}_2\text{O}$  Efflorescent**Bromopurpleorhodium bromide,**Much less easily sol in  $\text{H}_2\text{O}$  than the chloro chloride Insol in dil  $\text{HBr} + \text{Aq}$  and alcohol (Jorgensen, *J pr* (2) **27** 433)**— bromoplatinate,  $\text{BrRh}(\text{NH}_3)_5\text{PtBr}_4$** Almost insol in  $\text{H}_2\text{O}$ **— fluosilicate,  $\text{BrRh}(\text{NH}_3)_5\text{SiF}_6$** Sl sol in  $\text{H}_2\text{O}$  Sol in boiling  $\text{NaOH} + \text{Aq}$  as roseo salt**Bromopurpleorhodium nitrate,**Sl sol in  $\text{H}_2\text{O}$ , but much more sol than bromide**Bromorhodos acid****Ammonium bromorhodite,  $(\text{NH}_4)_2\text{RhBr}_5$** Sol in  $\text{H}_2\text{O}$  (Goloubkine, *Chem f c* 1911, **100** (2) 45)Sol in  $\text{H}_2\text{O}$  (Gutbier, *B* 1908, **41** 215)**Barium bromorhodite,  $\text{BaRhBr}_5$** Sol in  $\text{H}_2\text{O}$  (Goloubkine, *l c*)**Cæsium bromorhodite,  $\text{Cs}_2\text{RhBr}_5$** Difficultly sol in  $\text{H}_2\text{O}$  (Gutbier, *l c*)**Potassium bromorhodite,  $\text{K}_2\text{RhBr}_5$** Very sol in  $\text{H}_2\text{O}$  (Goloubkine, *l c*)Sol in  $\text{H}_2\text{O}$  (Gutbier, *l c*)**Rubidium bromorhodite,  $\text{Rb}_2\text{RhBr}_5$** Sol in  $\text{H}_2\text{O}$  (Goloubkine, *l c*)Difficultly sol in  $\text{H}_2\text{O}$  (Gutbier, *l c*)**Sodium bromorhodite,  $\text{Na}_2\text{RhBr}_5$** Very sol in  $\text{H}_2\text{O}$  (Goloubkine, *l c*)**Bromoruthenic acid****Potassium bromoruthenate,  $\text{K}_2\text{RuBr}_6$** Very sol in  $\text{H}_2\text{O}$  (Howe, *J Am Cl m Soc* 1904, **26** 946)**Potassium aquobromoruthenate,**Ppt (Howe, *l c*)**Rubidium bromoruthenate,  $\text{Rb}_2\text{RuBr}_6$** Sol in  $\text{H}_2\text{O}$  (Howe, *l c*)**Rubidium aquobromoruthenate,**Ppt (Howe, *l c*)**Bromoruthenious acid****Cæsium bromoruthenite,  $\text{Cs}_2\text{RuBr}_6 + \text{H}_2\text{O}$** Ppt (Howe, *J Am Chem Soc* 1904, **26** 945)**Potassium bromoruthenite,  $\text{K}_2\text{RuBr}_6$** Very sol in  $\text{H}_2\text{O}$  with decomp Very sol in dil  $\text{HBr}$  (Howe, *l c*)**Rubidium bromoruthenite,  $\text{Rb}_2\text{RuBr}_6 + \text{H}_2\text{O}$** Sol in dil  $\text{HBr}$  (Howe, *l c*)**Bromoselenic acid****Ammonium bromoselenate,  $(\text{NH}_4)_2\text{SeBr}_4$** Sol in  $\text{H}_2\text{O}$  with decomp (Muthmann and Schuler, *B* **26** 1008)**Cæsium bromoselenate,  $\text{Cs}_2\text{SeBr}_4$** Sl sol in  $\text{H}_2\text{O}$  (Fischer, *J Am Chem Soc* 1898, **20** 571)**Potassium bromoselenate,  $\text{K}_2\text{SeBr}_4$** As  $\text{NH}_4$  salt (M and S)

**Rubidium bromoselenate,  $\text{Rb}_2\text{SeBr}_6$** Less sol in  $\text{H}_2\text{O}$  than K salt (Lenher, *l c*)**Bromopyroselenious acid****Ammonium bromopyroselenite,  $\text{NH}_4\text{Br}, 2\text{SeO}_2 + 2\text{H}_2\text{O}$** More easily sol in  $\text{H}_2\text{O}$  than corresponding Cl compound (Muthmann and Schafer, B 1893, 26 1014)**Potassium bromopyroselenite,  $\text{KBr}, 2\text{SeO}_2 + 2\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  (Muthmann and Schafer, B 26 1008)**Bromosmic acid****Ammonium bromosmate,  $(\text{NH}_4)_2\text{OsBr}_6$** Only sl sol in  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1899, 21 135)**Cæsium bromosmate,  $\text{Cs}_2\text{OsBr}_6$** Nearly insol in  $\text{H}_2\text{O}$  and dil HBr (Gutbier, B 1913, 46 2103)**Potassium bromosmate,  $\text{K}_2\text{OsBr}_6$** Only sl sol in  $\text{H}_2\text{O}$  (Rosenheim, *l c*)**Rubidium bromosmate,  $\text{Rb}_2\text{OsBr}_6$** Difficultly sol in  $\text{H}_2\text{O}$  and in dil HBr (Gutbier, *l c*)**Silver bromosmate,  $\text{Ag}_2\text{OsBr}_6$** Ppt insol in  $\text{H}_2\text{O}$  (Rosenheim, *l c*)**Sodium bromosmate,  $\text{Na}_2\text{OsBr}_6 + 4\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  (Rosenheim, *l c*)**Bromostannic acid,  $\text{H}_2\text{SnBr}_6 + 8\text{H}_2\text{O}$** Very deliquescent Sol in  $\text{H}_2\text{O}$  (Seubert, B 20 794)**Ammonium bromostannate,  $(\text{NH}_4)_2\text{SnBr}_6$** Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Raymann and Preis, A 223 323)**Cæsium bromostannate**Sol in  $\text{H}_2\text{O}$  (Raymann and Preis)**Calcium bromostannate,  $\text{CaSnBr}_6 + 6\text{H}_2\text{O}$** Very deliquescent Sol in  $\text{H}_2\text{O}$  (Raymann and Preis)**Cobalt bromostannate,  $\text{CoSnBr}_6 + 10\text{H}_2\text{O}$** 

Deliquescent (Raymann and Preis)

**Ferrous bromostannate,  $\text{FeSnBr}_6 + 6\text{H}_2\text{O}$** 

Deliquescent (Raymann and Preis)

**Lithium bromostannate,  $\text{Li}_2\text{SnBr}_6 + 6\text{H}_2\text{O}$** 

Extremely deliquescent (Lewin, C R 113 541)

**Magnesium bromostannate,  $\text{MgSnBr}_6 + 10\text{H}_2\text{O}$** 

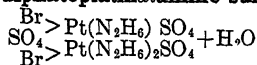
Deliquescent (Raymann and Preis)

**Manganous bromostannate,  $\text{MnSnBr}_6 + 6\text{H}_2\text{O}$** 

Deliquescent (Raymann and Preis)

**Nickel bromostannate,  $\text{NiSnBr}_6 + 8\text{H}_2\text{O}$** 

Deliquescent (Raymann and Preis)

**Potassium bromostannate,  $\text{K}_2\text{SnBr}_6$** Sol in  $\text{H}_2\text{O}$  (Topsoe)**Rubidium bromostannate**Sol in  $\text{H}_2\text{O}$  (Raymann and Preis)**Sodium bromostannate,  $\text{Na}_2\text{SnBr}_6 + 6\text{H}_2\text{O}$** Not deliquescent, but extremely sol in  $\text{H}_2\text{O}$  (Seubert, B 20 796)**Strontium bromostannate,  $\text{SrSnBr}_6 + 6\text{H}_2\text{O}$** Very hygroscopic, and sol in  $\text{H}_2\text{O}$  (Raymann and Preis)**Bromosulphatoplutindiamine sulphate,**Rather easily sol in hot  $\text{H}_2\text{O}$ **Bromosulphobismuthous acid****Cuprous bromosulphobismuthite,  $2\text{Cu}_3\text{S}, \text{Bi}_2\text{S}_3, 2\text{BiSBr}$** Stable in the air and insol in  $\text{H}_2\text{O}$  at ord temp Partially decomp by boiling  $\text{H}_2\text{O}$  Decomp by mineral acids with the evolution of  $\text{H}_2\text{S}$  (Ducatte, C R 1902, 134 1212)**Lead bromosulphobismuthite,  $\text{PbS}, \text{Bi}_2\text{S}_3, 2\text{BiSBr}$** Insol in  $\text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}$  Decomp by dil mineral acids with evolution of  $\text{H}_2\text{S}$  (Ducatte, *l c*)**Bromotantalum bromide,  $(\text{Ta}_6\text{B}_{11})\text{Br} + 7\text{H}_2\text{O}$** Stable in the air when in the solid state Sol in  $\text{H}_2\text{O}$  without decomp Sol in propyl alcohol (Chapin, J Am Chem Soc 1910, 32 328)**Bromotantalum chloride,  $(\text{Ta}_6\text{B}_{12})\text{Cl} + 7\text{H}_2\text{O}$** (Chapin, *l c*)**Bromotantalum hydroxide,  $(\text{Ta}_6\text{B}_{11})(\text{OH})_2 + 10\text{H}_2\text{O}$** Sl sol in  $\text{HCl}$  Stable in the air below  $100^\circ$  Sol in alcohol Insol in ether (Chapin, *l c*)**Bromotantalum iodide,  $(\text{Ta}_6\text{B}_{11})\text{I} + 7\text{H}_2\text{O}$** (Chapin, *l c*)**Bromotelluric acid****Ammonium bromotellurate,  $(\text{NH}_4)_2\text{TeBr}_6$** Less sol in  $\text{H}_2\text{O}$  than K salt (Muthmann and Schmidt, B 1893, 26 1011)

**Cæsium bromotellurate, Cs<sub>2</sub>TeBr<sub>6</sub>**

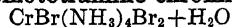
Decomp by H<sub>2</sub>O  
 100 pts HBr+Aq (sp gr 1.49) dissolve  
 0.02 pt at 22°  
 100 pts HBr+Aq (sp gr 1.08) dissolve  
 0.13 pt at 22°  
 Insol in alcohol (Wheeler, Sill Am J 145 267)

**Potassium bromotellurate, K<sub>2</sub>TeBr<sub>6</sub>+3H<sub>2</sub>O**

Sol in little, decomp by much H<sub>2</sub>O (v Hauer)  
 Contains 2H<sub>2</sub>O (Wheeler, Sill Am J 145 267)  
 Efflorescent  
 100 pts HBr+Aq (sp gr 1.49) dissolve  
 6.57 pts at 22°  
 100 pts HBr+Aq (sp gr 1.08) dissolve  
 62.90 pts at 22°  
*Anhydrous* Stable on air (Wheeler)

**Rubidium bromotellurate, Rb<sub>2</sub>TeBr<sub>6</sub>**

Sol in a little hot H<sub>2</sub>O, but H<sub>2</sub>TeO<sub>3</sub> separates on cooling  
 100 pts HBr+Aq (sp gr 1.49) dissolve  
 0.25 pt at 22°  
 100 pts HBr+Aq (sp gr 1.08) dissolve  
 3.88 pts at 22° (Wheeler)

**Bromotetramine chromium bromide,**

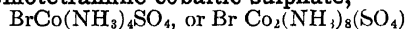
Easily sol in H<sub>2</sub>O (Cleve)

**— chloride, CrBr(NH<sub>3</sub>)<sub>4</sub>Cl + H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Cleve)

**— sulphate, CrBr(NH<sub>3</sub>)<sub>4</sub>SO<sub>4</sub> + H<sub>2</sub>O**

Easily sol in H<sub>2</sub>O (Cleve)

**Bromotetramine cobaltic sulphate,**

Sol in H<sub>2</sub>O (Vortmann and Blasberg, B 22 2652)

**Cadmium, Cd**

Not attacked by H<sub>2</sub>O Sol in HCl, or dil H<sub>2</sub>SO<sub>4</sub>+Aq, but more easily in HNO<sub>3</sub>+Aq Sol in HC<sub>2</sub>H<sub>3</sub>O+Aq

Chemically pure Cd like Zn is almost insol in dil acids, with the exception of HNO<sub>3</sub> (Weeren, B 1891, 24 1798)

Sol in HClO<sub>4</sub>+Aq without evolution of H<sub>2</sub> (Hendrixson, J Am Chem Soc 1904, 26 756)

Cadmium is sol in molten CdCl<sub>2</sub> and can be recryst therefrom (Auerbach, Z anorg 1901, 28 42)

From 4 g Cd in 32 g molten CdCl<sub>2</sub> at 650° 2.197 g were dissolved in ½ li (Helfenstein, Z anorg 1900, 23 295)

Moderately quickly sol in K<sub>2</sub>S<sub>2</sub>O<sub>8</sub>+Aq More slowly sol in (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub>+Aq (Icvi, Gazz ch it 1908, 38 (1) 583)

Sol in (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub>+Aq without evolution of gas (Turrentine, J phys Chem 1907, 11 627)

Sol in sulphostannates+Aq (Storch, 1883, 16 2015)

½ ccm oleic acid dissolves 0.0293 g Cd in 6 days (Gates, J phys Chem 1911, 15 14)

Not attacked by sugar solution (König and Berg, C R 102 1170)

**Cadmium amalgam, Cd<sub>2</sub>Hg,**

Stable from 0°-44° Can be cryst from Hg without decomp if temp does not exceed 44° (Kerp Z anorg 1900, 25 68)

**Cadmium amide, Cd(NH<sub>2</sub>)<sub>2</sub>**

Decomp by H<sub>2</sub>O (Bohart, J phys Chem 1915, 19 543)

**Cadmium arsenide, Cd<sub>3</sub>As**

(Descamps, C R 86 1022)

Cd<sub>3</sub>As<sub>2</sub> Sol in dil cold HNO<sub>3</sub> Attacked by aqua regia (Granger, C R 1904, 8 575)

**Cadmium azoimide, Cd(N<sub>3</sub>)<sub>2</sub>**

Ppt (Curtius, J pr 1898, (2) 58 294)

**Cadmium subbromide, Cd<sub>4</sub>Br<sub>7</sub>**

Decomp by H<sub>2</sub>O (Morse and Jones, J Ch J 1890, 12 490)

**Cadmium bromide, CdBr<sub>2</sub>**

Deliquescent Very sol in H<sub>2</sub>O

Solubility in H<sub>2</sub>O at t°

t°	% CdBr	t	% CdBr
-4	32.0	48	60
-1	34.7	71	61
+1	36.3	104	61
2	36.0	155	63
9	41.9	170	65
14	46.0	215	69
25	52.6	232	70
35	59.6	245	71

Solid phase above 100° is CdBr<sub>2</sub> + 1½ H<sub>2</sub>O (Fittid, Ch 1894 (7) 2 541)

See also under CdBr<sub>2</sub>+H<sub>2</sub>O and CdBr<sub>2</sub>+4H<sub>2</sub>O

Sp gr of CdBr<sub>2</sub>+Aq at 19.5° containing  
 5 10 15 20 25 % CdBr<sub>2</sub>  
 1.043 1.090 1.141 1.199 1.260  
 30 35 40 45 50 % CdBr<sub>2</sub>  
 1.326 1.400 1.481 1.578 1.680  
 (Kremers calculated by Gerlach Z anorg 8 280)

CdBr<sub>2</sub>+Aq containing 18.06% CdBr<sub>2</sub> is sp gr 20°/20°=1.1378

CdBr<sub>2</sub>+Aq containing 21.39% CdBr<sub>2</sub> is sp gr 20°/20°=1.1666

(F. Blanc and Rohlund, Z phys Chem 96, 19 252)

Sp gr of CdBr<sub>2</sub>+Aq containing 35.47% CdBr<sub>2</sub>=1.4231 at 19.4°/4° (Hüllrich W Ann 159, 68 27)

Sp gr of  $\text{CdBr}_2 + \text{Aq}$  at  $18^\circ/4^\circ$

% $\text{CdBr}_2$	33 289	23 973	20 552	11 983
Sp gr	1 384	1 252	1 209	1 112
% $\text{CdBr}_2$	6 543	3 734	1 927	
Sp gr	1 106	1 030	1 017	

(de Muynck, W Ann 1894, 53 561)

Sp gr of  $\text{CdBr}_2 + \text{Aq}$  at  $18^\circ$

% $\text{CdBr}_2$	1	5	10	15	20
Sp gr	1 0072	1 0431	1 0907	1 1432	1 1991
% $\text{CdBr}_2$	25	30	35	40	43
Sp gr	1 2605	1 3296	1 4052	1 4915	1 5467

(Grottrian, W Ann 1883, 18 193)

Sp gr of  $\text{CdBr}_2 + \text{Aq}$

% $\text{CdBr}_2$	$t^\circ$	Sp gr at $t^\circ$	Sp gr at $18^\circ$
0 0324	17 90	0 99901	0 99900
	22 75	0 99702	
0 0748	17 23	0 99949	0 99935
	21 50	0 99863	
0 154	17 67	1 00008	1 00002
	23 10	0 99896	
0 253	17 23	1 00119	0 00100
	22 95	0 99986	
0 506	18 07	0 00308	1 00310
	22 65	1 00212	
1 013	18 00		1 00750

(Wershofen, Z phys Ch 1890, 5 493)

Sp gr of  $\text{CdBr}_2 + \text{Aq}$  at  $20^\circ$

Normality of $\text{CdBr}_2 + \text{Aq}$	% $\text{CdBr}$	Sp gr
2 774	46 574	1 6198
1 997	37 53	1 4469
0 973	22 53	1 2293
0 5138	12 46	1 1211

(Forchheimer, Z phys Ch 1900, 34 29)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

Sol in  $\text{AlBr}_3$  (Isbekow, Z anorg 1913, 84, 27)

Sol in  $\text{HCl} + \text{Aq}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , alcohol, or ether (Berthelot, A ch 44 387)

Sol in 0.94 pt  $\text{H}_2\text{O}$ , 3.4 pts abs alcohol, 250 pts ether, and 16 pts alcohol-ether (1:1) (Eder, Dingl 221 89)

An  $\text{CdBr}_2$  is sol in acetone (Krug and M Frooy)

1 g  $\text{CdBr}_2$  is sol in 64.5 g acetone at  $18^\circ$  Sp gr of sat solution  $18^\circ/4^\circ = 0.8073$  (Naumann, B 1904, 37 4337)

Sol in acetone (Fidmann, C C 1899, II 1014)

Insol in mustard oil (Mathews, J phys Chem 1905, 9, 647)

Difficultly sol in methyl acetate (Naumann, B 1909, 42, 3790)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Sol in chinoline (Beckmann and Gabel, Z anorg 1906, 51 236)

100 g benzonitrile dissolve 0.857 g  $\text{CdBr}_2$  at  $18^\circ$  (Naumann, B 1914, 47 1370)

Mol weight determined in piperidine (Ferschland, Z anorg 1897, 15, 17)

+  $\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at  
 $35^\circ$   $40^\circ$   $45^\circ$   $60^\circ$   $80^\circ$   $100^\circ$   
 60.29 60.65 60.75 61.10 61.29 61.63 g  $\text{CdBr}_2$   
 (Dietz, Z anorg 1899, 20 261)

+  $1\frac{1}{2}\text{H}_2\text{O}$  (Étard, A ch 1894, (7) 2 541)

+  $4\text{H}_2\text{O}$  Efflorescent (Rammelsberg, Pogg 55 241)

Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at  
 $0^\circ$   $18^\circ$   $30^\circ$   $38^\circ$   
 37.92 48.90 56.90 61.84 g  $\text{CdBr}_2$   
 Sp gr of sat solution at  $18^\circ = 1.683$   
 (Dietz, Z anorg 1899, 20 261)

100 g sat solution of  $\text{CdBr}_2 + 4\text{H}_2\text{O}$  in absolute alcohol contain 20.93 g  $\text{CdBr}_2$  at  $15^\circ$

100 g sat solution of  $\text{CdBr}_2 + 4\text{H}_2\text{O}$  in absolute ether contain 0.4 g  $\text{CdBr}_2$  at  $15^\circ$  (Eder, Dingl 221 89)

### Cadmium hydrogen bromide

Decomp by  $\text{H}_2\text{O}$  (Berthelot, C R 91 1024)

### Cadmium caesium bromide, $\text{CdBr}_2, \text{CsBr}$

Easily sol in  $\text{H}_2\text{O}$  (Wells and Walden, Z anorg 5 270)

$\text{CdBr}_2, 2\text{CsBr}$  Decomp by  $\text{H}_2\text{O}$  into above comp (W and W)

$\text{CdBr}_2, 3\text{CsBr}$  Decomp by  $\text{H}_2\text{O}$  into  $\text{CdBr}_2, \text{CsBr}$  (W and W)

### Cadmium potassium bromide, $\text{CdBr}_2, \text{KBr} + \frac{1}{2}\text{H}_2\text{O}$

Sol in 0.79 pt  $\text{H}_2\text{O}$  at  $15^\circ$ , pptd by alcohol and ether (Eder, Dingl 221 89)

+  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  without decomp from  $0.4^\circ - 112.5^\circ$  (Rimbach, B 1905, 38, 1554)

100 pts of the solution contain at  
 $0.4^\circ$   $15.8^\circ$   $50^\circ$   $112.5^\circ$   
 53.75 58.68 68.25 78.10 pts of the salt

$\text{CdBr}_2, 4\text{KBr}$  Sol in 1.40 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , pptd by alcohol and ether (Eder, Dingl 221 89)

Cannot be prepared in a pure state as it is decomp by  $\text{H}_2\text{O}$  below  $160^\circ$  (Rimbach, B 1905, 38 1560)

### Cadmium rubidium bromide, $\text{CdBr}_2, \text{RbBr}$

Sol in  $\text{H}_2\text{O}$  without decomp from  $0.4^\circ$  to  $107.5^\circ$

100 pts of the solution contain at  
 $0.4^\circ$   $14.5^\circ$   $49.2^\circ$   $107.5^\circ$   
 32.65 41.87 58.54 75.77 pts of the salt  
 (Rimbach, B 1905, 38 1556)

$\text{CdBr}_2, 4\text{RbBr}$  Sol in  $\text{H}_2\text{O}$  without decomp from  $0.5^\circ$  to  $114.5^\circ$

100 pts of the solution contain at  
 $0.5^\circ$   $13.5^\circ$   $51.5^\circ$   $114.5^\circ$   
 47.95 55.17 68.82 79.04 pts of the salt  
 (Rimbach, B 1905, 38 1561)

**Cadmium sodium bromide**,  $\text{CdBr}_2$ ,  $\text{NaBr} + 2\frac{1}{2}\text{H}_2\text{O}$

Sol at  $15^\circ$  in 104 pts  $\text{H}_2\text{O}$ , 37 pts abs alcohol, and 190 pts ether (sp gr 0.729) (Eder, Dingl **221** 89)

$3\text{CdBr}_2$ ,  $2\text{NaBr} + 6\text{H}_2\text{O}$  Stable in conc solutions and decomp only by great dilution (Jones and Knight, Am Ch J 1899, **22** 134)

**Cadmium bromide ammonia**,  $\text{CdBr}_2 \cdot 2\text{NH}_3$

Can be crystallized out of warm  $\text{NH}_4\text{OH} + \text{Aq}$  (Croft, Phil Mag **21** 356)

$\text{CdBr}_2$ ,  $3\text{NH}_3$  (Tassily, C R 1897, **124** 1022)

$\text{CdBr}_2$ ,  $4\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$  (Croft)

**Cadmium bromide cupric oxide**,  $\text{CdBr}_2$ ,  $3\text{CuO} + 3\text{H}_2\text{O}$  (Mailhe, A ch 1902, (7) 27 383)

**Cadmium bromide hydrazine**,  $\text{CdBr}_2$ ,  $2\text{N}_2\text{H}_4$

Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Franzen, Z anorg 1908, **60** 280)

**Cadmium bromide hydroxylamine**,  $\text{CdBr}_2$ ,  $2\text{NH}_2\text{OH}$

Sol in hot  $\text{H}_2\text{O}$  with formation of a basic salt Sol in dil acids Insol in alcohol and ether (Adams, Am Ch J 1902, **28** 218)

**Cadmium subchloride**,  $\text{Cd}_4\text{Cl}_7$

Decomp by  $\text{H}_2\text{O}$  and by acids (Morse and Jones, Am Ch J 1890, **12** 490)

**Cadmium chloride**,  $\text{CdCl}_2$

Sol at  $20^\circ$   $40^\circ$   $60^\circ$   $80^\circ$   $100^\circ$   
in 0.71 0.72 0.72 0.70 0.67 pts  $\text{H}_2\text{O}$   
(Kremers Pogg **103** 57)

Sat  $\text{CdCl}_2 + \text{Aq}$  contains %  $\text{CdCl}_2$  at  $t^\circ$

$t^\circ$	% $\text{CdCl}_2$	$t^\circ$	% $\text{CdCl}_2$
-7	43.5	120	63.0
+1	47.6	150	64.8
6	49.7	165	68.2
7	51.3	170	68.4
10	51.6	180	70.1
19	52.7	190	71.9
25	52.9	200	72.0
61	57.9	235	76.0
82	58.8	270	77.7

(Étard, A ch 1894, (7) **2** 536)

100 mol  $\text{H}_2\text{O}$  dissolve at

$19.3^\circ$   $29.7^\circ$   $40.1^\circ$   $54.5^\circ$

10.94 12.74 13.15 13.16 mol  $\text{CdCl}_2$

(Sudhaus, Miner Jahrb Ber-Bd 1914, **37** 19)

See also under  $\text{CdCl} + \text{H}_2\text{O}$ ,  $\text{CdCl} + 2\frac{1}{2}\text{H}_2\text{O}$ , and  $\text{CdCl} + 4\text{H}_2\text{O}$

Sp gr of  $\text{CdCl}_2 + \text{Aq}$  containing pts  $\text{CdCl}_2$  to 100 pts  $\text{H}_2\text{O}$

13 26.9 41 pts  $\text{CdCl}_2$ ,

1.1068 1.2106 1.3100

55.8 72.5 114.2 pts  $\text{CdCl}_2$

1.4060 1.5060 1.7266

(Kremers, Pogg **103** 57)

$\text{CdCl}_2 + \text{Aq}$  containing 8.91%  $\text{CdCl}_2$  as  
sp gr  $20^\circ/20^\circ = 1.0715$  (Le Blanc  
Rohland, Z phys Ch 1896, **19** 282)

Sp gr of  $\text{CdCl}_2 + \text{Aq}$  at room temp containing

%  $\text{CdCl}_2$  11.09 16.30 24.786

Sp gr 1.1093 1.1813 1.3199

(Wagner, W Ann 1883, **18** 266)

Sp gr of  $\text{CdCl}_2 + \text{Aq}$  at  $18^\circ/4^\circ$

%  $\text{CdCl}_2$  57.524 41.547 29.977

Sp gr 1.852 1.515 1.330

%  $\text{CdCl}_2$  21.431 14.761

Sp gr 1.210 1.142

(de Mynck, W Ann 1894, **53** 561)

Sp gr of  $\text{CdCl}_2 + \text{Aq}$  at  $18^\circ$

%  $\text{CdCl}_2$  1 5 10 5

Sp gr 1.0063 1.0436 1.0919 1.443

%  $\text{CdCl}_2$  20 25 30 5

Sp gr 1.2007 1.2620 1.3305 1.075

%  $\text{CdCl}_2$  40 45 50

Sp gr 1.4878 1.5775 1.6799

(Grotrian, W Ann 1883, **18** 193)

Sp gr of  $\text{CdCl}_2 + \text{Aq}$  at  $25^\circ$

Concentration of  $\text{CdCl}_2 + \text{Aq}$  Sp gr

1-normal 1.077

$\frac{1}{2}$ - " 1.039

$\frac{1}{4}$ - " 1.019

$\frac{1}{8}$ - " 1.009

(Wagner, Z phys Ch 1890, **5** 36)

Sp gr of  $\text{CdCl} + \text{Aq}$

% $\text{CdCl}$	$t^\circ$	Sp gr at $t$	Sp gr at $15^\circ$
0.0503	17.59	0.99920	0.3910
	24.27	0.99781	
0.0999	17.70	0.99964	0.9955
	22.06	0.99533	
0.200	15.31	1.00038	1.0044
	24.00	0.99920	
0.399	16.86	1.00239	1.022
	24.21	1.00083	
0.599	17.49	1.00406	1.039
	25.12	1.00238	
0.769	17.58	1.00500	1.057
	21.76	1.00496	
0.997	17.55	1.00754	1.075
	19.65	1.00713	

(Weishofen, Z phys Ch 1890, **5** 4)

Sp gr of  $\text{CdCl} + \text{Aq}$  at  $t$

$t$	Specific gravity of $\text{CdCl} + \text{Aq}$	% $\text{CdCl}$ in solution	$\frac{K}{4}$
20.5	3.80	44.42	5645
"	2.61	34.22	3941
"	1.76	25.90	2435
"	1.29	19.91	1977
"	0.93	14.88	1404
"	0.52	8.84	0801

(Oppenheimer, Z phys Ch 1898, **27** 454)

Sp gr of  $\text{CdCl}_2 + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	Concentration of $\text{CdCl}_2 + \text{Aq}$	Sp gr
22	1 pt $\text{CdCl}_2$ in 1 3458 pts $\text{H}_2\text{O}$	1 6128
18 7	1 " " " 2 7005 " "	1 2896
17 2	1 " " " 53 988 " "	1 0155
16	1 " " " 54 18 " "	1 0152
17	1 " " " 57 479 " "	1 0136
22	1 " " " 77 232 " "	1 0076

(Hittorf, Z phys Ch 1902, 39 628)

Solubility in  $\text{KCl} + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	100 g $\text{H}_2\text{O}$ dissolve		Solid phase
	g $\text{CdCl}_2$	g $\text{KCl}$	
19 3	111 30		$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$
	59 59	6 70	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} + \text{CdCl}_2$ $\text{KCl} + \text{H}_2\text{O}$
	26 98	11 09	$\text{CdCl}_2 \text{ KCl} + \text{H}_2\text{O}$
	11 61	30 04	$\text{CdCl}_2 \text{ KCl} + \text{H}_2\text{O} + \text{CdCl}_2$ 4KCl
29 7	1 44	34 76	$\text{CdCl}_2$ 4KCl + KCl
		33 94	KCl
	129 65		$\text{CdCl}_2 + 3\frac{1}{2}\text{H}_2\text{O}$
	97 62	0 70	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$
40 1	65 23	7 08	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} + \text{CdCl}_2$ $\text{KCl} + \text{H}_2\text{O}$
	47 12	9 89	$\text{CdCl}_2 \text{ KCl} + \text{H}_2\text{O}$
	32 67	13 06	
	24 26	16 10	
54 5	15 99	25 97	
	15 47	33 58	$\text{CdCl}_2 \text{ KCl} + \text{H}_2\text{O} + \text{CdCl}_2$ 4KCl
	2 42	37 66	$\text{CdCl}_2$ 4KCl + KCl
		37 21	KCl
40 1	155 85		$\text{CdCl}_2 + \text{H}_2\text{O}$
	92 15	2 70	$\text{CdCl}_2 + \text{H}_2\text{O} + \text{CdCl}_2$ $\text{KCl} + \text{H}_2\text{O}$
	51 90	11 50	$\text{CdCl}_2 \text{ KCl} + \text{H}_2\text{O}$
	37 91	15 21	
54 5	24 15	21 73	
	18 97	35 51	
	19 92	37 66	$\text{CdCl}_2 \text{ KCl} + \text{H}_2\text{O} + \text{CdCl}_2$ 4KCl
	2 98	40 15	$\text{CdCl}_2$ 4KCl + KCl
54 5		40 36	KCl
	135 90		$\text{CdCl}_2 + \text{H}_2\text{O}$
	102 15	2 70	$\text{CdCl}_2 + \text{H}_2\text{O} + \text{CdCl}_2$ $\text{KCl} + \text{H}_2\text{O}$
	44 01	18 39	$\text{CdCl}_2 \text{ KCl} + \text{H}_2\text{O}$
54 5	26 13	43 78	$\text{CdCl}_2 \text{ KCl} + \text{H}_2\text{O} + \text{CdCl}_2$ 4KCl
	4 20	45 52	$\text{CdCl}_2$ 4KCl + KCl
		43 00	KCl

(Sudhaus, Minet J. J. Ber. Bd 1914, 37 34)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	100 g $\text{H}_2\text{O}$ dissolve		Solid phase
	g $\text{CdCl}_2$	g $\text{NaCl}$	
19 3	111 30		$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$
	116 64	7 52	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} + \text{CdCl}_2$ $2\text{NaCl} + 3\text{H}_2\text{O}$
	85 15	12 19	$\text{CdCl}_2$ 2NaCl + 3H <sub>2</sub> O
	40 01	25 67	
29 7	5 96	36 76	$\text{CdCl}_2$ 2NaCl + 3H <sub>2</sub> O + NaCl
		35 84	NaCl
	129 65		$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$
	132 67	9 63	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} + \text{CdCl}_2$ $2\text{NaCl} + 3\text{H}_2\text{O}$
40 1	123 54	10 10	$\text{CdCl}_2$ 2NaCl + 3H <sub>2</sub> O
	106 16	12 92	
	91 10	15 41	
	43 74	27 46	
54 5	9 43	37 54	$\text{CdCl}_2$ 2NaCl + 3H <sub>2</sub> O + NaCl
		35 88	NaCl
	133 85		$\text{CdCl}_2 + \text{H}_2\text{O}$
	137 03	15 14	$\text{CdCl}_2 + \text{H}_2\text{O} + \text{CdCl}_2$ $2\text{NaCl} + 3\text{H}_2\text{O}$
54 5	48 17	29 50	$\text{CdCl}_2$ 2NaCl + 3H <sub>2</sub> O
	13 31	38 16	$\text{CdCl}_2$ 2NaCl + 3H <sub>2</sub> O + NaCl
		36 18	NaCl
	133 90		$\text{CdCl}_2 + \text{H}_2\text{O}$
54 5	140 42	19 10	$\text{CdCl}_2 + \text{H}_2\text{O} + \text{CdCl}_2$ $2\text{NaCl} + 3\text{H}_2\text{O}$
	52 76	32 97	$\text{CdCl}_2$ 2NaCl + 3H <sub>2</sub> O
	22 53	39 07	$\text{CdCl}_2$ 2NaCl + 3H <sub>2</sub> O + NaCl
		36 82	NaCl

At 34 5°,  $\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} \rightarrow \text{CdCl}_2 + \text{H}_2\text{O}$  and  
(Sudhaus, Minet J. J. Ber. Bd 1914, 37 28)Insol in  $\text{SbCl}_3$  (Klemensiewicz, C. A. 1909, 269)Insol in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20 827)

Insol in abs. sol. in ethyl alcohol, furfural, acetophenone, ethyl monochloracetate, ethyl cyanacetate, ethyl oxalate, ethyl nitrate, amyl nitrate, o-nitrotoluene, p-nitrobenzidine, and quinoline. Sol. in absolute hydride (Lincoln, J. phys. Chem. 1899, 3 461)

Insol in anhydrous ether (Hump, Ch. Z. 1887, II, 547)

Readily sol. in alcohol

100 pts absolute methyl alcohol dissolve

1 71 pts  $\text{CdCl}_2$  at 15 5°100 pts absolute ethyl alcohol dissolve 1 52 pts  $\text{CdCl}_2$  at 15 5° (de Bruyn, Z. phys. Chem. 10 783)100 g  $\text{CdCl}_2 + \text{CH}_3\text{OH}$  contain 1 5 g  $\text{CdCl}_2$

at the critical temp (Centnerszwer, Z phys Ch 1910, **72** 437)

Somewhat sol in acetone (Krug and M'Elroy)

Sol in acetone, insol in methylal (Eidmann, C C **1899**, II, 1014)

Insol in methyl acetate (Naumann, B 1909, **42** 3790)

Sol in ethyl acetate (Naumann, B 1904, **37** 3601)

Difficultly sol in ethylacetate (Naumann, B 1910, **43** 314)

Sol in urethane (Castoro, Z anorg 1899, **20** 61)

At 18°, 100 g benzonitrile dissolve 0.06332 g CdCl<sub>2</sub> (Naumann, B 1914, **47**, 1370)

Insol in toluene (Baxter and Hines, Am Ch J 1904, **31** 222)

Sol in chinolin (Beckmann and Gabel, Z anorg 1906, **51** 236)

+H<sub>2</sub>O Solubility in H<sub>2</sub>O

100 g of the sat solution contain at

10° 20° 40° 60°

57.47 57.35 57.51 57.77

80° 100°

58.41 59.52 g CdCl<sub>2</sub>

110° is bpt of the sat solution

(Dietz, Z anorg 1899, **20** 257)

+2½H<sub>2</sub>O Solubility in H<sub>2</sub>O

100 g of the sat solution contain at

-10° 0° 18° 30° 36°

44.35 47.37 52.53 56.27 57.91 g CdCl<sub>2</sub>

Sp gr of sat solution = 1.741

(Dietz, Z anorg 1899, **20** 257)

+4H<sub>2</sub>O Solubility in H<sub>2</sub>O

100 g of the sat solution contain at

-9° 0° +10° +15°

43.58 49.39 55.58 59.12 g CdCl

(Dietz, Z anorg 1899 **20** 257)

+5H<sub>2</sub>O (Worobieff, Z anorg 1898, **18** 386)

**Cadmium hydrogen chloride**, CdCl<sub>2</sub>, 2HCl+7H<sub>2</sub>O

Decomp in air (Berthelot, C R **91** 1024)

**Cadmium caesium chloride**, CdCl<sub>2</sub>, 2CsCl

Easily sol in H<sub>2</sub>O and dil HCl+Ag, insol in conc HCl+Ag (Godeffroy, B **8** 9)

Nearly insol in CsCl+Ag (Wells and Walden, Z anorg **5** 286)

CdCl, CsCl Sl sol in H<sub>2</sub>O, nearly insol in CdCl<sub>2</sub>+Ag (Wells and Walden)

**Cadmium calcium chloride**, 2CdCl, CaCl<sub>2</sub>+7H<sub>2</sub>O

Rather deliquescent, and very sol in H<sub>2</sub>O. When ignited is only sl sol in H<sub>2</sub>O with evolution of heat (v Hauer, J pr **63** 432)

CdCl<sub>2</sub>, 2CaCl<sub>2</sub>+12H<sub>2</sub>O Very deliquescent (v Hauer)

**Cadmium cobaltous chloride**, 2CdCl<sub>2</sub>, CoCl+12H<sub>2</sub>O

Deliquescent Sol in H<sub>2</sub>O (v Hauer, W A B **17** 331)

**Cadmium cupric chloride**, CdCl, CuCl+4H<sub>2</sub>O

Sol in H<sub>2</sub>O (v Hauer, W A B **17** 331)

**Cadmium hydrazine chloride**, CdCl<sub>2</sub>, N<sub>2</sub>H<sub>4</sub>HCl

Unstable in the air when moist Very so in H<sub>2</sub>O, sl sol in alcohol, sol in NH<sub>3</sub>+Ac (Curtius, J pr 1894, (2) **50** 334)

CdCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>HCl+4H<sub>2</sub>O Very sol in H<sub>2</sub>O, sl sol in alcohol (Curtius, J pr 189 (2) **50** 335)

**Cadmium iron (ferrous) chloride**, 2CdCl FeCl<sub>2</sub>+12H<sub>2</sub>O

Sol in H<sub>2</sub>O (v Hauer, W A B **17** 331)

**Cadmium lithium chloride**, CdCl, LiCl-3½H<sub>2</sub>O

Very deliquescent Decomp by solution in H<sub>2</sub>O, but not in alcohol (Chassevant, ch (6) **30** 39)

**Cadmium magnesium chloride**, 2CdCl, MgCl<sub>2</sub>+12H<sub>2</sub>O

Deliquescent in moist, stable in dry air. Easily sol in H<sub>2</sub>O with absorption of heat. Much more sol in hot than in cold H<sub>2</sub>O (Hauer)

Solubility in H<sub>2</sub>O at t°

t	G. CdMgCl in 100 g solution	G. Cd MgCl in 100 g H <sub>2</sub> O
24	45.61	53.86
26.5	49.69	98.77
45.5	53.51	115.10
67.2	58.14	138.90
121.8	65.48	189.69

(Rumbach, B 1897, **30** 3684)

CdCl, 2MgCl+12H<sub>2</sub>O Very deliquescent (v Hauer)

**Cadmium manganese chloride**, 2CdCl, MnCl<sub>2</sub>+12H<sub>2</sub>O

Deliquescent in moist, efflorescent in air Sol in H<sub>2</sub>O (v Hauer)

**Cadmium nickel chloride**, CdCl, 2NiCl, 12H<sub>2</sub>O

Sol in H<sub>2</sub>O (v Hauer, W A B **20** 411)  
2CdCl<sub>2</sub>, NiCl+12H<sub>2</sub>O Sol in H<sub>2</sub>O (Hauer)

**Cadmium potassium chloride**, CdCl, KCl, ½H<sub>2</sub>O

Sol in H<sub>2</sub>O without decomp (v Hauer)

+H<sub>2</sub>O 100 mol H<sub>2</sub>O dissolve at  
19° 3' 29° 7' 40° 1' 54° 5'  
2 65 3 21 3 72 4 33 mol CdCl<sub>2</sub>, KCl+H<sub>2</sub>O  
(Sudhaus, Miner Jahrb Beil-Bd 1914, **37**  
26)

Solubility in H<sub>2</sub>O at t°

t°	G CdKCl <sub>2</sub> in 100 g solution	G CdKCl <sub>2</sub> in 100 g H <sub>2</sub> O
2 6	21 87	27 99
15 9	26 60	36 4
41 5	35 66	55 34
60 6	40 67	68 55
105 1	51 67	106 91

(Rimbach, B 1897, **30** 3079)

CdCl<sub>2</sub>, 2KCl 100 pts H<sub>2</sub>O at 15° dis-  
solve 33 45 pts Sl sol in alcohol (Croft,  
Phil Mag (3) **21** 356)

Solubility in salts+Aq at 16°  
CdCl<sub>2</sub>, 2KCl is sol without decomp in the  
following salt solutions at 16°

Salt	Mols salt in 100 mole H <sub>2</sub> O	In 1 litre of the solution mole			Sp gr of the solution
		CdCl	KCl	RCl	
LiCl	9 3	0 166	0 663	4 483	1 1380
CaCl	3 8	0 270	1 080	1 887	1 2333
KCl	2 375	0 507	3 195	1 214	1 214

(Rimbach, B 1905, **38** 1568,)

CdCl<sub>2</sub>, 4KCl More sol in H<sub>2</sub>O than  
CdCl<sub>2</sub>, KCl (v Hauer)

100 g H<sub>2</sub>O dissolve at  
19° 3' 29° 7' 40° 1' 54° 5'  
41 65 49 05 57 5, 69 91 g CdCl<sub>2</sub> 4KCl  
(Sudhaus, Miner Jahrb Beil-Bd 1914, **37**  
24)

Solubility in H<sub>2</sub>O at t°

t	100 pt. solution contain pts		
	Cl	Cl	K
1 0	5 61	9 84	8 31
2 6	5 66	11 02	11 52
50 2	9 10	18 09	13 60
105 8	11 97	23 08	17 10
109 0	11 91	23 15	17 22

(Rimbach, B 1897 **30** 3080)

Decomp by H<sub>2</sub>O

Can be recryst without decomp from LiCl,  
CaCl<sub>2</sub> or MgCl<sub>2</sub>+Aq (Rimbach, B 1905  
**38** 1565)

The salt is sol without decomp in HCl+Aq  
containing 19 8 mole HCl per 100 mole H<sub>2</sub>O  
at 16°

1 l of the solution contains 0 033 mole  
CdCl<sub>2</sub>, 0 132 mole KCl and 5 828 mole HCl  
sp gr of the solution = 1 1403 (Rimbach,  
B 1905, **38** 1568)

**Cadmium rubidium chloride**, CdCl<sub>2</sub>, 2RbCl  
Sol in H<sub>2</sub>O and HCl+Aq (Godeffroy, B  
**8** 9)  
CdCl<sub>2</sub>, RbCl Solubility in H<sub>2</sub>O at t°  
100 pts by wt of the solution contain pts  
by wt RbCl, CdCl<sub>2</sub>

t°	Pts RbCl CdCl
1 2	12 97
14 5	16 80
41 4	25 31
57 6	30 83
103 9	46 62

CdCl<sub>2</sub>, RbCl is sol in H<sub>2</sub>O without decomp  
from 0-104° (Rimbach, B 1902, **35** 1303)

CdCl<sub>2</sub>, 4RbCl

Solubility of CdCl<sub>2</sub>, 4RbCl and CdCl<sub>2</sub>, RbCl  
in H<sub>2</sub>O at t°

t°	In 100 pts by wt of the solution			Composition of the solid phase	
	Pts by wt Cd	Pts by wt Cl	Pts by wt Rb	Mol % mono salt	Mol-% tetra salt
0 7	0 65	6 52	14 73	30	70
8 8	1 07	7 37	16 13	24	76
13 8	1 32	7 86	16 93	16	84
42 4	3 21	11 35	22 45	14	86
59 0	4 61	13 41	25 31	33	67
108 4	8 94	18 57	31 15		

(Rimbach, B 1902, **35** 1305)

Decomp by H<sub>2</sub>O between 0° and 108°  
(Rimbach, B 1905, **38** 1571)

Sol in conc HCl without decomp (Rim-  
bach, B 1905, **38** 1571)

Not sol in CaCl<sub>2</sub>+Aq and LiCl+Aq with-  
out decomp (Rimbach, B 1905, **38** 1571)

**Cadmium sodium chloride**, CdCl<sub>2</sub>, 2NaCl+  
3H<sub>2</sub>O

Sol in 1 4 pts H<sub>2</sub>O at 16° (Croft)  
100 mol H<sub>2</sub>O dissolve at  
19° 3' 29° 7' 40° 1' 54° 5'  
3 93 4 29 4 73 5 18 mol CdCl<sub>2</sub>,  
2NaCl+3H<sub>2</sub>O

Stable between 19 and 55°  
(Sudhaus, Miner Jahrb Beil-Bd 1914, **37**  
25)

Sl sol in alcohol or wood alcohol (Croft)

**Cadmium strontium chloride**, 2CdCl<sub>2</sub>, SrCl<sub>2</sub>+  
7H<sub>2</sub>O

Sol in H<sub>2</sub>O (v Hauer)

**Cadmium chloride ammonia**, CdCl<sub>2</sub>, 2NH<sub>3</sub>

Nearly insol in H<sub>2</sub>O (v Hauer)  
CdCl<sub>2</sub>, 3NH<sub>3</sub>+ $\frac{1}{2}$ H<sub>2</sub>O  
CdCl<sub>2</sub>, 4NH<sub>3</sub>+ $\frac{1}{2}$ H<sub>2</sub>O  
CdCl<sub>2</sub>, 5NH<sub>3</sub> (Andr., C R **104** 908)  
CdCl<sub>2</sub>, 6NH<sub>3</sub> Difficultly sol in cold H<sub>2</sub>O  
(Schuler, A **87** 34)



**Cadmium chloride cupric oxide**,  $\text{CdCl}_2 \cdot 3\text{CuO} + 3\text{H}_2\text{O}$

Not decomp by  $\text{H}_2\text{O}$  (Mailhe, A ch 1902, (7) 27 378 and 174)

**Cadmium chloride hydrazine**,  $\text{CdCl}_2 \cdot 2\text{N}_2\text{H}_4$

Insol in  $\text{H}_2\text{O}$   
Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Franzen, Z anorg 1908, 60 279)

+ $\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Curtius, J pr 1894, (2) 50 345)

**Cadmium chloride hydroxylamine**,  $\text{CdCl}_2 \cdot 2\text{NH}_2\text{OH}$

Sl sol in cold, somewhat more in warm  $\text{H}_2\text{O}$  Very sol in hydroxylamine + Aq Very sl sol in alcohol and other organic solvents (Crismer, Bull Soc (3) 3 116)

Aq solution sat at 20° contains about 1% (Antonoff, C C 1905, II 810)

**Cadmium fluoride**,  $\text{CdF}_2$

Difficultly sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HF} + \text{Aq}$  (Berzelius, Pogg 1 26)

Very sol in  $\text{H}_2\text{O}$ , insol in 95% alcohol, sol in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3 + \text{Aq}$  with evolution of  $\text{HF}$  (Poulenc, C R 116 582)

1 l  $\text{H}_2\text{O}$  dissolves 0.289 mol  $\text{CdF}_2$  at 25°, or 100 cc sat aqueous solution contains 4.36 g  $\text{CdF}_2$  at 25° (Jaeger, Z anorg 1901, 27 35)

1 l of 1.08-N  $\text{HF}$  dissolves 0.372 mol  $\text{CdF}_2$  at 25° (Jaeger, Z anorg 1901, 27 35)  
Insol in liq  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 827)

**Cadmium ceric fluoride**,  $\text{CdF}_2 \cdot 2\text{CeF}_4 + 7\text{H}_2\text{O}$

Ppt Decomp by  $\text{H}_2\text{O}$  (Rimbach, A 1909, 368 106)

**Cadmium columbium fluoride**

See Fluocolumbate, cadmium

**Cadmium molybdenyl fluoride**

See Fluoxymolybdate, cadmium

**Cadmium silicon fluoride**

See Fluosilicate, cadmium

**Cadmium stannic fluoride**

See Fluostannate, cadmium

**Cadmium titanium fluoride**

See Fluotitanate, cadmium

**Cadmium zirconium fluoride**

See Fluozirconate, cadmium

**Cadmous hydroxide**,  $\text{CdOH}$

Insol in  $\text{H}_2\text{O}$  Decomp by acids into cadmic salt (Morse and Jones, Am Ch J 12 488)

**Cadmium hydroxide**,  $\text{CdO} \cdot \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$   
1 l  $\text{CdO} \cdot \text{H}_2\text{O} + \text{Aq}$  contains 0.0026 g  $\text{CdO} \cdot \text{H}_2\text{O}$

at 25° (Bodlander, Z phys Ch 1898, 7 66)

Solubility in  $\text{H}_2\text{O} = 2.6 \times 10^{-4}$  (Herz, Z anorg 1900, 24 126)

Sol in acids, very sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , insol in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{K}_2\text{CO}_3$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$

Easily sol in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_4\text{NO}_3$ , and  $\text{NH}_4$  succinate + Aq (Wittstein)

Freshly pptd  $\text{CdO} \cdot \text{H}_2\text{O}$  is sol in all haloids + Aq (Bersch, Z phys Ch 1891 8 392)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  increases with increase in concentration of  $\text{NH}_4\text{OH}$  (Et 1, B 1903, 36 3401)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at 25°

$\text{NH}_3$ norm	g $\text{CdO}$ per l
0.5	0.24
1.0	0.62
1.8	1.33
4.6	4.92

(Bonsdorff, Z anorg 1904, 41 187)

Insol in ethyl, and methyl amine + Aq (Wurtz)

Very sl sol in  $\text{HCN} + \text{Aq}$  even when freshly pptd (Schuler, A 87 48)

Not pptd in presence of Na citrate (Spil r), and many non-volatile organic substances (Rose)

**Cadmium iodide**,  $\text{CdI}_2$

Sol in 113 pts  $\text{H}_2\text{O}$  at 15° (Eder, D gl 221 89)

Sol at 20° 40° 60° 80° 100°  
in 108 100 93 86 75 pts 100

(Kremer Pogg 103 57)

Sat  $\text{CdI}_2 + \text{Aq}$  contains at

—4°	+2°	+10°	13°	24°	32
42.4	43.7	45.2	44.8	46.5	47.4, C 1
54°	64°	76°	94°	95°	135°
49.5	50.1	52.4	55.1	54.7	62.9, C 1
140°	165	185°	202°	202°	255°
63.1	68.1	70.7	73.4	73.2	84.5, C 1

(Etud A ch 1894 (7) 2 545)

Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at

0°	15°	50°	75°	100°
44.39	46.02	49.35	52.65	56.08 g C 11

(Ditz / anorg 1899, 20 262)

Sp gr of  $\text{CdI}_2 + \text{Aq}$  containing pts  $\text{CdI}_2$  to 100 pts  $\text{H}_2\text{O}$

21.4	43.7	88.5 pts $\text{CdI}_2$
1.1681	1.328	1.6139

(Kremer Pogg 111 60)

Sp gr of  $\text{CdI}_2 + \text{Aq}$  at  $19.5^\circ$  containing  
 5 10 15 20 25 % $\text{CdI}_2$ ,  
 1 044 1 088 1 138 1 194 1 253  
 30 35 40 45 50 % $\text{CdI}_2$   
 1 319 1 395 1 476 1 575 1 680  
 (Kremers, calculated by Gerlach, Z anal  
 8 285)

Sp gr of  $\text{CdI}_2 + \text{Aq}$  at  $18^\circ$   
 % $\text{CdI}_2$  1 5 10 15 20  
 Sp gr 1 0071 1 0425 1 0833 1 1392 1 1943  
 % $\text{CdI}_2$  25 30 35 40 45  
 Sp gr 1 2550 1 3228 1 4000 1 4816 1 5741  
 (Grottrian, W Ann 1883, 18 193)

Sp gr of  $\text{CdI}_2 + \text{Aq}$

g $\text{CdI}$ per l	Sp gr	g $\text{CdI}_2$ per l	Sp gr
98 85	1 08	289 5	1 237
197 7	1 162	400	1 328

(Barbier and Roux, Bull Soc 1890, (3) 3 425)

Sp gr of  $\text{CdI}_2 + \text{Aq}$

% $\text{CdI}_2$	$t^\circ$	Sp gr at $t^\circ$	Sp gr at $18.5^\circ$
0 0429	17 68	0 99915	0 99908
	22 88	0 99807	
0 100	17 55	0 99965	0 99956
	22 91	0 99363	
0 204	17 76	1 00052	1 0005
	22 79	0 99948	
0 399	17 40	0 00223	1 0021
	24 30	1 00082	
0 600	18 00		1 0038
0 800	17 44	1 00564	1 0056
	23 11	1 00442	
1 00	18 00		1 0072

(Wershofen, Z phys Ch 1890, 5 493)

Sp gr  $\text{CdI}_2 + \text{Aq}$  at  $18.4^\circ$  containing  
 31 123 13 677 9 559 % $\text{CdI}_2$   
 1 338 1 125 1 086

(de Mynck, W Ann 1894, 53 561)

$\text{CdI} + \text{Aq}$  at  $18.4^\circ$  10.97%  $\text{CdI}_2$  has sp  
 gr  $20^\circ/20^\circ = 0.9952$   
 $\text{CdI} + \text{Aq}$  containing 16.53%  $\text{CdI}$  has sp  
 gr  $20^\circ/20^\circ = 1.1562$   
 (Le Blanc and Rohland, Z phys Ch 1896,  
 19 282)

Sp gr of  $\text{CdI}_2 + \text{Aq}$  at  $20^\circ$

Normality of $\text{CdI} + \text{Aq}$	% $\text{CdI}_2$	Sp gr
1 924	44 53	1 5807
0 951	27 07	1 2837
0 447	14 40	1 1355
0 211	7 26	1 0630

(Forchheimer, Z phys Ch 1900, 34 29)

$\text{CdI}_2 + \text{Aq}$  containing 1 pt  $\text{CdI}_2$  in 2 2691  
 pts  $\text{H}_2\text{O}$  at  $17^\circ$  has sp gr = 1.3341 (Hit-  
 torf, Z phys Ch 1902, 39 628)

Sol in sat  $\text{HI} + \text{Aq}$

Sol in warm  $\text{NH}_4\text{OH} + \text{Aq}$

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J  
 1898, 20 827)

Sl sol in liquid  $\text{NH}_3$  (Franklin, Am Ch  
 J 1898, 20 827)

Sol in  $\text{S}_2\text{Cl}_2$  (Walden, Z anorg 1900, 25  
 217)

Difficultly sol in  $\text{POCl}_3$  (Walden, Z  
 anorg 1900, 25 212)

Nearly insol in  $\text{AsBr}_3$  (Walden, Z anorg  
 1902, 29 374)

Sol in  $\text{SO}_2\text{Cl}_2$  (Walden, Z anorg 1900,  
 25 215)

Sol in 15 pts alcohol (Vogel, N Rep  
 Pharm 12 393)

Sol in 0.98 pt abs alcohol (Eder, Dingl  
 221 89)

Sp gr of  $\text{CdI}_2 + \text{alcohol}$

% $\text{CdI}_2$  Sp gr  $20^\circ/20^\circ$

0 0 7949

7 28 0 8470

(Le Blanc and Rohland, Z phys Ch 1896,  
 19 284)

Sol in 5.2 mols methyl, 7 mols ethyl, and  
 9.8 mols propyl alcohol at  $20^\circ$  (Timofejew,  
 C R 112 1224)

Sol in 3.6 pts ether (Eder, l c)

Sol in 2.0 pts alcohol-ether (1 1) (Eder,  
 l c)

Very sl sol in anhydrous abs  
 (Hampe, Ch Z 1887, 11 847)

100 g of sat solution in abs ether con-  
 0.143 g  $\text{CdI}_2$  at  $12^\circ$  (Tyrer, Proc Che  
 Soc 1911, 27 142)

Solubility in ether + Aq at  $12^\circ$

% $\text{H}_2\text{O}$ in ether	% $\text{CdI}$	% $\text{H}_2\text{O}$ in ether	% $\text{CdI}$	% $\text{H}_2\text{O}$ in ether	% $\text{CdI}_2$
0 0	0 143	0 50	3 36	1 00	7 30
0 10	0 78	0 70	4 77	1 10	8 27
0 30	2 07	0 90	6 46	1 14	8 68

(Tyrer, Proc Chem Soc 27 142)

Solubility in benzene at  $16^\circ = 0.01\%$

"  $35^\circ = 0.02\%$

Solubility in ethyl ether at  $0^\circ = 0.03\%$

"  $15.5^\circ = 0.04\%$

"  $20.3^\circ = 0.05\%$

(Imbuge, Am J Sci 1895 (3) 49 52)

Sol in acetone (Fidmann, C C 1899, II  
 1014)

1 g  $\text{CdI}_2$  is sol in 4 g acetone at  $18^\circ$   
 Sp gr of sat solution  $18^\circ/4^\circ = 0.994$  (Nau-  
 mann, B 1904, 37 4338)

Sp gr of  $\text{CdI}_2 + \text{acetone}$

$\text{CdI}$	Sp gr $20^\circ/20^\circ$
0	0 7998
12 02	0 8929

(Le Blanc and Rohland, Z phys Ch 1896,  
 19 284)

Sol in chinolin (Beckmann and Gabel, Z anorg 1906, **51** 236)

100 g benzonitrile dissolve 1.6295 g  $\text{CdI}_2$  at  $18^\circ$  (Naumann, B 1914, **47** 1370)

Insol in methylene iodide (Retgers, Z anorg **3** 343)

Sl sol in ethylamine (Shinn, J phys Chem 1907, **11** 538)

Insol in  $\text{CS}_2$  (Arcetowski, Z anorg 1849, **6** 257)

Solubility in methyl acetate = 0.7–1.5%, 2.1% at bpt (Schroder and Steiner, J pr 1909, (2) **79** 49)

Sol in methyl acetate (Naumann, B 1909, **42** 3790)

1 pt is sol in 54.3 pts ethyl acetate at  $18^\circ$ . The sat solution has  $D_{18^\circ/4^\circ} = 0.9145$  (Naumann, B 1910, **43** 318)

Insol in mustard oil (Mathews, J phys Chem 1905, **9** 647)

Mol weight determined in piperidine, pyridine, methyl and ethyl sulphide (Werner, Z anorg 1897, **15** 17)

**Cadmium hydrogen iodide**,  $\text{CdI}_2 \cdot \text{HI} + 3\text{H}_2\text{O}$

Decomp in air (Dobroserdow, C C 1900, II 527)

**Cadmium caesium iodide**,  $\text{CdI}_2, \text{CsI} + \text{H}_2\text{O}$

n  $\text{H}_2\text{O}$  without decomp (Wells and Z anorg **5** 271)

2CsI As above  
3CsI Decomp by  $\text{H}_2\text{O}$  into the salt

**Cadmium hydrazine iodide**,  $\text{CdI}_2 \cdot 2\text{N}_2\text{H}_4\text{HI}$

Sol in  $\text{H}_2\text{O}$  (Ferratin, C A 1912 1612)

**Cadmium mercuric iodide**

Very sol in  $\text{H}_2\text{O}$  (Berthelot, J Pharm **14** 613)

$\text{CdI}_2 \cdot 3\text{HgI}_2$  Sol in  $\text{H}_2\text{O}$ . Can be recrystallized in alcohol (Clark and Koble, Am Ch J **5** 235)

**Cadmium potassium iodide**,  $\text{CdI}_2 \cdot \text{KI} + \text{H}_2\text{O}$

Sol in 0.94 pt  $\text{H}_2\text{O}$  at  $15^\circ$  (Eder, Dingl **221** 89)

$\text{CdI}_2 \cdot 2\text{KI} + 2\text{H}_2\text{O}$  Deliquescent. Externally sol in  $\text{H}_2\text{O}$ . Sol at  $15^\circ$  in 0.73 pt  $\text{H}_2\text{O}$ . Sl sol in alcohol and wood spirit, but less than  $\text{CdI}_2$  (Croft)

Sol at  $15^\circ$  in 1.4 pts absolute alcohol, 24.5 pts ether (0.729 sp gr), and 4.5 pts alcohol ether (1.1) (Eder, l c)

Sp gr of  $\text{K CdI}_4 + \text{Aq}$  at  $18^\circ$

% $\text{K CdI}_4$	1	5	10	15	20
Sp gr	1.0065	1.0384	1.0808	1.1269	1.1770

% $\text{K CdI}_4$	25	30	35	40	45
Sp gr	1.2313	1.2890	1.3557	1.4282	1.5065

(Grotrian, W Ann 1883, **18** 193)

Sp gr of  $\text{K}_2\text{CdI}_4 + \text{Aq}$

% $\text{K}_2\text{CdI}_4$	$t^\circ$	Sp gr at $t^\circ$	Sp gr at $8^\circ$
0.0328	18		0.99
0.0596	18		0.99
0.0804	18		0.99
0.100	17.12	0.99962	0.99
	21.82	0.99872	
0.250	18		1.00
0.500	18		1.00
1.003	17.32	1.0068	1.00
	20.63	1.0061	

(Wershofen, Z phys Ch 1890, **5** 493)

Sol in ethyl acetate (Naumann, B 1914, **37** 3601)

**Cadmium sodium iodide**,  $\text{CdI}_2, 2\text{NaI} + 6\text{H}_2\text{O}$

Deliquescent (Croft)

Sol at  $15^\circ$  in 0.63 pt  $\text{H}_2\text{O}$ , 0.86 pt alcohol, and 10.1 pts ether (sp gr 0.7) (Eder, Dingl **221** 89)

**Cadmium strontium iodide**,  $\text{CdI}_2, \text{SrI}_2 + 8\text{H}_2\text{O}$

Deliquesces in moist, effloresces in dry, sol in  $\text{H}_2\text{O}$  (Croft)

**Cadmium iodide ammonia**,  $\text{CdI}_2, 2\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  (Rammelsberg)

$\text{CdI}_2, 4\text{NH}_3$  (Dawson and McCrae, Ch n Soc 1900, **77** 1246)

$\text{CdI}_2, 6\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$ , sol in warm, less sol in cold  $\text{NH}_4\text{OH} + \text{Aq}$  (Rammelsberg)

**Cadmium iodide hydrazine**,  $\text{CdI}_2 \cdot 2\text{N}_2\text{H}_4$

Easily sol in warm  $\text{NH}_4\text{OH} + \text{Aq}$  (Fenzl, Z anorg 1908, **60** 281)

**Cadmium iodide hydroxylamine**,  $\text{CdI}_2 \cdot 3\text{NH}_2\text{OH}$

Sol in  $\text{H}_2\text{O}$  and alcohol. Insol in ether (Adams, Am Ch J 1902, **28** 218)

**Cadmium iodide selenide**,  $\text{CdI}_2 \cdot 3\text{CdSe}$

Easily decomp (Fonzes-Ducon, C R 1900 **131** 897)

**Cadmium iodosulphide**,  $\text{CdI}_2 \cdot 2\text{CdS}$

Ppt (Naumann, B 1904 **37** 4338)

**Cadmium suboxide**,  $\text{Cd}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$ , acids and  $\text{NH}_4\text{O} + \text{Aq}$  (Fenzl, Z anorg 1901, **27** 433)

$\text{CdO}$  Properties as cadmium hydroxide (Morse and Jones)

**Cadmium oxide**,  $\text{CdO}$

Insol in  $\text{H}_2\text{O}$ . Sol in acids. Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Easily sol in  $\text{NH}_4\text{Cl} + \text{Aq}$ , less in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett, 1837)

Insol in KOH, NaOH,  $K_2CO_3$ , and  $Na_2CO_3$   
+Aq

See also Cadmium hydroxide

Solubility in (calcium succate+sugar)+  
Aq

1 l solution containing 418.6 g sugar and  
34.3 g CaO dissolves 0.22 g CdO

1 l solution containing 174.4 g sugar and  
14.1 g CaO dissolves 0.48 g CdO

(Bodenbender, J B 1865 600)

Insol in acetone (Naumann, B 1904, 37  
4329)

Insol in methyl acetate (Naumann, B  
1909, 42 3790)

Insol in ethyl acetate (Naumann, B  
1904, 37 3601)

**Cadmium peroxide**,  $Cd_5O_8$  or  $Cd_3O_5$ (?)

(Haas)

$CdO_2$ ,  $Cd(OH)_2$  (Kouriloff, A ch (6) 23  
431)

Very stable towards  $H_2O$  Insol in  $NH_4OH$   
+Aq (Haas, B 1884, 17 2253)

$4CdO_2$ ,  $Cd(OH)_2$  Ppt Insol in NaOH+  
Aq (Eykman, C C 1905, I 1629)

$5CdO_2$ ,  $CdO+3H_2O$  Ppt (Teletow, C A  
1912, 43)

**Cadmium oxybromide**,  $CdO$ ,  $CdBr_2+H_2O$

Decomp by  $H_2O$  (Tassily, C R 1897,  
124 1023)

+ $2H_2O$  Stable in dry air, insol in  $H_2O$   
(Tassily, C R 1897, 124 1022)

+ $3H_2O$  Slowly decomp by  $H_2O$  (Tas  
sily, C R 1897, 124 1022)

+ $7H_2O$  (Mailhe, C R 1901, 132 1561)

**Cadmium oxychloride**,  $CdCl_2$ ,  $CdO+H_2O$

Sl sol in hot  $H_2O$  (Habermann, M Ch  
5 432)

+ $7H_2O$  (Mulhe, Bull Soc 1901, (3) 25  
791)

$2CdO$ ,  $CdCl_2$  Insol in  $H_2O$ , but slowly  
decomp thereby (Cunzoneri, Gazz ch it  
1897, 27 (2) 486)

**Cadmium oxyiodide**,  $CdO$ ,  $CdI_2+H_2O$

Decomp by  $H_2O$  (Tassily, C R 1897,  
124 1023)

+ $3H_2O$  Stable in dry air, insol in  $H_2O$   
(Tassily, C R 1897, 124 1022)

**Cadmium phosphide**,  $Cd_3P_2$

Sol in HCl+Aq with evolution of  $PH_3$

$Cd_3P_2$  in conc HCl+Aq (Lemmerling, B 12 152)

Easily decomp by acids (Kulisch, A 231  
327)

$CdP_2$  Decomp by boiling conc HCl+Aq  
(Renault, C R 76 283)

**Cadmium selenide**,  $CdSe$

Sol in HCl+Aq (Uellmann, A 116 122)

Easily decomp by acids (Fonze-Diacon,  
C R 1900, 131 897)

**Cadmium sulphide**,  $CdS$

Insol in  $H_2O$

Solubility in  $H_2O$  at  $16-18^\circ = 6.6 \times 10^{-6}$   
mols per l (Biltz, Z phys Ch 1907, 58  
291)

1 l  $H_2O$  dissolves  $9.00 \times 10^{-6}$  mols  $CdS$   
(artificial greenockite) at  $18^\circ$

1 l  $H_2O$  dissolves  $8.86 \times 10^{-6}$  mols pptd  
 $CdS$  at  $18^\circ$  (Weigel, Z phys Ch 1907, 58  
294)

Difficultly sol in hot dil HCl+Aq Easily  
sol in cold conc HCl+Aq (Stromeyer)  
Sol in  $HNO_3$ +Aq (Meissner), and boiling dil  
 $H_2SO_4$ +Aq (1 6) (A W Hoffmann, A  
115 286) Very sl sol in  $NH_4OH$ +Aq  
(Wackenroder, Report 46 226) Insol in  
KOH, or  $(NH_4)_2S$ +Aq Appreciably sol in  
an acid solution of  $NH_4Cl$  (Baxter and  
Hines, Z anorg 1905, 44 160)

Much more sol in  $(NH_4)_2S$ +Aq than usu-  
ally supposed (Ditte, C R 85 402) Sol-  
ubility increases by warming, and at  $68^\circ$  is  
twice that at ordinary temperatures A sat  
solution of  $(NH_4)_2S$  dissolves about 2 g  $CdS$   
to a litre Alkali sulphides dissolve much  
less (Ditte)

Fresenius (Z anal 20 236) could not con-  
firm the above According to Fresenius,  $CdS$   
is not appreciably sol in  $(NH_4)_2S$ +Aq

Insol in  $Na_2SO_3$  or  $KCN$ +Aq (Fresenius)

Insol in  $NH_4Cl$  or  $NH_4NO_3$ +Aq (Brett)

Sol in alkali sulpho-molybdates, -tung-  
states, -vanadates, -arsenates, -antimonates,  
-stannates+Aq (Storch, B 16 2015)

Insol in liquid  $NH_3$  (Franklin, Am Ch  
J 1898, 20 827)

Insol in acetone (Naumann, B 1904, 37  
4329, Erdmann, C C 1899, II 1014)

Insol in ethyl acetate (Naumann, B  
1910, 43 314)

Min Greenockite Sol in HCl+Aq

**Colloidal**—Solution of 4 g colloidal C  
in a litre  $H_2O$  remains transparent several  
days If it contains 11 g  $CdS$  in a litre, it is  
completely coagulated in 24 hours Solutions  
of salts of the following concentration cause  
an immediate coagulation in an aqueous solu-  
tion of  $CdS$  containing 3.62 g in a litre

KCl	1 1615
KBr	1 727
KI	1 57
KCN	1 166
KClO <sub>3</sub>	1 1666
KNO <sub>3</sub>	1 1000
K <sub>2</sub> SO <sub>4</sub>	1 5000
K <sub>2</sub> SO <sub>3</sub>	1 833
K <sub>3</sub> Fe(CN) <sub>6</sub>	1 166
K <sub>4</sub> Fe(CN) <sub>6</sub>	<1 100
K <sub>2</sub> CrO <sub>4</sub>	1 400
K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub>	1 3571
NaCl	1 2666
Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	1 98
NaHCO <sub>3</sub>	1 333
Na <sub>2</sub> CO <sub>3</sub>	1 166
Na <sub>2</sub> HPO <sub>4</sub>	1 202

$\text{NaC}_2\text{H}_3\text{O}_2$	1	2451
Na benzoate	1	10,000
$(\text{NH}_4)_2\text{C}_2\text{O}_4$	1	588
$\text{BaCl}_2$	1	11,764
$\text{Ba}(\text{NO}_3)_2$	1	8032
$\text{BaS}_2\text{O}_8$	1	5617
$\text{MgSO}_4$	1	41,666
$\text{MnSO}_4$	1	22,222
$\text{CdSO}_4$	1	250,000
$\text{Cd}(\text{NO}_3)_2$	1	285,714
$\text{Pb}(\text{ClO}_3)_2$	1	209
$\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$	1	147,058
$\text{Hg}(\text{CN})_2$	<1	20
$\text{Al}_2(\text{SO}_4)_3$	1	232,558
Alum	1	192,377
Chrome alum	1	42,555
HCl	1	4807
$\text{H}_2\text{SO}_4$	1	8000
$\text{HC}_2\text{H}_3\text{O}_2$	1	15
$\text{H}_2\text{C}_2\text{O}_4$	1	23,255
Succinic acid	<1	100
Tartaric acid	1	333

(Prost, Belg Acad Bull (3) 14 312, J B 1887 537)

#### Cadmium pentasulphide, $\text{CdS}_5$

Insol in  $\text{H}_2\text{O}$  (Schiff, A 115 74)  
Mixture of CdS and S (Follenius, Z anal 13 412)

#### Cadmium potassium sulphide, $\text{K}_2\text{CdS}_4$

, anorg 1904, 42 439)

#### Cadmium sulphide, $3\text{CdS}$ , $\text{Na}_2\text{S}$

by  $\text{H}_2\text{O}$  (Schneider, J pr (2)

#### Cadmium sulphoiodide

See Cadmium iodosulphide

#### Cadmium telluride, $\text{CdTe}$

Not attacked by dil acids. Attacked in the cold only by  $\text{HNO}_3$  (Gibbals, J Am Chem Soc 1909, 31 908)

#### Cadmic acid

#### Potassium cadmate

Insol in  $\text{H}_2\text{O}$ , but gradually decomp when in contact therewith (Mummi, C R 63 330)

#### Cæsium, Cs

Decomp  $\text{H}_2\text{O}$  with great violence (Settemberg, A 211 100)

Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

#### Cæsium acetylide acetylene, $\text{Cs}_2\text{C}_2\text{H}_2$

Insol in  $\text{C}_6\text{H}_6$  and in  $\text{CHCl}_3$  (Moissan, C R 1903, 136 1218)

#### Cæsium amide, $\text{CsNH}_2$

Decomp by  $\text{H}_2\text{O}$ . Very sol in liquid  $\text{NH}_3$  (Rengade, C R 1905, 140 1185)

#### Cæsium ammonia, $\text{Cs}_3\text{NH}_3$

Sol in liquid  $\text{NH}_3$  (Moissan, C R 1903, 136 1177)

#### Cæsium azoumide, $\text{CsN}_3$

Deliquescent Stable in aq solution  
224 2 pts sol in 100 pts  $\text{H}_2\text{O}$  at  $0^\circ$   
307 4 " " " 100 "  $\text{H}_2\text{O}$  "  $16^\circ$   
1 0366 " " " 100 " abs alcohol "  $16^\circ$   
Insol in pure ether (Curtius, J pr 1898, (2) 58 283)

#### Cæsium bromide, $\text{CsBr}$

Ppt (Chabrie, C R 1901, 132 679)  
Sat  $\text{CsBr} + \text{Aq}$  at  $25^\circ$  contains 55.23%  
 $\text{CsBr}$  (Foote, Am Ch J 1907, 37 125)

#### Cæsium tribromide, $\text{CsBr}_3$

Sol in  $\text{H}_2\text{O}$ , decomp by alcohols (Wells, Sill Am J 143 17)

#### Cæsium pentabromide, $\text{CsBr}_5$

Very unstable (Wells and Wheeler, Sill Am J 144 42)

#### Cæsium cobalt bromide, $\text{Cs}_2\text{CoBr}_4$

Decomp by  $\text{H}_2\text{O}$  (Campbell, Z anorg 1894, 8 126)

Decomp by  $\text{H}_2\text{O}$  and by alcohol (Campbell, Am J Sci 1894, (3) 48 418)

$\text{Cs}_2\text{CoBr}_5$  Decomp by  $\text{H}_2\text{O}$  (Campbell, Z anorg 1894, 8 126)

Decomp by  $\text{H}_2\text{O}$  and by alcohol (Campbell, Am J Sci 1894, (3) 48 418)

#### Cæsium copper bromide, $\text{CsBr}$ , $\text{CuBr}$

Sol in  $\text{H}_2\text{O}$  without decomp (Wells and Walden, Z anorg 5 304)

2  $\text{CsBr}$ ,  $\text{CuBr}_2$  (W and W)

#### Cæsium iridium bromide

See Bromiridate, cæsium

#### Cæsium iron (ferric) bromide, $\text{Cs}_2\text{FeBr}_4$

Sol in  $\text{H}_2\text{O}$  (Walden, Z anorg 1894, 7 332)

$\text{Cs}_2\text{FeBr}_4 + \text{H}_2\text{O}$  (Walden, Z anorg 1894 7 332)

#### Cæsium lead bromide, $\text{CsBr}$ , $2\text{PbBr}_2$

Nearly stable in aqueous solution (Walden, Sill Am J 145 127)

$\text{CsBr}$ ,  $\text{PbBr}_2$  Decomp by  $\text{H}_2\text{O}$  (Walden)

4  $\text{CsBr}$ ,  $\text{PbBr}_2$  As above

Solubility determinations show that the double salts formed by cæsium and lead bromides at  $25^\circ$  are  $\text{CsPbBr}_3$ ,  $\text{Cs}_2\text{PbBr}_4$ , and  $\text{Cs}_4\text{PbBr}_6$  (Foote, Am Ch J 1907 37 125)

#### Cæsium magnesium bromide, $\text{CsBr}$ , $\text{MgBr}_2 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Wheeler and Campbell, Z anorg 5 275)

**Cæsium mercuric bromide, CsBr, 2HgBr<sub>2</sub>**

Not decomp by H<sub>2</sub>O 100 pts solution sat at 16° contain 0.807 pt CsBr, 2HgBr<sub>2</sub>. Sol in hot strong alcohol, from which CsBr, HgBr<sub>2</sub> separates on cooling (Wells, Sill Am J 144 221)

CsBr, HgBr<sub>2</sub> Decomp by H<sub>2</sub>O into above salt Sol in alcohol without decomp (Wells)

2CsBr, HgBr<sub>2</sub> Decomp by H<sub>2</sub>O into CsBr, 2HgBr<sub>2</sub>

3CsBr, HgBr<sub>2</sub> As above

**Cæsium molybdenyl bromide, 2CsBr,**

MoOBr<sub>3</sub>

(Weinland and Knoll, Z anorg 1905, 44 107)

**Cæsium nickel bromide, CsNiBr<sub>3</sub>**

Decomp by H<sub>2</sub>O (Campbell, Z anorg 1894, 8 126)

Decomp by H<sub>2</sub>O and by alcohol (Campbell, Am J Sci 1894, (3) 48 418)

**Cæsium osmium bromide**

See Bromosmate, cæsium

**Cæsium palladium bromide**

See Bromopalladate, cæsium and bromopalladite, cæsium

**Cæsium platinum bromide**

See Bromoplatinate, cæsium

**Cæsium ruthenium bromide**

See Bromoruthenite, cæsium

**Cæsium selenium bromide**

See Bromoselenate, cæsium

**Cæsium tellurium bromide**

See Bromotellurate, cæsium

**Cæsium thallic bromide, CsBr, TlBr<sub>3</sub>**

Sol in H<sub>2</sub>O with decomp (Pitt, Z anorg 1895, 9 19)

By recryst from H<sub>2</sub>O, forms 3CsBr, 2TlBr<sub>3</sub> (Pitt, Am J Sci 1895 (3) 49 403)

3CsBr, 2TlBr<sub>3</sub> Can be recryst unchanged from H<sub>2</sub>O (Pitt, Am J Sci 1895, (3) 49 402)

**Cæsium tin (stannic) bromide**

See Bromostannate, cæsium

**Cæsium zinc bromide, 3CsBr, ZnBr<sub>2</sub>**

Sol in H<sub>2</sub>O (Wells and Campbell, Z anorg 5 275)

2CsBr, ZnBr<sub>2</sub> As above

**Cæsium bromide columbium oxybromide,**

2CsBr, CbOBr<sub>3</sub>

Unstable in moist air Decomp by H<sub>2</sub>O (Weinland, B 1906, 39 3059)

**Cæsium bromochloride, CsBr<sub>2</sub>Cl**

Properties as CsBr<sub>3</sub> (Wells)

CsBrCl<sub>2</sub> As above (Wells)

**Cæsium mercuric bromochloride,**

Cs<sub>2</sub>HgCl<sub>3</sub>Br<sub>2</sub>

Decomp by H<sub>2</sub>O finally to HgBr (Wells, Sill Am J 144 121)

Cs<sub>2</sub>HgCl<sub>3</sub>Br As above

CsHgClBr<sub>2</sub> As above

CsHg<sub>2</sub>ClBr<sub>4</sub> As above

CsHg<sub>5</sub>ClBr<sub>10</sub> As above

**Cæsium bromochloriodide, CsBrClI**

More sol in H<sub>2</sub>O than in alcohol Not decomp at once by ether (Wells)

**Cæsium bromiodide, CsBrI<sub>2</sub>**

Decomp by H<sub>2</sub>O Sol in alcohol Decomp by ether with residue of CsBr (Wells, Sill Am J 143 17)

CsBr<sub>2</sub>I More sol in H<sub>2</sub>O than in alcohol Not decomp by ether

CsBr<sub>2</sub>I + Aq sat at 20° contains about 4.45% CsBr<sub>2</sub>I (Wells)

**Cæsium carbide, Cs<sub>2</sub>C<sub>2</sub>**

Decomp by cold H<sub>2</sub>O (Moissan, C R 1903, 136 1221)

**Cæsium chloride, CsCl**

Very deliquescent, sol in H<sub>2</sub>O and alcohol

Solubility of CsCl at t°

t°	Pts by wt of CsCl in 100 pts solution
0	3
10	61.9
20	63.5
30	64.9
40	66.3
50	67.4

(Hinrichsen, Z phys Ch 1904, 50 99)

Solubility of CsCl at t°

t	% CsCl	t	% CsCl
0	61.7	60	69.7
10	63.6	70	70
20	65.1	80	71.4
30	66.4	90	72.2
40	67.5	100	73.0
50	68.0	119.4	74.4

(Berkeley, Trans Roy Soc 1904, 203 A 208)

A normal solution of CsCl has sp gr at 25° = 1.1076 (Wagner, Z phys Ch 1890, 5 36)

Sp gr at 20°/4° of a normal solution of CsCl = 1.125815 (Haugh, J Am Chem Soc 1912, 34 1151)

Sp gr of CsCl+Aq			
G equiv CsCl per l at 18°	Sp gr at 6°/8°	Sp gr at 18°/18°	Sp gr at 30°/30°
0 504	1 06556	1 06483	1 06452
1 002	1 12962	1 12825	1 12750
2 007	1 25705	1 25452	1 25307
3 994	1 50514	1 50100	1 49859

(Clausen, W Ann 1914, (4) 44 1071)

Solubility of CsCl+FeCl<sub>3</sub> in H<sub>2</sub>O at 21°

Substance added		Pts by weight in 100 pts of solution	
FeCl <sub>3</sub> grams	CsCl grams	FeCl <sub>3</sub>	CsCl
0	65	0	65 0
0 6	11 6	0 45	55 18
1 4	10 2	2 1	52 38
2 2	8 8	5 24	51 44
2 0	7 4	7 8	47 70
3 8	6 0	8 93	41 15
4 6	4 6	15 34	25 25
5 4	2 8	21 65	14 96
6 2	1 4	27 96	8 42
35	0 2	48 71	0 94
35	0	83 89	0

(Hennrichsen, Z phys Ch 1904, 50 96)

Solubility of CsCl+HgCl<sub>2</sub> in H<sub>2</sub>O at 25°

Solution contains		Solid phase
% CsCl	% HgCl <sub>2</sub>	
65 61	0 00	CsCl
65 78	0 215	CsCl+Cs <sub>2</sub> HgCl
62 36	0 32	Cs <sub>2</sub> HgCl
57 01	0 64	"
52 35	1 23	"
51 08	1 44	Cs <sub>3</sub> HgCl <sub>5</sub> +Cs <sub>2</sub> HgCl <sub>4</sub>
49 30	1 49	Cs <sub>2</sub> HgCl <sub>4</sub>
45 95	1 69	"
45 23	1 73	Cs <sub>2</sub> HgCl <sub>4</sub> +Cs <sub>2</sub> HgCl <sub>3</sub>
38 63	1 32	Cs <sub>2</sub> HgCl <sub>3</sub>
17 03	0 51	"
1 55	0 42	"
0 61	2 64	Cs <sub>2</sub> HgCl <sub>3</sub> +Cs <sub>2</sub> HgCl <sub>2</sub>
0 49	2 91	Cs <sub>2</sub> HgCl <sub>2</sub>
0 40	3 78	Cs <sub>2</sub> HgCl <sub>2</sub> +Cs <sub>2</sub> Hg <sub>3</sub> Cl <sub>11</sub>
0 44	4 63	"
0 41	4 68	Cs <sub>2</sub> Hg <sub>3</sub> Cl <sub>11</sub>
0 25	5 65	"
0 18	7 09	Cs <sub>2</sub> Hg <sub>3</sub> Cl <sub>11</sub> +HgCl
0 00	6 90	HgCl

(Foote, Am Ch J 1903 30 340)

Insol in acetone (Naumann, B 1904, 37 4329, Fiedmann, C C 1899, II 1014)

100 g solution in acetone sat at 25° contains 0.032 g CsCl (Foote and Hugh, J Am Chem Soc 1911, 33 461)

Solubility of CsCl+HgCl<sub>2</sub> in acetone at 21°

Solution contains		Solid phase
% HgCl	% CsCl	
57 74	0 00	HgCl <sub>2</sub>
57 79	0 13	HgCl <sub>2</sub> +CsHg <sub>5</sub> Cl <sub>11</sub>
57 74	0 20	CsHg <sub>5</sub> Cl <sub>11</sub>
52 54	0 22	"
49 83	0 32	"
44 32	0 50	CsHg <sub>5</sub> Cl <sub>11</sub> +CsHg <sub>2</sub> Cl <sub>5</sub>
44 46	0 44	"
39 65	0 48	CsHg <sub>2</sub> Cl <sub>5</sub>
28 48	0 48	"
26 96	0 52	CsHg <sub>2</sub> Cl <sub>5</sub> +CsHgCl <sub>3</sub>
27 32	0 61	"
21 50	0 46	CsHgCl <sub>3</sub>
13 08	0 45	"
0 16	0 19	Mixtures of salts
0 17	0 25	"
0 02	0 11	"
0 00	0 032	CsCl

(Foote and Haigh, J Am Ch Soc 1911, 461)

Insol in methyl acetate (Naumann, 1909, 42 3790)

Solubility in glycol at ord temp = 10 - 10.8% (de Coninck, Belg Acad Bull 19 359)

Insol in anhydrous pyridine and in 9% pyridine+Aq. Sol in 95% pyridine+ and in 93% pyridine+Aq (Kahlenberg, Am Chem Soc 1908, 30 1107)

Caesium chromium chloride, 2CsCl, CrCl<sub>3</sub> + H<sub>2</sub>O

Stable in the air. Sol in H<sub>2</sub>O (Wells, anorg 1895, 10 182)

2CsCl, CrCl<sub>3</sub>+4H<sub>2</sub>O, hygroscopic, very l in H<sub>2</sub>O (Wells, l c)

Caesium tri-aquo chromium chloride, CrCl<sub>3</sub>(OH<sub>2</sub>)<sub>4</sub>Cl, 2CsCl

Ppt (Werner, B 1901, 34 1602)

Caesium cobalt chloride, CsCoCl<sub>4</sub>+2H<sub>2</sub>O

Decomp by H<sub>2</sub>O and alcohol (Cunphy Z anorg 1894, 8 126)

Cs<sub>2</sub>CoCl<sub>7</sub> Decomp by H<sub>2</sub>O and by alcohol (Cunphy Z anorg 1894 8 126)

Cs<sub>2</sub>CoCl<sub>7</sub> Decomp by H<sub>2</sub>O and by alcohol (Cunphy Z anorg 1894 8 126)

Caesium cuprous chloride, Cs<sub>2</sub>Cl, CuCl

Decomp by H<sub>2</sub>O into CuCl, CsCl (Wells, Z anorg 5 306)

3CsCl, CuCl (Wells)

6CsCl, CuCl (Wells)

Caesium cupric chloride, 2CsCl, CuCl<sub>2</sub>

Easily sol in H<sub>2</sub>O and dil HCl + 4, insol in conc HCl+Aq (Godeffroy, 3 8 9)

Sol in small amount  $\text{H}_2\text{O}$  without decomp (Wells and Dupee, Z anorg 5 300)  
 $+2\text{H}_2\text{O}$  Efflorescent (W and D)  
 $3\text{CsCl}, 2\text{CuCl}_2 + 2\text{H}_2\text{O}$   
 $\text{CsCl}, \text{CuCl}_2$  Sol in  $\text{H}_2\text{O}$  without decomp (W and D)

### Cæsium gold chloride

See Chloraurate, cæsium

### Cæsium iridium tetrachloride

See Chloriridate, cæsium

### Cæsium iron (ferric) chloride, $\text{CsFeCl}_4 + \frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Decomp in the air (Walden, Z anorg 1894, 7 332)  
 $\text{Cs}_2\text{FeCl}_5 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Walden)  
 $\text{Cs}_3\text{FeCl}_6 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Walden)

### Cæsium lanthanum chloride, $\text{Cs}_3\text{LaCl}_6 + 4\text{H}_2\text{O}$

Very hygroscopic Easily sol in  $\text{H}_2\text{O}$  (R J Meyer, Z anorg 1914, 86 273)

### Cæsium lead chloride, $\text{CsCl}, 2\text{PbCl}_2$

Nearly stable in aqueous solution (Campbell, Sill Am J 145 126)  
 $\text{CsCl}, \text{PbCl}_2$  Decomp by  $\text{H}_2\text{O}$  (Campbell)  
 $4\text{CsCl}, \text{PbCl}_2$  As above (Campbell)

### Cæsium lead tetrachloride

See Chloroplumbate, cæsium

### Cæsium magnesium chloride, $\text{CsCl}, \text{MgCl}_2 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Wells and Campbell, Z anorg 5 275)

### Cæsium manganous chloride, $\text{CsCl}, \text{MnCl}_2 + 2\text{H}_2\text{O}$

Not deliquescent, sol in  $\text{H}_2\text{O}$  (Saunders, Am Ch J 14 143)  
 $2\text{CsCl}, \text{MnCl}_2$  (Godffroy)  
 $+ 2\frac{1}{2}\text{H}_2\text{O}$  (Godffroy)  
 $+ 3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Conc  $\text{HCl} + \text{Aq}$  precipitates anhydrous salt from aqueous solution (Godffroy, B 8 9)  
 The only salt which exists contains  $2\text{H}_2\text{O}$  (Saunders Am Ch J 14 143)

### Cæsium manganic chloride, $2\text{CsCl}, \text{MnCl}_3$

Easily decomp (Meyer and Best, Z anorg 1899, 22 187)

### Cæsium mercuric chloride, $\text{CsCl}, \text{HgCl}_2$

100 pts solution sat at  $17^\circ$  contain 1 406 pts  $\text{CsHgCl}_3$  Not decomp by  $\text{H}_2\text{O}$  Insol in absolute alcohol, but sol on diluting with  $\frac{1}{3}$  vol  $\text{H}_2\text{O}$  (Wells, Sill Am J 144 221)  
 $2\text{CsCl}, \text{HgCl}_2$  Easily sol in  $\text{H}_2\text{O}$  and dil  $\text{HCl} + \text{Aq}$ , insol in conc  $\text{HCl} + \text{Aq}$  (Godffroy)

$3\text{CsCl}, \text{HgCl}_2$  Decomp by  $\text{H}_2\text{O}$ , on re-crystallizing from  $\text{H}_2\text{O}$ ,  $\text{CsCl}, \text{HgCl}_2$  is finally formed (Wells, Sill Am J 144 221)

$\text{CsCl}, 5\text{HgCl}_2$  Decomp by  $\text{H}_2\text{O}$  (Wells)  
 Solubility determinations show that the only double salts of  $\text{CsCl}$  and  $\text{HgCl}_2$  which exist at  $25^\circ$  are  $\text{Cs}_3\text{HgCl}_5$ ,  $\text{Cs}_2\text{HgCl}_4$ ,  $\text{CsHgCl}_3$ ,  $\text{CsHg}_2\text{Cl}_5$ ,  $\text{CsHg}_3\text{Cl}_{11}$  (Foote, Am Ch J 1903, 30 340)

### Cæsium molybdenum chloride, $\text{Cs}_2\text{MoCl}_5 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Nearly insol in alcohol and ether (Chilesotti, C C 1903, II 652)

### Cæsium molybdenyl chloride, $\text{CsCl}, \text{MoO}_2\text{Cl}_2 + \text{H}_2\text{O}$

Hygroscopic Decomp by  $\text{H}_2\text{O}$  (Weinland and Knoll, Z anorg 1905, 44 93)  
 $2\text{CsCl}, \text{MoO}_2\text{Cl}_2$  Hygroscopic Decomp by  $\text{H}_2\text{O}$  (Weinland and Knoll, Z anorg 1905, 44 92)  
 $2\text{CsCl}, 6\text{MoO}_2\text{Cl}_2 + 22\text{H}_2\text{O}$  Very hygroscopic Decomp by  $\text{H}_2\text{O}$  (Weinland and Knoll, Z anorg 1905, 44 94)  
 $2\text{CsCl}, \text{MoOCl}_3$  Only sl sol in  $\text{H}_2\text{O}$  (Nordenskiöld, B 1901, 34 1573)

### Cæsium neodymium chloride, $\text{Cs}_3\text{NdCl}_6 + 5\text{H}_2\text{O}$

Very hygroscopic Easily sol in  $\text{H}_2\text{O}$  (R J Meyer, Z anorg 1914, 86 273)

### Cæsium nickel chloride, $2\text{CsCl}, \text{NiCl}_2$

As the corresponding Cu salt  
 $\text{CsNiCl}_2$  Decomp by  $\text{H}_2\text{O}$  and by alcohol (Campbell, Am J Sci 1894, (3) 48 418)

### Cæsium palladium dichloride

See Chloropalladate, cæsium

### Cæsium palladium tetrachloride

See Chloropalladate, cæsium

### Cæsium praseodymium chloride, $\text{Cs}_3\text{PrCl}_6 + 5\text{H}_2\text{O}$

Very hygroscopic Easily sol in  $\text{H}_2\text{O}$  (R J Meyer, Z anorg 1914, 86 273)

### Cæsium rhodium chloride

See Chlororhodite, cæsium

### Cæsium ruthenium chloride

See Chlororuthenite, cæsium and chlororuthenate, cæsium

### Cæsium oxyruthenium chloride, $\text{Cs}_2\text{RuO}_2\text{Cl}_4$

Ppt, decomp by  $\text{H}_2\text{O}$ , sol in cold  $\text{HCl}$  (Howe, J Am Chem Soc 1901, 23 779)

### Cæsium samarium chloride, $\text{Cs}_3\text{SmCl}_6 + 5\text{H}_2\text{O}$

Very hygroscopic Easily sol in  $\text{H}_2\text{O}$  (R J Meyer, Z anorg 1914, 86 273)



**Cæsium silver chloride,  $2\text{CsCl}$ ,  $\text{AgCl}$** 

Easily decomp by  $\text{H}_2\text{O}$  (Wells and Wheeler, *Sill Am J* **144** 155)

**Cæsium tellurium chloride**

See Chlorotellurate, cæsium

**Cæsium thallic chloride,  $2\text{CsCl}$ ,  $\text{TlCl}_3$** 

By recryst from  $\text{H}_2\text{O}$  forms  $3\text{CsCl}$ ,  $2\text{TlCl}_3$  (Pratt, *Am J Sci* 1895, (3) **49** 398)

$+\text{H}_2\text{O}$  Readily sol in hot  $\text{H}_2\text{O}$  but  $3\text{CsCl}$ ,  $2\text{TlCl}_3$  cryst from the solution (Pratt, *Am J Sci* 1895, (3) **49** 399)

$3\text{CsCl}$ ,  $2\text{TlCl}_3$  Can be recryst from  $\text{H}_2\text{O}$  without change (Pratt, *Am J Sci* 1895, (3) **49** 401)

$3\text{CsCl}$ ,  $\text{TlCl}_3 + 2\text{H}_2\text{O}$  Sol in 36.4 pts  $\text{H}_2\text{O}$  at  $17^\circ$  and 3 pts at  $100^\circ$  (Godeffroy, *Zeitsch d allgem osterri Apothekerv* **1880** No 9)

**Cæsium tin (stannic) chloride**

See Chlorostannate, cæsium

**Cæsium titanium chloride,  $\text{TiCl}_3$ ,  $2\text{CsCl} + \text{H}_2\text{O}$** 

Difficultly sol in  $\text{H}_2\text{O}$  (Stahler, *B* 1904,

**ungsten chloride,  $\text{Cs}_3\text{W}_2\text{Cl}_9$** 

is insol in cold  $\text{H}_2\text{O}$

sol in a hot mixture of equal pts  $\text{H}_2\text{O}$  and conc  $\text{HCl}$

Nearly insol in conc  $\text{HCl}$

Sol in very dil  $\text{NaOH} + \text{Aq}$

Nearly insol in most organic solvents (Olsson, *B* 1913, **46** 574)

**Cæsium uranous chloride,  $\text{Cs}_2\text{UCl}_6$** 

As K salt (Aloy, *Bull Soc* 1899, (3) **21** 264)

**Cæsium uranyl chloride,  $2\text{CsCl}$ ,  $(\text{UO})\text{Cl}$** 

Sol in  $\text{H}_2\text{O}$  (Wells, *Z anorg* 1895, **10** 183)

100 pts of the solution contain at  $29.75^\circ$ , 56.07 pts  $\text{UO}_2\text{Cl}_2$ ,  $2\text{CsCl}$  (Rimbach, *B* 1904, **37** 468)

Pptd from aq solution by gaseous  $\text{HCl}$  (Wells, *Am J Sci* 1894, (3) **50** 251)

**Cæsium vanadium chloride,  $\text{Cs}_2\text{VdCl}_5 + \text{H}_2\text{O}$** 

Difficultly sol in  $\text{H}_2\text{O}$  and alcohol (Stahler, *B* 1904, **37** 4412)

**Cæsium zinc chloride,  $3\text{CsCl}$ ,  $\text{ZnCl}_2$** 

Sol in  $\text{H}_2\text{O}$  (Wells and Campbell, *Z anorg* **5** 275)

$2\text{CsCl}$ ,  $\text{ZnCl}_2$  Easily sol in  $\text{H}_2\text{O}$  and dil  $\text{HCl} + \text{Aq}$  Insol in conc  $\text{HCl} + \text{Aq}$  (Godeffroy)

**Cæsium chloride chromic oxychloride,  $2\text{CsCl}$ ,  $\text{CrOCl}_3$** 

Decomp in the air

Sol in conc  $\text{HCl}$  without decomp (Weinland, *B* 1906, **39** 4045)

**Cæsium chloride columbium oxychloride  $2\text{CsCl}$ ,  $\text{CbOCl}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Weinland, *B* 1906 **39** 3057)

**Cæsium chloroiodide,  $\text{CsCl}_2\text{I}$** 

Properties as  $\text{CsBrClI}$  (Wells)

$\text{CsCl}_4\text{I}$  Sol in  $\text{H}_2\text{O}$ , from which it can be recrystallized without decomp (Well and Wheeler)

**Cæsium mercuric chloroiodide,  $\text{Cs}_2\text{HgCl}_2\text{I}_2$** 

Decomp instantly by  $\text{H}_2\text{O}$  to  $\text{HgI}_2$  (Wells)

**Cæsium fluoride,  $\text{CsF}$** 

Ppt (Chabrie, *C R* 1901, **132** 680)

$+1\frac{1}{2}\text{H}_2\text{O}$  100 g  $\text{H}_2\text{O}$  dissolve 366.5 g  $\text{CsF}$  at  $15^\circ$  (de Forcrand, *C R* 1911, **152** 1210)

**Cæsium hydrogen fluoride,  $\text{CsHF}_6$** 

Ppt (Chabrie, *C R* 1901, **132** 680)

**Cæsium tantalum fluoride**

See Fluotantalate, cæsium

**Cæsium tellurium fluoride,  $\text{CsF}$ ,  $1\text{eF}_4$** 

Decomp by  $\text{H}_2\text{O}$  (Wells, *Am J Sci* 1901 (4) **12** 190)

**Cæsium titanium fluoride**

See Fluotitanate, cæsium

**Cæsium zirconium fluoride**

See Fluozirconate, cæsium

**Cæsium hydride,  $\text{CsH}$** 

Decomp by  $\text{H}_2\text{O}$  with evolution of  $\text{H}_2$  (Moissan, *C R* 1903, **136** 589)

**Cæsium hydroxide,  $\text{CsOH}$** 

Very deliquescent and sol in  $\text{H}_2\text{O}$  So in alcohol

79.41%  $\text{CsOH}$  is contained in sat aq solution at  $15^\circ$  (de Forcrand, *C R* 1909 **14** 1344)

75.08%  $\text{CsOH}$  is contained in sat aq solution at  $30^\circ$  (Schreinemakers, *C C* **1909**, **11**)

**Cæsium iodide,  $\text{CsI}$** 

Sol in  $\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve 44 pts  $\text{CsI}$  at 0 66.3 pts at  $14.5^\circ$ , 160 pts at  $61^\circ$

Sp gr of  $\text{CsI} + \text{Aq}$  sat at  $14^\circ = 1.39$  (Betekoff, *Bull Soc Pétrobr* (4) **2** 197)

**Cæsium periodide**

Solubility determinations show that  $\text{CsI}_3$  and  $\text{CsI}_5$  are the only periodides of cæsium existing between  $-4^\circ$  and  $+73^\circ$  (Foote, Am Ch J 1903, 29 203)

**Cæsium triiodide,  $\text{CsI}_3$** 

1 ccm sat  $\text{CsI} + \text{Aq}$  dissolves 0.0097 g  $\text{CsI}_3$ , and sp gr of solution is 1.154. Only sl decomp by solution in  $\text{H}_2\text{O}$ . Much more sol in alcohol than in  $\text{H}_2\text{O}$ . Not immediately decomp by ether (Wells, Sill Am J 143 17)

**Cæsium pentaoidide,  $\text{CsI}_5$** **Cæsium cobalt iodide,  $\text{Cs}_2\text{CoI}_4$** 

Decomp by  $\text{H}_2\text{O}$  (Campbell, Z anorg 1894, 8 12)

Deliquescent, decomp by  $\text{H}_2\text{O}$  and by alcohol (Campbell, Am J Sci 1894, (3) 43 418)

**Cæsium lead iodide,  $\text{CsPbI}_2$** 

Sl sol in hot  $\text{CsI} + \text{Aq}$  (Wheeler, Sill Am J 145 129)

**Cæsium mercuric iodide,  $\text{CsI}, 2\text{HgI}_2$** 

Decomp by  $\text{H}_2\text{O}$  finally into  $\text{HgI}_2$  (Wells, Sill Am J 144 221)

$2\text{CsI}, 3\text{HgI}$  Decomp by  $\text{H}_2\text{O}$  finally into  $\text{HgI}$

$\text{CsI}, \text{HgI}_2$  As above

$2\text{CsI}, \text{HgI}$  Decomp by  $\text{H}_2\text{O}$  insol in alcohol

$3\text{CsI}, \text{HgI}_2$  As above

**Cæsium silver iodide,  $\text{CsI}, \text{AgI}$** 

(Penfield, Z anorg 1 100)

$\text{CsI}, 2\text{AgI}$  Moist sol in hot th un in cold acetone (Mush, Chem Soc 1913, 103 782)

**Cæsium tellurium iodide**

See Iodotellurate, cæsium

**Cæsium thallic iodide,  $\text{CsI}, \text{HI}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Pratt, Am J Sci 1895, (3) 49 403)

**Cæsium zinc iodide,  $3\text{CsI}, \text{ZnI}_2$** 

Sol in  $\text{H}_2\text{O}$  (Wells and Campbell, Z anorg 5 275)

$2\text{CsI}, \text{ZnI}_2$  As above

**Cæsium oxide,  $\text{Cs}_2\text{O}$** 

Absorbs  $\text{H}_2\text{O}$  and  $\text{CO}_2$  from the air. Decomp by  $\text{H}_2\text{O}$  and by liquid  $\text{NH}_3$  (Rengade, C R 1906, 143 593)

**Cæsium dioxide,  $\text{Cs}_2\text{O}_2$** 

Decomp by  $\text{H}_2\text{O}$  (Rengade, C R 1905, 140 1537)

**Cæsium trioxide,  $\text{Cs}_2\text{O}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Rengade, C R 1905, 140 1537)

**Cæsium tetroxide,  $\text{Cs}_2\text{O}_4$** 

Decomp by  $\text{H}_2\text{O}$  (Rengade, C R 1905, 140 1538)

**Cæsium sulphide,  $\text{Cs}_2\text{S} + 4\text{H}_2\text{O}$** 

Deliquescent, very sol in  $\text{H}_2\text{O}$  (Biltz, Z anorg 1906, 48 300)

**Cæsium disulphide,  $\text{Cs}_2\text{S}_2$** 

Anhydrous Sol in  $\text{H}_2\text{O}$  Hydrosopic (Biltz, Z anorg 1906, 50 72)

$+ \text{H}_2\text{O}$  From  $\text{Cs}_2\text{S}_2 + \text{Aq}$  Hydrosopic (Biltz, Z anorg 1906, 50 72)

**Cæsium trisulphide,  $\text{Cs}_2\text{S}_3$** 

Anhydrous Sol in  $\text{H}_2\text{O}$  Not hydrosopic (Biltz, Z anorg 1906, 50 75)

$+ \text{H}_2\text{O}$  From  $\text{Cs}_2\text{S}_3 + \text{Aq}$  (Biltz, Z anorg 1906, 50 76)

**Cæsium tetrasulphide,  $\text{Cs}_2\text{S}_4$** 

Sol in  $\text{H}_2\text{O}$  Insol in abs alcohol (Biltz, Z anorg 1906, 48 305)

**Cæsium pentasulphide,  $\text{Cs}_2\text{S}_5$** 

Mpt  $2^\circ$  Not hydrosopic. Very sol in cold 70% alcohol (Biltz, B 1905, 38 129)

**Cæsium hydrogen sulphide,  $\text{CsHS}$** 

Deliquescent, very sol in  $\text{H}_2\text{O}$  (Biltz, Z anorg 1906, 48 300)

**Cæsium copper tetrasulphide,  $\text{CsCuS}_4$** 

Sl sol in cold  $\text{H}_2\text{O}$

Decomp by conc and dil  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$

Sl sol in alcohol (Biltz, B 1907, 40 978)

**Calcium,  $\text{Ca}$** 

Decomp  $\text{H}_2\text{O}$  violently. Slowly attacked by cold  $\text{H}_2\text{SO}_4$ . Dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  or  $\text{HCl} + \text{Aq}$  attack violently and dissolve. Dil  $\text{HNO}_3 + \text{Aq}$  oxidizes, but fuming  $\text{HNO}_3$  scarcely attacks even on boiling (Bunsen and Matthiessen). Not attacked by anhydrous alcohol (Fies-Bodart and Jobin, A ch (3) 54 364)

Pure  $\text{Ca}$  is only very slowly decomp by  $\text{H}_2\text{O}$  at ordinary temp, sol in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  (Moissan, C R 1898, 129 589)

Insol in liquid  $\text{NH}_3$  (Gron, Am Ch J 1898, 20 527)

1 ccm conc acid dissolves 0.0334 g  $\text{Ca}$  in 6 days (Gates, J phys Chem 1911, 15 143)

**Calcium amalgam,  $\text{Ca}, \text{Hg}_4$** 

Decomp  $\text{H}_2\text{O}$  readily (Bercl, C R 1898, 127 619)

$\text{CaHg}_5$  Rapidly decomp in moist air (Schurger, Z anorg 1900, 25 425)

**Calcium amide,  $\text{Ca}(\text{NH}_2)_2$** 

(Moissan, A ch 1899, (7) 18 326)

**Calcium ammonia,  $\text{Ca}, 4\text{NH}_3$** Decomp at ordinary temp, takes fire in contact with the air, sl sol in liquid  $\text{NH}_3$  (Moissan, C R 1898, 127 691) $\text{Ca}, 6\text{NH}_3$  (Kraus, J Am Chem Soc 1908, 30 665)**Calcium arsenide,  $\text{Ca}_3\text{As}_2$** Decomp by cold  $\text{H}_2\text{O}$ , insol in cold fuming  $\text{HNO}_3$ , very sol in hot  $\text{HNO}_3$  (Lebeau, C R 1899, 128 98)**Calcium azomide,  $\text{Ca}(\text{N}_3)_2$** 

Hydroscopic, explosive

38 1 pts sol in 100 pts  $\text{H}_2\text{O}$  at  $0^\circ$   
45 0 " " " 100 " " 15 2  
0 211 " " " 100 " abs alcohol " 16Sol in  $\text{H}_2\text{O}$ , decomp when heated and on standing in the air (Dennis, Z anorg 1898, 17 21)

Insol in pure ether (Curtius, J pr 1898, (2) 58 286)

**Calcium boride,  $\text{CaB}_2$** Not decomp by  $\text{H}_2\text{O}$  at  $250^\circ$ , sol in fused oxidizing agentsInsol in aq acids, sl sol in conc  $\text{H}_2\text{SO}_4$ , sol in dil or conc  $\text{HNO}_3$  (Moissan, C R 1897, 125 631-32)**Calcium bromide,  $\text{CaBr}$** Very deliquescent 100 pts  $\text{H}_2\text{O}$  dissolve—  
at  $0^\circ$  20° 40° 60° 105°  
125 143 213 278 312 pts  $\text{CaBr}$   
(Krems, Pogg 103 65)Sat  $\text{CaBr}_2 + \text{Aq}$  contains at  
 $-22^\circ$   $-22^\circ$   $-14^\circ$   $-7^\circ$   $-5^\circ$   
50 5 50 2 52 5 52 6 52 6%  $\text{CaBr}_2$  $+8^\circ$   $9^\circ$   $11^\circ$   $20^\circ$   $50^\circ$   
1 55 1 55 7 57 1 62 6%  $\text{CaBr}_2$   
(Étard, A ch 1894, (7) 2 540)Sp gr of  $\text{CaBr}_2 + \text{Aq}$  at  $19.5^\circ$  containing  
5 10 15 20 25 %  $\text{CaBr}_2$ ,  
1 044 1 089 1 139 1 194 1 25030 35 40 45 50 %  $\text{CaBr}_2$   
1 315 1 385 1 461 1 549 1 641

(Krems, Pogg 99 444, calculated by Goulach, Z anal 8 285)

Sl sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

Very sol in alcohol (Henry)

Sol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4328)

Sol in methyl acetate (Naumann, B 1909, 42 3790)

Sol in ethyl acetate (Naumann, B 1910 43 314)

Insol in benzonitrile (Naumann, B 1914 47 1370)  
 $+4\text{H}_2\text{O}$  (Kuznetsov, C A 1911 842)  
 $+6\text{H}_2\text{O}$ **Calcium manganous bromide,  $\text{CaMnBr}_4 + 4\text{H}_2\text{O}$** 

Sl hydroscopic Unstable (Ephraim, Z anorg 1910, 67 377)

**Calcium mercuric bromide**Decomp by  $\text{H}_2\text{O}$  (v Bonsdorff)**Calcium molybdenyl bromide,  $\text{CaBr}_2, 2\text{MoOBr}_3 + 7\text{H}_2\text{O}$** 

(Weinland and Knoll, Z anorg 1905, 44 112)

**Calcium stannic bromide**

See Bromostannate, calcium

**Calcium bromide ammonia,  $\text{CaBr}_2, 6\text{NH}_3$** Sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 55 239)**Calcium bromide hydrazine,  $\text{CaBr}_2, 3\text{N}_2\text{H}_4$** Easily sol in  $\text{H}_2\text{O}$  (Franzen, Z anorg 1908, 60 288)**Calcium bromofluoride,  $\text{CaBrF}$** Decomp by  $\text{H}_2\text{O}$  (Defacqz, A ch 1904, (8) 1 357)**Calcium carbide,  $\text{CaC}$** Sp gr 2 22 at  $18^\circ$  Insol in fuming  $\text{HNO}_3$  and conc  $\text{H}_2\text{SO}_4$  but readily decomp by dil acids and  $\text{H}_2\text{O}$  (Moissan, Bull Soc 1894, (3) 11 1005)Insol in  $\text{HCl}$  in the cold, but decomp at red heat Strong min acids do not act in the cold sol in glacial acetic in the cold, sol in fused alkali (Venables, J Am Chem Soc 1895, 17 307-310)**Calcium chloride,  $\text{CaCl}$** Very deliquescent Very sol in  $\text{H}_2\text{O}$  with evolution of heatAnhydrous  $\text{CaCl}$  is sol in 1 59 pts  $\text{H}_2\text{O}$  (Crichton)Anhydrous  $\text{CaCl}$  is sol in 1 58 pts  $\text{H}_2\text{O}$  at  $10.2^\circ$  (Krems, Pogg 103 67)Anhydrous  $\text{CaCl}$  is sol in 1 33 pts  $\text{H}_2\text{O}$  at  $20.0^\circ$  83 pt  $\text{H}_2\text{O}$  at  $40.0^\circ$  72 pt  $\text{H}_2\text{O}$  at  $60.0^\circ$  ( $\text{CaCl} + 6\text{H}_2\text{O}$ )Sol in 0 5 pt  $\text{H}_2\text{O}$  at 0 and 2 03 pt at  $16^\circ$  (Crichton) $\text{CaCl}$  is sol in 1 5 pts cold and 0 83 pt boiling  $\text{H}_2\text{O}$  (Fourroy) $\text{CaCl}_2 + \text{Aq}$  sat in the cold contains 40 7 %  $\text{CaCl}$  (Fourroy) $\text{CaCl} + \text{Aq}$  sat at  $12^\circ$  contains 33 8 %  $\text{CaCl}$  (Hassendratz)100 pts  $\text{H}_2\text{O}$  dissolve 165 7 pts  $\text{CaCl} + 6\text{H}_2\text{O}$  at  $0^\circ$ , 7141 pts at  $40^\circ$  (Hilden Chem Soc 45 409)100 pts  $\text{H}_2\text{O}$  dissolve 60 3 pts  $\text{CaCl}_2$  from  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  at  $0^\circ$ , and solution has sp gr = 1 367 (Engel, Bull Soc (2) 47 318)

Solubility of  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Sat solution contains % $\text{CaCl}_2$	Sat solution contains % $\text{CaCl}_2 + 6\text{H}_2\text{O}$
-22	32 24	63 61
0	36 91	72 82
+ 7 39	38 77	76 49
13 86	41 03	80 95
19 35	42 50	83 85
23 46	44 15	87 11
24 47	45 33	89 44
27 71	46 30	91 35
29 53	50 67	99 97

(Hammerl, W A B 72, 2 287)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$
0	59 39	13 86	69 49
5	64 83	19 35	73 91
7 88	66 20	21 89	79 77

(Hammerl, calculated by Bakhuis Roozeboom, R t c 8 5)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$
0	49 6	19	72	38	108
1	50	20	74	39	109
2	51	21	75	40	110
3	52	22	77	41	111
4	53	23	79	42	112
5	54	24	80	43	113
6	55	25	82	44	114
7	56	26	84	45	115
8	57	27	87	46	116
9	58	28	89	47	117
10	60	29	91	48	118
11	61	30	93	49	119
12	62	31	96	50	120
13	63	32	98	51	121
14	65	33	100	52	122
15	66	34	103	53	123
16	68	35	104	54	124
17	69	36	105	55	125
18	71	37	107	56	126
57	127	72	137	87	145
58	128	73	138	88	146
59	129	74	138	89	147
60	129	75	139	90	147
61	130	76	139	91	148
62	131	77	140	92	149
63	131	78	141	93	150
64	132	79	141	94	150
65	133	80	142	95	151
66	133	81	142	96	152
67	134	82	143	97	152
68	135	83	143	98	153
69	135	84	144	99	154
70	136	85	144	179 5	325
71	136	86	145		

If solubility  $S = \text{pts anhydrous } \text{CaCl}_2$  in 100 pts solution,  $S = 32 + 0.2148t$  from  $-18^\circ$  to  $+6^\circ$ ,  $S = 54.5 + 0.0755t$  from  $50^\circ$  to  $120^\circ$  (Étard, C R 98 1432)

According to Bakhuis Roozeboom, the solubility of  $\text{CaCl}_2$  varies according to the hydrate employed, and the following data were obtained as the result of very exact experiments

Solubility of  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$
20 4	75 1	28 0	88 8	29 5	96 07
25 05	81 67	28 9	92 05	30 2	102 7

There are two modifications of  $\text{CaCl}_2 + 4\text{H}_2\text{O}$ ,  $\alpha$  and  $\beta$

Solubility of  $\text{CaCl}_2 + 4\text{H}_2\text{O}\beta$  in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$
18 4	103 3	35 0	122 74
25 0	108 8	38 4	127 50
30 0	114 1		

Solubility of  $\text{CaCl}_2 + 4\text{H}_2\text{O}\alpha$  in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$
22 0	92 67	35 95	107 21
24 7	95 59	40 00	115 3
29 8	100 6	45 00	129 9

Solubility of  $\text{CaCl}_2 + 2\text{H}_2\text{O}$  in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$	$t^\circ$	Pts $\text{CaCl}_2$
40	128 1	95 8	156 5	139	191 0
45	129 9	115	169 5	155	214 3
50	132 3	124	176 0	165	236 2
59 5	136 5	137	187 6	174	275 7
80 5	145 3				

Solubility of  $\text{CaCl}_2 + \text{H}_2\text{O}$  in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{CaCl}_2$
191	306
235	331

(Mulder, Scheik Verhandel 1864 107)

(Bakhuis Roozeboom, R t c 8 1)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$ 

% $\text{CaCl}_2$	Sp gr	% $\text{CaCl}_2$	Sp gr	% $\text{CaCl}_2$	Sp gr
3.95	1.03	20.85	1.18	34.57	1.33
7.66	1.06	23.93	1.21	36.49	1.36
11.23	1.09	26.86	1.24	38.31	1.39
14.42	1.12	29.67	1.27	40.43	1.42
17.60	1.15	32.35	1.30	41.91	1.45

(Richter)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$  at 19.5° containing pts  $\text{CaCl}_2$  to 100 pts  $\text{H}_2\text{O}$ 

Pts $\text{CaCl}_2$	Sp gr	Pts $\text{CaCl}_2$	Sp gr
6.97	1.0545	36.33	1.2469
12.58	1.0954	50.67	1.3234
23.33	1.1681	62.90	1.3806

(Kremers Pogg 99 444)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$   $G = \text{sp gr at } 15^\circ \text{ if } \%$   
 is  $\text{CaCl}_2$ , according to Gerlach,  $S = \text{sp gr}$   
 at  $18.3^\circ \text{ if } \%$  is  $\text{CaCl}_2 + 6\text{H}_2\text{O}$ , according  
 to Schiff

%	G	S	%	G	S
1	1.00852	1.0039	36	1.35610	1.1575
2	1.01704	1.0079	37	1.36790	1.1622
3	1.02555	1.0119	38	1.37970	1.1671
4	1.03407	1.0159	39	1.39150	1.1719
5	1.04259	1.0200	40	1.40330	1.1768
6	1.05146	1.0241	41		1.1816
7	1.06033	1.0282	42		1.1865
8	1.06921	1.0323	43		1.1914
9	1.07808	1.0365	44		1.1963
10	1.08695	1.0407	45		1.2012
11	1.09628	1.0449	46		1.2062
12	1.00561	1.0491	47		1.2112
13	1.10494	1.0534	48		1.2162
14	1.12427	1.0577	49		1.2212
15	1.13360	1.0619	50		1.2262
16	1.14332	1.0663	51		1.2312
17	1.15305	1.0706	52		1.2363
18	1.16277	1.0750	53		1.2414
19	1.17250	1.0794	54		1.2465
20	1.18222	1.0838	55		1.2516
21	1.19251	1.0882	56		1.2567
22	1.20279	1.0927	57		1.2618
23	1.21308	1.0972	58		1.2669
24	1.22336	1.1017	59		1.2721
25	1.23365	1.1062	60		1.2773
26	1.24450	1.1107	61		1.2825
27	1.25535	1.1153	62		1.2877
28	1.26619	1.1199	63		1.2929
29	1.27704	1.1246	64		1.2981
30	1.28789	1.1292	65		1.3034
31	1.29917	1.1339	66		1.3087
32	1.31045	1.1386	67		1.3140
33	1.32174	1.1433	68		1.3193
34	1.33602	1.1480	69		1.3246
35	1.34430	1.1527	70		1.3300

(Calculated by Gerlach, Z. anal. 8, 283)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$   $a = \text{no of half molec}$   
 in grammes dissolved in 1000 g  $\text{H}_2\text{O}$ ,  
 $b = \text{sp gr at } 24.3^\circ \text{ when } a = \text{CaCl}_2 +$   
 $6\text{H}_2\text{O}$  ( $\frac{1}{2} \text{ mol} = 109.5 \text{ g}$ ),  $c = \text{sp gr at}$   
 $24.3^\circ \text{ when } a = \text{CaCl}_2$  ( $\frac{1}{2} \text{ mol} = 55.5$ )

a	b	c	a	b	c
1	1.041	1.043	7	1.198	1.2
2	1.076	1.084	8	1.214	
3	1.106	1.122	9	1.229	
4	1.133	1.159	10	1.242	
5	1.157	1.193	11	1.255	
6	1.179	1.227			

(Favre and Valson, C. R. 79 968)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$  at  $18^\circ$ 

% $\text{CaCl}_2$	Sp gr	% $\text{CaCl}_2$	Sp gr
5	1.0409	25	1.2305
10	1.0852	30	1.2841
15	1.1311	35	1.3420
20	1.1794		

(Kohlrausch, W. Ann. 1879 1)

$\text{CaCl}_2 + \text{Aq}$  sat at  $0^\circ$  has sp gr = 1.7  
 (Engel, Bull. Soc. 1887, (2) 47 318)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$  at  $9.5^\circ\text{C}$ 

Mass of salt per unit mass of solution	Density of solution ( $\mu$ per cc)
0.00191	1.00168
0.00381	1.00317
0.00570	1.00465
0.00759	1.00615
0.00947	1.00765
0.01320	1.01050

(McGregor, C. N. 1887, 55 6)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$  at  $25^\circ$ 

Concentration of $\text{CaCl}_2 + \text{Aq}$	Sp gr
1-normal	1.0446
$\frac{1}{2}$ -normal	1.0218
$\frac{1}{3}$ -normal	1.0105
$\frac{1}{4}$ -normal	1.0050

(Wagner, Z. phys. Ch. 1890 5 36)

Sp gr at  $16^\circ/4^\circ$  of  $\text{CaCl}_2 + \text{Aq}$  containing  
 12.1638%  $\text{CaCl}_2 = 1.10489$  (Schonrock, Z.  
 phys. Ch. 1895 11 768)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$  at 17 925°C

% $\text{CaCl}_2$	Sp gr	% $\text{CaCl}_2$	Sp gr	% $\text{CaCl}_2$	Sp gr
0 0	0 99869	13	1 11206	33	1 31562
0 1	0 99954	14	1 12130	34	1 32689
0 2	1 00037	15	1 13067	35	1 33821
0 3	1 00116	16	1 14016	36	1 34956
0 4	1 00201	17	1 14969	37	1 36100
0 6	1 00371	18	1 15926	38	1 37242
0 8	1 00539	19	1 16920	39	1 38400
1 0	1 00703	20	1 17910	40	1 39489
1 5	1 01127	21	1 18897	41	1 40641
2	1 01548	22	1 19901	42	1 41770
3	1 02386	23	1 20901	43	1 42882
4	1 03238	24	1 21918	44	1 44007
5	1 04089	25	1 22941	45	1 45124
6	1 04951	26	1 23969	46	1 46238
7	1 05822	27	1 25030	47	1 47329
8	1 06680	28	1 26092	48	1 48450
9	1 07569	29	1 27182	49	1 49573
10	1 08467	30	1 28271	50	1 50676
11	1 09373	31	1 29360	51	1 51778
12	1 10288	32	1 30461		

(Pickering, B 1894, 27 1385)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$  at t°

t	Concentration of $\text{CaCl}_2 + \text{Aq}$	Sp gr
20	1 pt $\text{CaCl}_2$ in 7 1045 pts $\text{H}_2\text{O}$	1 1062
20	1 " " " 164 25 " "	1 0032

(Hittorf, Z phys Ch 1902, 39 628)

Sp gr of  $\text{CaCl}_2 + \text{Aq}$  at 20°

$\mu$ mol $\text{CaCl}_2$ per l	Sp gr
0 010	1 000982
0 025	1 002539
0 050	1 004874
0 075	1 006814
0 10	1 008971
0 25	1 02267
0 50	1 04451
0 75	1 06641
1 00	1 08744

(Jones and Pearce, Am Ch J 1907, 38 606)

Sat  $\text{CaCl}_2 + \text{Aq}$  forms crust at 150°, and contains 178 pts  $\text{CaCl}_2$  to 100 pts  $\text{H}_2\text{O}$  (Gerlach)

Sat  $\text{CaCl}_2 + \text{Aq}$  boils at 180° (Rudolf)

B-pt of  $\text{CaCl}_2 + \text{Aq}$  containing pts  $\text{CaCl}_2$  to 100 pts  $\text{H}_2\text{O}$  G=according to Gerlach (Z anal 26 440), L=according to Le-grand (A ch (2) 39 43)

B pt	G	L	B pt	G	L
101°	6 0	10	134°		117 2
102	11 5	16 5	135	119	
103	16 5	21 6	136		123 5
104	21 0	25 8	138		129 9
105	25 0	29 4	140	137 5	136 3
106	29 0	32 6	142		142 8
107	32 5	35 6	144		149 4
108	35 5	38 5	145	157	
109	38 5	41 3	146		156 2
110	41 5	44 0	148		163 2
111		46 8	150	178	170 5
112		49 7	152		178 1
113		52 6	154		186 0
114		55 6	155	200	
115	55 0	58 6	156		194 3
116		61 6	158		203 0
117		64 6	160	222	212 1
118		67 6	162		221 6
119		70 6	164		231 5
120	69 0	73 6	165	245	
121		76 7	166		241 9
122		79 8	168		252 8
123		82 9	170	268	264 2
124		86 0	172		276 1
125		89 1	174		285 5
126		92 2	175	292	
128		98 4	176		301 4
130	101	104 6	178	305	314 8
130 4	102 67		179 5		325 0
132		110 9			

B-pt of  $\text{CaCl}_2 + \text{Aq}$ 

% $\text{CaCl}_2$	B pt	% $\text{CaCl}_2$	B pt
5 6	101°	17 5	104°
10 3	102	20 0	105
14 5	103		

(Skinner, Chem Soc 61 340)

Less sol in  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$   $\text{HCl} + \text{Aq}$  sat at 12° dissolves 27%  $\text{CaCl}_2$  which crystallizes out with  $2\text{H}_2\text{O}$  (Ditt, C R 92 242)

Solubility of  $\text{CaCl}_2$  in  $\text{HCl} + \text{Aq}$  at 0°

Sp gr of solutions	$\mu$ per 100 cc solution	
	$\text{CaCl}_2$	$\text{HCl}$
1 367	51 45	0 0
1 344	46 45	3 32
1 326	42 80	5 83
1 310	36 77	10 66
1 285	29 84	15 84
1 250	20 12	23 05
1 238	11 29	34 62

(Engel, C R 1887 104, 434)

$\text{CaCl}_2 + \text{CaO}_2\text{H}_2$  Solubility of  $\text{CaCl}_2 + \text{CaO}_2\text{H}_2$  in  $\text{H}_2\text{O}$  at  $25^\circ$

% $\text{CaCl}_2$	% $\text{CaO}_2\text{H}_2$	Solid phase
5 02	0 101	$\text{CaO}_2\text{H}_2 + \text{CaCl}_2 \cdot 4\text{CaO} \cdot 14\text{H}_2\text{O}$ $\text{CaCl}_2 \cdot 4\text{CaO} \cdot 14\text{H}_2\text{O}$
10 00	0 115	
12 94	0 128	
15 14	0 140	
17 20	0 145	
18 15	0 148	
18 01	0 152	
21 02	0 147	
23 80	0 146	
24 33	0 147	
28 37	0 170	$\text{CaO} \cdot \text{H}_2\text{O}$ $\text{CaCl}_2 \cdot 4\text{CaO} \cdot 14\text{H}_2\text{O}$ $\text{CaO} \cdot 2\text{H}_2\text{O}$ $\text{CaCl}_2 \cdot \text{CaO} \cdot 2\text{H}_2\text{O}$
29 54	0 180	
32 67	0 225	
33 21	0 245	
33 72	0 254	
34 36	0 173	
38 61	0 060	
41 32	0 048	
44 30	0 030	
44 60	0 029	
44 77		$\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$

(Schreinemakers and Figuee, Chem Weekbl 1911, 8 685)

See also under **Calcium hydroxide**

$\text{CaCl}_2 + \text{KCl}$  100 pts  $\text{H}_2\text{O}$  dissolve 56 pts  $\text{CaCl}_2$  at  $7^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve 31 pts  $\text{KCl}$  at  $7^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve 63 5 pts  $\text{CaCl}_2 + 4 9$  pts  $\text{KCl}$  at  $7^\circ$  (Mulder, J B 1866 67)

$\text{CaCl}_2 + \text{NaCl}$  100 pts  $\text{H}_2\text{O}$  dissolve 53 pts  $\text{CaCl}_2$  at  $4^\circ$ , and 56 pts at  $7^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve 35 7 pts  $\text{NaCl}$  at  $4^\circ$ , and 35 7 pts at  $7^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve 57 6 pts  $\text{CaCl}_2 + 2 4$  pts  $\text{NaCl}$  at  $4^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve 59 5 pts  $\text{CaCl}_2 + 4 6$  pts  $\text{NaCl}$  at  $7^\circ$  (Mulder, l c)

100 g  $\text{H}_2\text{O}$  dissolve 72 6 g  $\text{CaCl}_2 + 16 0$  g  $\text{NaCl}$  at  $15^\circ$  (Rudorff)

Sol in sat  $\text{KNO}_3 + \text{Aq}$  (Foureroy)  
Insol in liquid  $\text{CO}_2$  (Buchner, Z phys Ch 1906, 54 674)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

Sol in 1 pt strong boiling alcohol (Wenzel)

Sol in 8 pts alcohol at  $15^\circ$ , and in 1 pt spirits of wine (Beigman)

Sol in 0 7 pt boiling absolute alcohol (Otto)

Sol in 1 43 pts boiling absolute alcohol at  $78 3^\circ$  (Graham)

Solubility of  $\text{CaCl}_2$  in methyl alcohol  
 $\text{CaCl}_2$  forms with methyl alcohol two complexes  $\text{CaCl}_2 \cdot 4\text{CH}_3\text{OH}$  and  $\text{CaCl}_2 \cdot 3\text{CH}_3\text{OH}$

Solubility of  $\text{CaCl}_2, 4\text{CH}_3\text{OH}$  in  $\text{CH}_3\text{OH}$

$t^\circ$	% by weight of $\text{CaCl}_2 \cdot 4\text{CH}_3\text{OH}$
0	33 3
10	37 6
20	42 2
30	47 0
40	52 0
50	57 3
55	60 0
56	61 3

Solubility of  $\text{CaCl}_2, 3\text{CH}_3\text{OH}$  in  $\text{CH}_3\text{OH}$

$t^\circ$	% by weight of $\text{CaCl}_2 \cdot 3\text{CH}_3\text{OH}$
55	60 5
75	63 1
95	66 3
115	70 3
135	75 2
155	81 8
165	86 2
170	89 5
174	93 5
177 (mpt)	100

(Menschutkin, Z anorg 1907, 52 21)

Solubility of  $\text{CaCl}_2$  in ethyl alcohol

$\text{CaCl}_2$  forms with ethyl alcohol a complex  $\text{CaCl}_2 \cdot 3\text{C}_2\text{H}_5\text{OH}$

Solubility of  $\text{CaCl}_2 \cdot 3\text{C}_2\text{H}_5\text{OH}$  in  $\text{C}_2\text{H}_5\text{OH}$  at  $t^\circ$

$t^\circ$	% by weight of $\text{CaCl}_2 \cdot 3\text{C}_2\text{H}_5\text{OH}$	$t$	%
0	34 8	80	56 5
20	46 0	85	59 2
40	58 7	90	91 9
60	73 0	95	96 2
70	80 8	97 mpt	100

(Menschutkin, Z anorg 1907, 52 21)

Sp gr at  $16^\circ/4^\circ$  of  $\text{CaCl}_2$  + alcohol containing 5 668%  $\text{CaCl}_2 = 0 836 36$  (Schonrod Z phys Ch 1893, 11 768)

B-pt of an alcoholic solution of  $\text{CaCl}_2$

% $\text{CaCl}_2$	B pt
2 4	$78 43 + 0 70$
5 39	$78 43 + 2 11$
8 01	$78 43 + 4 18$
9 93	$78 43 + 5 55$
15 94	$78 43 + 11 71$

(Skinner, Chem Soc 61 340)

Sol sol in propyl alcohol (Berthelot)

100 g propyl alcohol dissolve 10 75 g  $\text{CaCl}_2$  (Schlamp Z phys Ch 1894, 14, 276)

Sol sol in amyl alcohol (Bous)

Pptd from alcoholic solution by ether (Dobbiner)

Sol in wood-spirit, sol in lignone (Liebig),  
insol in lignone (Gmelin)

Insol in acetone, sol in butyl alcohol  
(Wurtz)

Very sl sol in acetone (Krug and  
M'Elroy, J Anal Ch 6 184)

Solubility in acetone + Aq at 20°

CaCl<sub>2</sub> will salt out acetone from aqueous  
solution. The table shows the composition  
of the solutions at the points at  
which inhomogeneous solutions of CaCl<sub>2</sub>,  
acetone and H<sub>2</sub>O just become homogen-  
eous at 20° 100 g of the solution contain

g CaCl <sub>2</sub>	g H <sub>2</sub> O	g acetone
13 03	52 49	34 48
8 5	45 37	46 15
6 38	39 51	54 11
5 35	35 95	58 70
4 11	31 8	64 09
3 58	29 88	66 54
3 31	28 59	68 10
3 04	27 03	69 93
2 77	26 67	70 56
13 90	53 47	32 63
10 12	48 86	41 02
8 47	45 59	45 94
6 92	41 24	51 84
6 31	39 15	54 54
5 28	36 09	58 63
4 94	34 72	60 34
4 37	33 8	61 83
1 99	23 38	74 63
1 6	21 4	77 00
1 35	19 92	78 73
18 787	55 301	25 913
12 443	52 153	35 404
10 70	49 61	39 69
9 59	47 75	42 66
8 52	46 04	45 14
7 48	42 75	49 77
7 07	41 54	51 39
6 72	40 48	52 8
30 04	49 39	20 57
18 23	55 01	26 76
15 49	54 00	30 51
13 18	52 52	34 3
11 40	50 20	38 40
28 09	51 71	20 20
26 81	52 01	21 18
22 67	55 66	21 67
18 189	56 21	25 60
31 21	48 00	20 81
2 23	24 93	72 84
1 82	22 27	75 89
0 68	15 57	83 44
0 58	14 93	84 49
0 45	13 55	86 00
0 48	14 49	85 13
0 27	12 31	87 42
0 20	9 95	89 85
0 15	9 05	90 81

(Frankforter, J Am Chem Soc 1914, 36  
1125)

Sol in many compound ethers, as ethyl  
acetate (Liebig), ethyl lactate (Strecker)

Sol in considerable quantity in amyl sul-  
phocyanide (Medlock, Chem Soc 1 374)

Sol in valyl (Kolbe)

Very sol in conc HC<sub>2</sub>H<sub>3</sub>O (Liebig)

Solubility of CaCl in acetic acid

CaCl<sub>2</sub> forms with acetic acid a complex,  
CaCl<sub>2</sub>, 4CH<sub>3</sub>COOH

Solubility of CaCl<sub>2</sub>, 4CH<sub>3</sub>COOH in  
CH<sub>3</sub>COOH at t°

t°	% by wt CaCl <sub>2</sub> 4CH <sub>3</sub> COOH
11 1	42 0
30	47 6
35	50 0
40	54 7
45	63 0
50	69 5
60	79 5
65	84 5
70	91 2
73	100 0

(Menschutkin, Z anorg 1907, 54 95)

Insol in benzomtrile (Naumann, B 1914,  
47 1370)

Insol in ethyl acetate (Naumann, B  
1910, 43 314)

Sl sol in anhydrous pyridine

Sol in 97%, 95% and 93% pyridine + Aq  
(Kahlenberg, J Am Chem Soc 1908, 30  
1107)

100 g sat solution of CaCl<sub>2</sub> in sat sugar +  
Aq at 31 25° contain 42 84 g sugar + 25 25 g  
CaCl<sub>2</sub>, or 100 g H<sub>2</sub>O dissolve 135 1 g sugar  
+ 79 9 g CaCl<sub>2</sub> at 31 25° (Kohler, Z Ver  
Zuckerind, 1907, 47 447)

+H<sub>2</sub>O (Bakhuus Roozeboom) See above

+2H O (Bakhuus Roozeboom) See above

+4H O Two modifications (Bakhuus  
Roozeboom) See above

α and β modifications (α = stable form)

(Kuznetsov, C A 1911, 842)

+6H<sub>2</sub>O Very deliquescent Sol in H O  
with absorption of much heat

250 pts CaCl<sub>2</sub> + 6H<sub>2</sub>O with 100 pts H<sub>2</sub>O  
at 10 8° lower the temp 23 2° (Rudorff, B  
2 68)

Melts in crystal H O at 28° (Tilden, Chem  
Soc 45 409), at 30 2° (Bakhuus Roozeboom)

Sat solution in H<sub>2</sub>O contains at

-22°	-17°	-5°	-5°	+4°
31 5	32 4	35 1	35 2	36 5% salt,

8°	22°	29°	35°	49°
37 9	42 1	46 1	49 0	55 1% salt,

63°	80°	104°	115°
55 9	57 5	58 5	58 6% salt

(Étard, A ch 1894, (7) 2 532)

Sat solution of CaCl + 6H O contains



44 77 g  $\text{CaCl}_2$  at  $25^\circ$  (Schreinemakers and Figgie, Chem Weekbl 1911, 8 685)  
See also above

Solubility of  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  in ethyl alcohol + Aq under addition of increasing amounts of  $\text{CaCl}_2$

Per cent of alcohol by volume	G $\text{CaCl}_2$ added	Grams $\text{CaCl}_2$ in 5 cc of solution
92 3		1 430
97 3		1 409
99 3		1 429
"	1	1 529
"	2	1 561
"	3	1 590
"	4	1 641
"	5	1 709

(Bodtker, Z phys Ch 1897, 22 510)

**Calcium hydroxylamine chloride**,  $\text{CaCl}_2$ ,  $3\text{NH}_2\text{OH}$ ,  $\text{HCl}$

(Antonow, J Russ Phys Chem Soc 1905, 37 479)

**Calcium iodine trichloride**,  $2\text{ICl}_3$ ,  $\text{CaCl}_2 + 8\text{H}_2\text{O}$

Hydroscopic (Weinland, Z anorg 1902, 30 142)

**Calcium mercuric chloride**,  $\text{CaCl}_2$ ,  $5\text{HgCl} + 8\text{H}_2\text{O}$

Decomp by cold  $\text{H}_2\text{O}$ , which dissolves out  $\text{CaCl}_2$ , but all dissolves on heating (v Bonsdorff, 1829)

$\text{CaCl}_2$ ,  $2\text{HgCl}_2 + 6\text{H}_2\text{O}$  Deliquescent  
Very sol in  $\text{H}_2\text{O}$  (v Bonsdorff)

$\text{CaCl}_2$ ,  $6\text{HgCl}_2 + 6\text{H}_2\text{O}$  Very deliquescent  
Decomp by  $\text{H}_2\text{O}$  (Stromholm, J pr 1902, (2) 66 521)

**Calcium lead chloride, basic**

See Calcium lead oxychloride

**Calcium magnesium chloride**,  $\text{CaCl}_2$ ,  $2\text{MgCl} + 12\text{H}_2\text{O}$

Min *Pachhydrite* Deliquescent  
100 pts  $\text{H}_2\text{O}$  dissolve 160 3 pts at  $15-75^\circ$   
By dissolving 20 pts in 80 pts  $\text{H}_2\text{O}$  the temp is raised  $7-75^\circ$  (Bischof)

**Calcium mercuric chloride, basic**,  $\text{CaCl}_2$ ,  $2\text{HgO} + 4\text{H}_2\text{O}$

See Calcium mercuric oxychloride

**Calcium thallic chloride**,  $2\text{HCl}_3$ ,  $\text{CaCl}_2 + 6\text{H}_2\text{O}$

Can be cryst from  $\text{H}_2\text{O}$  (Gewecke A 1909, 366 222)

**Calcium tin (stannic) chloride**

See Chlorostannate, calcium

**Calcium uranium chloride**,  $\text{CaCl}_2$ ,  $\text{UCl}_4$

Decomp by  $\text{H}_2\text{O}$  (Aloy, Bull Soc 1899, (3) 21 265)

**Calcium zinc chloride**

$\text{CaZnCl}_4 + 5\frac{1}{2}\text{H}_2\text{O}$ , and  $\text{Ca}_2\text{ZnCl}_6 + 6\text{H}_2\text{O}$   
Very hygroscopic (Ephraim, Z anorg 1910 67 379)

**Calcium chloride ammonia**,  $\text{CaCl}_2$ ,  $8\text{NH}_3$

Sol in  $\text{H}_2\text{O}$  with decomp (Faraday)

**Calcium chloride hydrazine**,  $\text{CaCl}_2$ ,  $2\text{N}_2\text{H}_4$ (?)

Ppt (Franzen, Z anorg 1908, 60 288)

**Calcium chloride hydroxylamine**,  $\text{CaCl}_2$ ,  $\text{NH}_2\text{OH} + 5\text{H}_2\text{O}$

Not hygroscopic (Antonow, J Russ Phys Chem Soc 1905, 37 479)

$\text{CaCl}_2$ ,  $2\text{NH}_2\text{OH}$

+  $\text{H}_2\text{O}$  Aqueous solution sat at  $20^\circ$  contains 56 6 pts salt

+  $2\text{H}_2\text{O}$  (Antonow, l c)

$2\text{CaCl}_2$ ,  $3\text{NH}_2\text{OH} + 6\text{H}_2\text{O}$  (Antonow, l c)

$2\text{CaCl}_2$ ,  $5\text{NH}_2\text{OH} + 4\text{H}_2\text{O}$  (Antonow, l c)

**Calcium chloride lead oxide**,  $\text{CaCl}_2$ ,  $3\text{PbO} + 3\text{H}_2\text{O}$

See Calcium lead oxychloride

**Calcium chloroferrite**,  $\text{CaO}$ ,  $\text{CaCl}_2$ ,  $\text{Fe}_2\text{O}_3$

Insol in  $\text{H}_2\text{O}$  (le Chatelier, C R 99 276)

**Calcium chlorofluoride**,  $\text{CaF}_2$ ,  $\text{CaCl}_2$

Decomp by  $\text{H}_2\text{O}$ , by very dil  $\text{HCl}$ ,  $\text{HNO}_3$  or acetic acid, by hot dil or conc  $\text{H}_2\text{SO}_4$   
Sol in conc  $\text{HCl}$  or  $\text{HNO}_3$  Insol in, and no decomp by cold or boiling alcohol (Defregg A ch 1904, (8) 1 355)

**Calcium cyanamide, basic**,  $\text{CN}(\text{COH})$ ,  $6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Meyer J pr 1878, (2) 1 42)

**Calcium cyanamide**,  $\text{CaCN}_2$

Decomp by  $\text{H}_2\text{O}$  (Meyer, J pr 1878, (2) 1 42)

**Calcium subfluoride**,  $\text{CaF}$

Decomp by  $\text{H}_2\text{O}$

Sol in hot dil  $\text{HCl}$  and somewhat sol in dil acetic acid

Somewhat sol in boiling absolute alcohol (Wohler, Z anorg 1909, 61 51)

**Calcium fluoride**,  $\text{CaF}_2$

Sol in 26,923 pts  $\text{H}_2\text{O}$  at  $15-5^\circ$  (Wilse, Ch Gaz 1850 366)

1 l  $\text{H}_2\text{O}$  dissolves 16 mg  $\text{CaF}_2$  at  $1^\circ$  (Kohlrausch, Z phys Ch 1904, 50 556)

16 3 mg in 1 l of sat solution at  $1^\circ$  (Kohlrausch, Z phys Ch 1908, 64 168)

When pptd not completely insol in  $H_2O$ , scarcely sol in dil, more sol in conc  $HCl + Aq$ , decomp by conc  $H_2SO_4$ , not decomp by dil alkaline solutions (Fresenius)

Not decomp by conc  $H_2SO_4$  below  $40^\circ$ , but forms a transparent syrup  $CaF_2$  is pptd from this solution by addition of  $H_2O$

Sol in conc  $HCl$  and  $HNO_3 + Aq$  in the same way, but the liquid is not viscid Very sl sol in  $HF$  Boiling  $HCl + Aq$  dissolves slightly Decomp by boiling  $HNO_3 + Aq$

Sol in  $NH_4$  salts +  $Aq$  (Rose)  
Partly decomp by boiling  $K_2CO_3$ , and  $Na_2CO_3 + Aq$  (Dulong, A ch 82 278)

Insol in liquid  $HF$  (Franklin, Z anorg 1905, 46 2)

Insol in acetone (Naumann, B 1904, 37 4329)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Min *Fluorite* (*Fluorspar*) Calculated from electrical conductivity of  $CaF_2 + Aq$ , 1 l  $H_2O$  dissolves 14 mg  $CaF_2$  at  $18^\circ$  (Kohlrausch and Rose, Z phys Ch 12 241)

**Calcium hydrogen fluoride,  $CaH_2F_4 + 6H_2O$**

Decomp by boiling  $H_2O$  Sol in  $HF + Aq$  (Fremy, A ch (3) 47 35)

**Calcium tantalum fluoride**

See Fluotantalate, calcium

**Calcium stannic fluoride**

See Fluostannate, calcium

**Calcium titanium fluoride**

See Fluotitanate, calcium

**Calcium fluoiodide,  $CaI_2$**

Very deliquescent Decomp by cold  $H_2O$ , more rapidly by hot  $H_2O$ , by dil  $HCl$ ,  $HNO_3$ ,  $H_2SO_4$  conc  $H_2SO_4$ , and by alcohol and by ether if these reagents are not absolute (De lauz, A ch 1904, (8) 1 358)

**Calcium hydride,  $CaH_2$**

Decomp by  $HCl + Aq$  (Winkler, B 24 1975 (Moldenhauer, Z anorg 1913, 82 136)

$CaH_2$  Readily decomp by  $H_2O$  and dil acids, almost insol in conc acids Insol in benzene, turpentine and alkyl haloids (Moissan, C R 1898 127 30-31)

Decomp  $H_2O$  and ether, sol in dil  $H_2SO_4$  and  $HNO_3$ , almost insol in conc  $H_2SO_4$  and  $HNO_3$  (von Lngyll, C C 1898, II 262)

Insol in  $CCl_4$ ,  $CS_2$ , alcohols and ethers No known solvent (Moissan, C C 1903, I 563)

**Calcium hydrosulphide,  $CaS_2H$**

Cryst with  $6H_2O$  Extremely sol in  $H_2O$  and alcohol  $\frac{1}{4}$  of its weight of  $H_2O$  at or-

dinary temp more than suffices to hold it in solution (Divers and Shumidzu, Chem Soc 45 271)

Sp gr of aqueous solution containing 32% anhydrous  $CaS_2H_2$  ( $64\% CaS_2H_2 + 6H_2O$ ) = 1.255, 37.5%  $CaS_2H_2$  ( $75.5\% CaS_2H_2 + 6H_2O$ ) = 1.310 (Divers and Shumidzu)

**Calcium hydroxide,  $CaO_2H_2$**

See also Calcium oxide

Sl sol in cold, and less in hot  $H_2O$

1 pt  $CaO$  dissolves at  $t^\circ$  in pts  $H_2O$

$t^\circ$	Pts $H_2O$	Authority
20	450	Davy
0	556	Phillips (A Phil 17 107)
	700	Bergman (Essays etc)
13	785	Pavesi and Rotondi (B 7 817)
18	806	Bineau (A ch (3) 51 290)
19 5	806	P and R (l c)
23	814	P and R (l c)
18 75	960	Abt
54 4	972	Dalton (Syst 2 231)
15 6	778	Dalton (l c)
15 6	752	Phillips (l c)
15 6	731	Wittstein (Repert Pharm 1 182)
15 6	741	Tichborne (Bull Soc (2) 17 24)
100	1270	Dalton (l c)
100	1280	Phillips (l c)
100	1330	Wittstein (l c)
100	1340	Tichborne (l c)
100	1500	Bineau (l c)
100	1758	Tichborne (l c)

Solubility in  $H_2O$  1000 pts  $CaO_2H_2 + Aq$  sat at  $t^\circ$  contain pts  $CaO$

$t^\circ$	Pts $CaO$		
	From Nitrate	Marble	Hydrate
0	1 362	1 381	1 430
10	1 311	1 342	1 384
15	1 277	1 299	1 344
30	1 142	1 162	1 195
45	0 996	1 005	1 033
60	0 854	0 868	0 885
100	0 562	0 576	0 584

(Lamy, C R 86 333)

Solubility of  $CaO_2H_2$  in  $H_2O$  at  $t^\circ$

$t$	Pts $H_2O$ to 1 pt $CaO$	Pts $CaO$ in 100 pts $H_2O$	$t$	Pts $H_2O$ to 1 pt $CaO$	Pts $CaO$ in 100 pts $H_2O$
0	759	0 131	60	1136	0 088
10	770	0 129	70	1235	0 080
20	791	0 126	80	1362	0 073
30	862	0 116	90	1579	0 063
40	932	0 107	100	1650	0 060
50	1019	0 098			

(Mabon, Pharm J Trans (3) 14 505)

1 pt  $CaO_2H_2$  is sol in 640 pts  $H_2O$  at  $19^\circ$ , and 3081 pts at  $150^\circ$  (Shenstone and Cundall, Chem Soc 53 550)

1000 g  $H_2O$  dissolve 1.251 g  $CaO$  (Carles, Arch Pharm (3) 4 558)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$   
dissolve pts  $\text{CaO}$  at  $t^\circ$

$t^\circ$	Pts $\text{CaO}$	$t$	Pts $\text{CaO}$
20	0 1374	80	0 0845
40	0 1162	100	0 0664
60	0 1026		

(Zahorsky, Z anorg 3 34)

1 pt  $\text{CaO}$  is sol in pts  $\text{H}_2\text{O}$  at  $t^\circ$   
 $t^\circ$  15° 20° 25° 30° 35° 40° 45°  
 pts  $\text{H}_2\text{O}$  776 813 848 885 924 962 1004

$t^\circ$  50° 55° 60° 65° 70° 75° 80°  
 pts  $\text{H}_2\text{O}$  1044 1108 1158 1244 1330 1410 1482

(Herzfeld, C C 1897, I, 932)

100 g sat  $\text{CaO}_2\text{H}_2 + \text{Aq}$  contain g  $\text{CaO}$   
 at  $t^\circ$   
 $t^\circ$  5 10 15 20 25  
 g  $\text{CaO}$  0 135 0 1342 0 132 0 1293 0 1254

$t^\circ$  30 35 40 50 60  
 g  $\text{CaO}$  0 1219 0 1161 0 1119 0 0981 0 0879

$t^\circ$  70 80 90 100  
 g  $\text{CaO}$  0 0781 0 074 0 0696 0 0597  
 (J Soc Chem Ind 1901, 20 223)

ity in  $\text{H}_2\text{O}$  at high temp  
 of the solution contains at

$0^\circ$  150° 190°  
 0 305 0 169 0 084 g  $\text{CaO}$

(Herold, Z elektrochem 1905, 11 421)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	1 g $\text{CaO}$ is sol in g $\text{H}_2\text{O}$ at $t$
2	768 5
10	786 8
15	804 3
20	826 4
25	868 7
30	908 2
40	988 1
50	1083 0
60	1179 0
70	1274 8
80	1368 1

(Moody, Chem Soc 1908, 93 1772)

Sat  $\text{CaO}_2\text{H}_2 + \text{Aq}$  contains at  
 $95^\circ$   $76^\circ$   
 0 0580 0 0705% by wt  $\text{CaO}$

(Tschugaeff, Z anorg 1914, 86 159)

100 g sat solution of  $\text{CaO}_2\text{H}_2$  in  $\text{H}_2\text{O}$  at  
 $25^\circ$  contain 0 117 g  $\text{CaO}_2\text{H}_2$  (Cameron and  
 Potter, J phys Ch 1911, 15 70)  
 Readily sol in most acids

Sol in  $\text{H}_3\text{BO}_3 + \text{Aq}$  at  $30^\circ$  (Sborgi, Real  
 Ac Linc 1913, (5) 22 I, 715 and 798)  
 Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  Much more sol in  
 $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Rose)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $25^\circ$

Concentration of $\text{NH}_4\text{Cl} + \text{Aq}$ in millimols per liter	Solubility of $\text{CaO}_2\text{H}_2$ in millimols per liter
0 00	20 22
21 76	29 08
43 52	39 23
87 03	59 68

(Noyes and Chapin, Z phys Ch 1899, 26 520)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{CaCl}_2 + \text{Aq}$  100 pt  
 $\text{CaCl}_2 + \text{Aq}$  of given strength dissolve pt  
 $\text{CaO}$  at  $t^\circ$

$t^\circ$	$\text{CaCl}_2 + \text{Aq}$ 5% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 10% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 15% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 20% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 25% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 30% $\text{CaCl}_2$
20	0 1370	0 1661	0 1993	0 1857*	0 1661*	0 1630
40	0 1160	0 1419	0 1781	0 2249	0 3030*	0 3682
60	0 1020	0 1313	0 1706	0 2204	0 2989	0 3662
80	0 0936	0 1328	0 1736	0 2295	0 3261	0 412
100	0 0906	0 1389	0 1842	0 2325	0 3710	0 492

\* In these cases ppts of  $3\text{CaO} \cdot \text{CaCl}_2 + 10\text{H}_2\text{O}$  were formed

(Zahorsky, Z anorg 3 34)

See also  $\text{CaCl} + \text{CaO} \cdot \text{H}_2$  under Calcium chloride

Solubility in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$

$\text{bp } 25^\circ/25$	g $\text{CaO}$ as $\text{Ca}(\text{OH})_2$ in 100 g $\text{H}_2\text{O}$	g $\text{Ca}(\text{NO}_3)_2$ in 100 g $\text{H}_2\text{O}$	Solid phase
1 0249	0 096	3 38	$\text{Ca}(\text{OH})_2$ $\text{Ca}(\text{OH})_2$ and solid solution $\text{CaO} \cdot x\text{H}_2\text{O}$
1 0484	0 109	5 52	
1 0940	0 125	13 42	
1 1383	0 181	20 73	
1 1840	0 187	28 98	
1 2101	0 198	32 84	Solid solution $\text{CaO} \cdot x\text{H}_2\text{O}$
1 2287	0 212	36 83	
1 2290	0 213	37 55	
1 2541	0 224	40 25	
1 2581	0 230	41 98	
1 2826	0 260	47 00	Solid solution $\text{CaO} \cdot x\text{H}_2\text{O}$ and $\text{Ca}(\text{NO}_3)_2 \cdot 3\frac{1}{2}\text{H}_2\text{O}$
1 2905	0 263	47 16	
1 3337	0 332	58 67	
1 3735	0 429	69 40	
1 4195	0 545	83 03	
1 4840	0 449	99 70	$\text{Ca}(\text{NO}_3)_2 \cdot 3\frac{1}{2}\text{H}_2\text{O}$
1 5330	0 371	115 50	
1 5809	0 303	135 30	
1 5842	0 000	139 30	$\text{Ca}(\text{NO}_3)_2$

(Cameron and Robinson, J phys Chem 1907, 11 275)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$   
Temp =  $25^\circ$ 

G per 100 g sat solution		Solid phase
CaO	$\text{Ca}(\text{NO}_3)_2$	
0 1150	0	$\text{CaO H}_2$
0 0978	4 84	
0 1074	9 36	
0 1193	13 77	
0 1444	22 46	
0 1650	27 83	
0 1931	32 94	
0 2579	40 66	
0 3060	44 44	
0 2802	45 28	$\text{Ca}_2\text{N}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$
0 2314	47 79	
0 1894	51 07	
0 1659	53 20	$\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
0 1486	55 25	
0 0836	57 72	
0	57 98	

Temp =  $100^\circ$ 

0 0561	0	$\text{CaO H}$
0 0550	2 42	
0 0624	4 91	
0 1110	15 39	
0 1200	16 10	
0 155	21 86	
0 269	33 03	
0 480	42 26	
0 973	50 94	
1 261	53 75	$\text{CaO}_2\text{H} + \text{Ca}_2\text{N}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$ $\text{Ca}_2\text{N}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$
1 477	55 40	
1 476	55 43	
1 491	55 65	
1 635	56 89	
1 686	57 03	
1 596	57 91	
1 576	58 67	
1 348	60 44	
1 167	62 82	$\text{Ca N}_2\text{O}_7 \cdot 2\text{H}_2\text{O} + \text{Ca N}_2\text{O}_7 \cdot 1/2\text{H}_2\text{O}$ $\text{Ca N}_2\text{O}_7 \cdot 1/2\text{H}_2\text{O}$
1 077	66 44	
1 141	69 12	
1 252	70 60	
1 203	70 40	
1 103	71 44	
0 937	73 85	
0 849	75 74	
0 815	76 94	
0 804	77 62	$\text{Ca}(\text{NO}_3)_2$
0 412	77 74	
0	78 43	

(Bassett and Laylor, Chem Soc 1914, **105**  
1926)Solubility of  $\text{CaO}$  in  $\text{KCl}$  and  $\text{NaCl} + \text{Aq}$ Curves are given which show that the solubility of lime in solutions of either  $\text{NaCl}$  or

$\text{KCl}$  is a maximum for all temps when the solution contains about 60 g of salt per l. It is a minimum at any fixed temp when the solution is sat, the solubility then being much less than in pure  $\text{H}_2\text{O}$  of the same temp. A solution of  $\text{NaCl}$  dissolves more lime at all temps and concentrations than a corresponding solution of  $\text{KCl}$ . In all cases the maximum solubility of lime occurs when the temp is lowest. With solutions of all concentrations the solubility decreases regularly as the temp increases (Cabot, J Soc Chem Ind 1897, **16** 417-419).

Solubility in  $\text{KCl} + \text{Aq}$  increases with increased quantities of  $\text{KCl}$  and then diminishes, becoming less than the solubility in  $\text{H}_2\text{O}$  alone (Kernot, Gazz ch it 1908, **38** (1) 532).

$\text{KOH}$  or  $\text{NaOH} + \text{Aq}$  containing 1 pt  $\text{KOH}$  or  $\text{NaOH}$  in 100 pts  $\text{H}_2\text{O}$  do not dissolve more than  $1/50000$  pt  $\text{CaO}_2\text{H}_2$ , but it is sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Pelouze, A ch (3) **33** 11).

Solubility in  $\text{NaOH} + \text{Aq}$  at  $t^\circ$ 

G $\text{NaOH}$ per l	Solubility of $\text{CaO}$ in g per liter at			
	$20^\circ$	$50^\circ$	$70^\circ$	$100^\circ$
0	1 17	0 88	0 75	0 54
0 400	0 94	0 65	0 53	0 35
1 600	0 57	0 35	0 225	0 14
2 666	0 39	0 20	0 11	0 05
5 000	0 18	0 06	0 04	0 01
8 000	0 11	0 02	0 01	traces
20 000	0 02	traces	0	0

(d'Anselme, Bull Soc 1903, (3) **29** 936)Solubility of  $\text{CaO}$  in  $\text{NaCl} + \text{NaOH} + \text{Aq}$ 

G $\text{NaCl}$ per l	G $\text{CaO}$ per l of solution containing		
	No $\text{NaOH}$	0.59 g $\text{NaOH}$ per l	4.09 g $\text{NaOH}$ per l
0	1 3	0 8	0 22
5	1 4	0 9	
10	1 6	1 0	
25	1 7	1 1	
50	1 8	1 25	
75	1 9	1 4	0 55
100	1 85	1 4	
150	1 65	1 25	0 44
175	1 6	1 2	
182	1 6	1 2	
225	1 4	1 0	
250	1 3	0 9	
300	1 1	0 7	0 22

(Maugret, Bull Soc 1905, (3) **33** 631)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$   
dissolve pts  $\text{CaO}$  at  $t^\circ$

$t^\circ$	Pts $\text{CaO}$	$t^\circ$	Pts $\text{CaO}$
20	0 1374	80	0 0845
40	0 1162	100	0 0664
60	0 1026		

(Zahorsky, Z anorg 3 34)

1 pt  $\text{CaO}$  is sol in pts  $\text{H}_2\text{O}$  at  $t^\circ$   
 $t^\circ$  15° 20° 25° 30° 35° 40° 45°  
 pts  $\text{H}_2\text{O}$  776 813 848 885 924 962 1004

$t^\circ$  50° 55° 60° 65° 70° 75° 80°  
 pts  $\text{H}_2\text{O}$  1044 1108 1158 1244 1330 1410 1482

(Herzfeld, C C 1897, I, 932)

100 g sat  $\text{CaO}_2\text{H}_2 + \text{Aq}$  contain g  $\text{CaO}$   
 at  $t^\circ$   
 $t^\circ$  5 10 15 20 25  
 g  $\text{CaO}$  0 135 0 1342 0 132 0 1293 0 1254

$t^\circ$  30 35 40 50 60  
 g  $\text{CaO}$  0 1219 0 1161 0 1119 0 0981 0 0879

$t^\circ$  70 80 90 100  
 g  $\text{CaO}$  0 0781 0 074 0 0696 0 0597  
 (Guthrie, J Soc Chem Ind 1901, 20 223)

Solubility in  $\text{H}_2\text{O}$  at high temp

1 litre of the solution contains at

120° 150° 190°  
 0 305 0 169 0 084 g  $\text{CaO}$

(Herold, Z elektrochem 1905, 11 421)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	1 g $\text{CaO}$ is sol in g $\text{H}_2\text{O}$ at $t^\circ$
2	768 5
10	786 8
15	804 3
20	826 4
25	868 7
30	908 2
40	988 1
50	1083 0
60	1179 0
70	1274 8
80	1368 1

(Moody, Chem Soc 1908, 93 1772)

Sat  $\text{CaO}_2\text{H}_2 + \text{Aq}$  contains at

95° 76°  
 0 0580 0 0705% by wt  $\text{CaO}$

(Tschugaëff, Z anorg 1914, 86 159)

100 g sat solution of  $\text{CaO}_2\text{H}_2$  in  $\text{H}_2\text{O}$  at  
 25° contain 0 117 g  $\text{CaO}_2\text{H}_2$  (Cameron and  
 Potter, J phys Ch 1911, 15 70)  
 Readily sol in most acids

Sol in  $\text{H}_3\text{BO}_3 + \text{Aq}$  at 30° (Sborgi, I al  
 Ac Linc 1913, (5) 22 I, 715 and 798)  
 Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  Much more so in  
 $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Rose)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $t^\circ$

Concentration of $\text{NH}_4\text{Cl} + \text{Aq}$ in millimols per liter	Solubility of $\text{CaO}$ millimols per lit
0 00	20 22
21 76	29 08
43 52	39 23
87 03	59 68

(Noyes and Chapin, Z phys Ch 1899 28  
520)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{CaCl}_2 + \text{Aq}$  100 pts  
 $\text{CaCl}_2 + \text{Aq}$  of given strength dissolv pts  
 $\text{CaO}$  at  $t^\circ$

$t^\circ$	$\text{CaCl}_2 + \text{Aq}$ 5% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 10% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 15% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 20% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 25% $\text{CaCl}_2$	$\text{CaCl}_2$
20	0 1370	0 1661	0 1993	0 1857*	0 1661*	630*
40	0 1160	0 1419	0 1781	0 2249	0 3030*	684*
60	0 1020	0 1313	0 1706	0 2204	0 2989	664
80	0 0936	0 1328	0 1736	0 2295	0 3261	122
100	0 0906	0 1389	0 1842	0 2325	0 3710	922

\* In these cases ppts of  $3\text{CaO} \cdot \text{CaCl}_2 + 1\text{H}_2\text{O}$  were  
 formed

(Zahorsky, Z anorg 3 34)

See also  $\text{CaCl} + \text{CaO} + \text{H}$  under **Ca** num  
 chloride

Solubility in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 25°

$\frac{\text{bp}}{25^\circ/25^\circ}$	$\frac{\text{g } \text{CaO} \text{ as } \text{Ca}(\text{OH})_2}{\text{in } 100 \text{ g } \text{H}_2\text{O}}$	$\frac{\text{g } \text{Ca}(\text{NO}_3)_2}{\text{in } 100 \text{ g } \text{H}_2\text{O}}$	Solid phase
1 0249	0 096	3 38	$\text{Ca}(\text{OH})_2$
1 0484	0 109	5 32	
1 0940	0 12, 13 42		
1 1383	0 181	20 73	
1 1840	0 187	28 98	$\text{Ca}(\text{OH})_2$ and solid solution $\text{CaO} \cdot x\text{N}(\text{O})_2 \cdot y\text{H}_2\text{O}$
1 2101	0 198	32 54	
1 2287	0 212	36 83	
1 2290	0 213	37 55	
1 2341	0 224	40 25	Solid solution $\text{CaO} \cdot x\text{N}(\text{O})_2 \cdot y\text{H}_2\text{O}$
1 2581	0 230	41 98	
1 2826	0 260	47 00	
1 2905	0 263	47 16	
1 3337	0 332	58 67	Solid solution $\text{CaO} \cdot \text{N}(\text{O})_2$ $3\text{H}_2\text{O}$ and $\text{Ca}(\text{NO}_3)_2$
1 3735	0 429	69 10	
1 4195	0 545	83 03	
1 4840	0 449	99 70	$\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ $\text{Ca}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$ and $\text{Ca}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$
1 5330	0 371	115 30	
1 5809	0 303	135 30	
1 5842	0 000	139 30	

(Cameron and Robinson, J phys chem  
 1907, 11 275)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$   
Temp =  $25^\circ$

G per 100 g sat solution		Solid phase
CaO	$\text{Ca}(\text{NO}_3)_2$	
0 1150	0	CaO H
0 0978	4 84	
0 1074	9 36	
0 1193	13 77	
0 1444	22 46	
0 1650	27 83	
0 1931	32 94	
0 2579	40 66	
0 3060	44 44	
0 2802	45 28	Ca $\text{N}_2\text{O}_7$ 3H O
0 2314	47 79	
0 1894	51 07	
0 1659	53 20	
0 1486	55 25	
0 0836	57 72	
0	57 98	
		Ca $(\text{NO}_3)_2$ 4H O

Temp =  $100^\circ$ 

0 0561	0	CaO H
0 0550	2 42	
0 0624	4 91	
0 1110	15 39	
0 1200	16 10	
0 155	21 86	
0 269	33 03	
0 480	42 26	
0 973	50 94	
1 261	53 75	
1 477	55 40	CaO $_2$ H + Ca $\text{N}_2\text{O}_7$ 2H O Ca $_2$ N $_2$ O 2H O
1 476	55 43	
1 491	55 65	
1 635	56 89	
1 686	57 03	
1 596	57 91	
1 576	58 67	
1 348	60 44	
1 167	62 82	
1 077	66 44	
1 141	69 12	Ca $\text{N}_2\text{O}_7$ 2H $_2$ O + Ca $\text{N}_2\text{O}_7$ $\frac{1}{2}$ H O Ca N O $_7$ $\frac{1}{2}$ H O
1 252	70 60	
1 203	70 40	
1 103	71 44	
0 937	73 85	
0 849	75 74	
0 815	76 94	
0 804	77 62	
0 412	77 74	
0	78 43	

KCl is a maximum for all temps when the solution contains about 60 g of salt per l. It is a minimum at any fixed temp when the solution is sat, the solubility then being much less than in pure  $\text{H}_2\text{O}$  of the same temp. A solution of NaCl dissolves more lime at all temps and concentrations than a corresponding solution of KCl. In all cases the maximum solubility of lime occurs when the temp is lowest. With solutions of all concentrations the solubility decreases regularly as the temp increases (Cabot, J Soc Chem Ind 1897, 16 417-419).

Solubility in KCl + Aq increases with increased quantities of KCl and then diminishes, becoming less than the solubility in  $\text{H}_2\text{O}$  alone (Kernot, Gazz ch it 1908, 38 (1) 532).

KOH or NaOH + Aq containing 1 pt KOH or NaOH in 100 pts  $\text{H}_2\text{O}$  do not dissolve more than  $\frac{1}{50000}$  pt  $\text{CaO}_2\text{H}_2$ , but it is sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Pelouze, A ch (3) 33 11).

Solubility in NaOH + Aq at  $t^\circ$ 

G NaOH per l	Solubility of CaO in g per liter at			
	20°	50°	70°	100°
0	1 17	0 88	0 75	0 54
0 400	0 94	0 65	0 53	0 35
1 600	0 57	0 35	0 225	0 14
2 666	0 39	0 20	0 11	0 05
5 000	0 18	0 06	0 04	0 01
8 000	0 11	0 02	0 01	traces
20 000	0 02	traces	0	0

(d'Anselme, Bull Soc 1903, (3) 29 936)

## Solubility of CaO in NaCl + NaOH + Aq

G NaCl per l	G CaO per l of solution containing		
	No NaOH	0 89 g NaOH per l	4 09 g NaOH per l
0	1 3	0 8	0 22
5	1 4	0 9	
10	1 6	1 0	
25	1 7	1 1	
50	1 8	1 25	
75	1 9	1 4	0 55
100	1 85	1 4	
150	1 65	1 25	0 44
175	1 6	1 2	
182	1 6	1 2	
225	1 4	1 0	
250	1 3	0 9	
300	1 1	0 7	0 22

(Maigret, Bull Soc 1905, (3) 33 631)

(Bassett and Laylor, Chem Soc 1914, 105 1926)

Solubility of CaO in KCl and NaCl + Aq. Curves are given which show that the solubility of lime in solutions of either NaCl or

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{CaSO}_4 + \text{Aq}$  at  $25^\circ$ 

G per 100 cc sat solution		Solid phase
$\text{CaSO}_4$	$\text{CaO}$	
0	0 1166	$\text{CaO}_2\text{H}$
0 0391	0 1141	
0 0666	0 1150	
0 0955	0 1215	
0 1214	0 1242	
0 1588	0 1222	$\text{CaO}_2\text{H}_2 + \text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
0 1634	0 0939	
0 1722	0 0611	
0 1853	0 0349	
0 1918	0 0176	
0 2030	0 0062	
0 2126	0	

(Cameron and Bell, J Am Chem Soc 1906, **28** 1220)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, **20** 827)

Alcohol dissolves traces

Methyl alcohol forms colloidal solution containing 1.125 g per l (Neuberg and Rewald, Biochem Z 1908, **9** 545)

Insol in ether

Insol in acetone (Naumann, B 1904, **37** 4329)

Insol in acetone and in methylal (Eidmann, C C 1899, II 1014)

Insol in methyl acetate (Naumann, B 1909, **42** 3790)

Insol in ethyl acetate (Naumann, B 1904, **37** 3601)

Much more sol in glycerine, or sugar + Aq than in  $\text{H}_2\text{O}$

Solubility of  $\text{CaO}$  in glycerine

Wt of glycerine in 100 cc of solution	Wt $\text{CaO}$ contained in 100 cc of liquid at with $\text{CaO}$	Relation of $\text{CaO}$ to glycerine	
		$\text{CaO}$	Glycerine
10 00	0 370	3 6	96 4
5 00	0 240	4 6	95 4
2 86	0 196	6 4	93 6
2 50	0 192	7 1	92 9
2 00	0 186	8 5	91 5
1 00	0 165	14 2	85 8

(Berthelot, A ch (3) **46** 176)

1000 g  $\text{H}_2\text{O}$  dissolve 1.251 g  $\text{CaO}$ , 1000 g  $\text{H}_2\text{O} + 50$  g glycerine dissolve 1.865 g  $\text{CaO}$ , 1000 g  $\text{H}_2\text{O} + 100$  g glycerine dissolve 2.583 g  $\text{CaO}$ , 1000 g  $\text{H}_2\text{O} + 200$  g glycerine dissolve 4.040 g  $\text{CaO}$ , 1000 g  $\text{H}_2\text{O} + 400$  g glycerine dissolve 6.569 g  $\text{CaO}$  (Carles, Aich Pharm (3) **4** 558)

Insol in pure glycerine

Solubility of  $\text{CaO}_2\text{H}_2$  in glycerine + Aq at  $5^\circ$   
G = g glycerine in 100 g glycerine + A  
 $\frac{1}{2}\text{CaO}(\text{H})$  = millimols sol in 100 cc glycerine + Aq

G	$\frac{1}{2}\text{CaO}(\text{H})$	Sp gr
0	4 3	1 0003
7 15	8 13	1 0244
20 44	14 9	1 0537
31 55	22 5	1 0842
40 95	40 1	1 1137
48 7	44 0	1 1356
69 2	95 8	1 2027

(Herz and Knoch, Z anorg 1905, **46** 3)

Solubility in glycerine + Aq at  $25^\circ$ 

Solution contains			Sp g
% $\text{Ca}(\text{OH})_2$	% glycerine	% $\text{H}_2\text{O}$	
0 117	0		
0 178	3 50	96 32	1 00
0 413	15 59	80 28	
0 48	17 84	81 68	1 0
0 88	34 32	64 80	1 00
1 34	55 04	43 62	1 1

Solid phase in this system is  $\text{CaO} \cdot \text{H}_2\text{O}$ .  
(Cameron and Patten, J phys Chem 1914, **15** 71)

100 pts sugar dissolved in  $\text{H}_2\text{O}$  dissolve 50 pts  $\text{CaO}$  (Osann) 50 pts  $\text{CaO}$  (Ure) 49 6 pts  $\text{CaO}$  (Daniell) 29-30 6 pts  $\text{CaO}$  (Huntton) 23 pts  $\text{CaO}$  (Soubeiran)

Sugar solution at 100 takes up  $\frac{1}{4}$  mol  $\text{CaO}$  for each mol sugar at  $0^\circ$  if it contains not less than 25% of sugar it takes up 2 mols  $\text{CaO}$  to 1 mol sugar (Brunfauf)

Amount dissolved is proportional to the density and temperature of the solutions

Solubility of  $\text{CaO}$  in sugar + Aq

Pt sugar dissolved in 100 pt $\text{H}_2\text{O}$	Relation of $\text{CaO}$ to sugar	
	$\text{CaO}$	Sugar
40	21 0	79 8
37	20 8	79 2
33 0	20	79
32	20 3	79 7
30 0	20 1	79 9
27	19 3	80 1
25 0	19 8	80 2
22	19 3	80 7
20 0	18 8	81 2
17	18 7	81 3
15 0	18	81
12	18 3	81 7
10 0	18 1	81 9
7	16 9	83 1
5 0	15 3	84 7
2	13 8	86 2

(Berthelot, C R **32** 33)

100 g solution of sugar sat with  $\text{CaO}$  between 10 and  $14^\circ$  contain 22 to 23 %  $\text{CaO}$  (Huntton **1** 7)

## Solubility of CaO in dil sugar solutions

Wt of sugar in 100 cem of solution	Wt of CaO contained in 100 cem of liquid sat with CaO	Relation of CaO to sugar	
		CaO	Sugar
4 850	1 031	17 5	82 5
2 401	0 484	16 8	83 2
2 000	0 433	17 8	82 2
1 660	0 364	18 0	82 0
1 386	0 326	19 0	81 0
1 200	0 316	20 8	79 2
1 058	0 281	21 0	79 0
0 960	0 264	21 6	78 4
0 400	0 194	32 7	67 3
0 191	0 172	47 4	52 6
0 096	0 154	61 6	78 4
0 000	0 148		

(Berthelot, A ch (3) 46 176 )

## Solubility in sugar + Aq at t°

t°	G sugar in 100 cem of solution	G CaO dissolved per 100 g sugar
16-17°	0 7814	37 9
	0 9120	32 3
	1 4000	30 5
	1 6930	28 9
	4 754	27 7
	5 730	27 1
	10 159	27 5
	11 200	27 2
	12 500	27 3
	13 930	27 9
	14 487	27 5
	16 410	28 0
15°	0 625	71 6
	0 964	53 4
	2 084	36 0
	3 028	32 3
	3 451	31 7
	4 168	30 2
	4 880	28 7
	5 73	28 3
	6 12	27 4
	6 25	27 7
	6 51	27 5
	7 55	27 9
	8 20	27 3

(Weisberg, Bull Soc 1899, (3) 21 775 )

## Solubility in sugar + Aq at 25°

Solution contains			Sp gr
% Ca(OH)	% sugar	% H O	
0 117	0		0 983
0 188	0 62	99 19	1 000
0 730	4 82	94 50	1 021
1 355	7 50	91 12	1 037
2 31	9 87	87 85	1 051
3 21	11 90	84 89	1 067
4 57	15 10	80 33	1 092
5 38	17 42	76 93	1 109
6 07	19 86	73 07	1 123

The solid phase in this system consists of a series of solid solutions with Ca(OH) a limiting case

(Cameron and Patten, J phys Chem 1911, 15 70 )

## Solubility of CaO in sugar + Aq at 80°

% sugar	% CaO	% Sugar	% CaO
4 90	0 117	19 50	0 358
9 90	0 189	24 60	0 458
14 75	0 230	29 70	1 017

Solid phase, CaO<sub>2</sub>H<sub>2</sub>.  
(von Ganneken, Proc Kon Akad v Wetensch, Amsterdam, 1911, 14 457 )

## Solubility of CaO in mannite + Aq

Wt of mannite in 100 cem of solution	Wt of CaO contained in 100 cem of liquid sat with CaO	Relation of CaO to mannite	
		CaO	Mannite
9 60	0 753	7 3	92 7
4 80	0 372	7 2	92 8
2 40	0 255	9 6	90 4
1 92	0 225	10 5	89 5
1 60	0 207	11 4	88 6
1 37	0 194	12 5	87 5
1 20	0 193	13 9	86 1
1 07	0 190	15 1	84 9
0 96	0 186	16 2	86 8
0 192	0 155	44 6	55 4
0 096	0 154	61 6	38 4
0 000	0 148		

(Berthelot, A ch (3) 46 176 )

Solutions of CaO in sugar, mannite, or glycerine afford an abundant ppt on being heated, but this redissolves on cooling (Berthelot)

Sol in sorbite + Aq (Pelouze), sl sol in quercite + Aq. Sol in monobasic C<sub>12</sub> sugar charate + Aq (Peligot) Much more sol in gelatine + Aq than in pure H<sub>2</sub>O

**Calcium hydroxyhydrosulphide, Ca(OH)SH + 3H<sub>2</sub>O**

Easily sol in H<sub>2</sub>O with almost immediate decomposition Insol in alcohol, but slowly



decomp thereby (Divers and Shimidzu, Chem Soc **45** 270)

### Calcium subiodide, $\text{CaI}$

Decomp by moisture (Wohler, Z anorg 1909, **61** 76)

### Calcium iodide, $\text{CaI}_2$

Deliquescent 100 pts  $\text{H}_2\text{O}$  dissolve—  
at 0° 20° 40° 43° 92°  
192 204 228 286 435 pts  $\text{CaI}_2$   
(Kremers, Pogg **103** 65)

Sp gr of  $\text{CaI}_2 + \text{Aq}$  at 19.5° containing  
5 10 15 20 25 30%  $\text{CaI}_2$ ,  
1.044 1.09 1.14 1.198 1.26 1.321

35 40 45 50 55 60%  $\text{CaI}_2$   
1.398 1.477 1.567 1.665 1.78 1.91  
(Kremers, calculated by Gerlach, Z anal **8** 285)

Sol in absolute alcohol (Gay-Lussac, A ch **91** 57)

Sol in acetone (Naumann, B 1904, **37** 4328, Eidmann, C C **1899**, II 1014)

Sol in ethyl acetate (Naumann, B 1910, **43** 314)

+4H<sub>2</sub>O (Kuznetzov, C A **1911** 842)

+6H<sub>2</sub>O Sat aq solution contains at  
—22° +7° 10° 19°  
61.6 65.0 65.1 66.3% salt

51° 64° 130° 248°  
69.4 75.9 81.3 87.1% salt

(Étard, A ch 1894 (7) **2** 543)

+7H<sub>2</sub>O (Kuznetzov)

### Calcium periodide, $\text{CaI}_3 + 15\text{H}_2\text{O}$

(Mosnier, A ch 1897, (7) **12** 401)

$\text{CaI}_4$  (Herz and Bulla, Z anorg 1911, **71** 255)

### Calcium mercuric iodide, $\text{CaI}_2 \cdot \text{HgI}_2 + 8\text{H}_2\text{O}$

Very deliquescent Sol in  $\text{H}_2\text{O}$ , alcohols, allyl iodide, aldehyde, acetic acid, ethyl oxalate and iniline Sl sol in nitrobenzene Completely insol in  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , ethyl iodide ethylene bromide,  $\text{C}_6\text{H}_6$ , monochlorobenzene and toluene (Duboin, C R 1906, **142** 573)

3C<sub>6</sub>H<sub>5</sub>I, 4HgI<sub>2</sub> + 24H<sub>2</sub>O Sol in H<sub>2</sub>O with pptn of red HgI

Very sol in alcohols, glycerine, ethyl acetate, methyl and isobutyl propionate, allyl iodide, aldehyde, acetone, aniline and ethyl oxalate Insol or sl sol in nitrobenzene Insol in  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$ , ethyl iodide, monochlorobenzene, etc (Duboin, C R 1906, **142** 397)

$\text{CaI}_2 \cdot 2\text{HgI}_2$

Decomp by  $\text{H}_2\text{O}$  (Boullay)

$\text{CaI}_2 \cdot 5\text{HgI}_2 + 8\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$ ,

alcohols, glycerine, aldehyde, and acetic id, slowly by nitrobenzene and ethyl oxalate Insol in monochlorobenzene, toluene,  $\text{C}_6\text{H}_6$ , and ethylene bromide (Duboin, l c)

### Calcium silver iodide, $\text{CdI}_2 \cdot 2\text{AgI} + 6\text{H}_2\text{O}$

Immediately decomp by  $\text{H}_2\text{O}$  (Simmons, Roy Soc Proc **27** 120)

### Calcium zinc iodide, $\text{CaI}_2 \cdot \text{ZnI}_2 + 8\text{H}_2\text{O}$

Very hygroscopic (Ephraim, Z anorg 1910, **67** 384)

### Calcium iodide ammonia, $\text{CaI}_2 \cdot 6\text{NH}_3$

(Isambert, C R **66** 1259)

### Calcium nitride, $\text{Ca}_3\text{N}_2$

Sol in dil acids, insol in conc (water free) acids (Moissan, C R 1898, **127** 499)

### Calcium oxide, $\text{CaO}$

Decomp by  $\text{H}_2\text{O}$ , with evolution of much heat, to form  $\text{CaO}_2\text{H}_2$ , which see for solubility in  $\text{H}_2\text{C}$ , etc

### Calcium peroxide, $\text{CaO}_2$

Very sl sol in  $\text{H}_2\text{O}$ , easily sol in acids, and  $\text{NH}_4$  salts + Aq Insol in  $\text{NH}_4\text{OH} + \text{q}$  (Conroy, Chem Soc (2) **11**, 808)

+2H<sub>2</sub>O True composition is  $\text{CaO}_2\text{H}_2 + \text{H}_2\text{O}_2$  (de Forcrand, C R 1900, **130** 13)

+8H<sub>2</sub>O Efflorescent Difficultly sol in  $\text{H}_2\text{O}$  with gradual decomp Insol in alcohol or ether (Gay-Lussac and Thenard, A ch (2) **8** 313)

### Calcium oxybromide, $3\text{CaO} \cdot \text{CaBr}_2 + 16\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  and alcohol Very easily sol in hydracids and dil  $\text{HNO}_3$  (Fas, y, C R 1894, **119** 372)

### Calcium oxychloride, $\text{Ca}_4\text{O}_3\text{Cl} + 15\text{H}_2\text{O} = 3\text{CaO} \cdot \text{CaCl}_2 + 15\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  or alcohol (Rosen) Formula is  $\text{Ca}_2\text{HOCl} + 7\text{H}_2\text{O}$  (Grumsh, C N **30** 280)

+16H<sub>2</sub>O Decomp by H<sub>2</sub>O into  $\text{CaO}$  and  $\text{CaCl}_2$  until a maximum of 85 g  $\text{CaI}_2$  are dissolved per litre (Ditté, C R **91** 5)

4CaO,  $\text{CaCl}_2 + 14\text{H}_2\text{O}$  (Schreinemakers and Figue, Chem Weekbl 1911, **8** 685)

$\text{CaO} \cdot \text{CaCl}_2$  (Schreinemakers and Figue)

### Calcium lead oxychloride, $\text{CaCl}_2 \cdot \text{CaO} \cdot 2\text{PbO} + 4\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with decomp (Andrić, C R **104** 359)

$\text{CaCl}_2 \cdot 3\text{PbO} + 3\text{H}_2\text{O}$  (Andrić)

### Calcium mercuric oxychloride, $\text{CaCl}_2 \cdot 2\text{HgO} + 4\text{H}_2\text{O}$

Decomp immediately by H<sub>2</sub>O (Klingner, B **16** 997)

**Calcium oxyiodide,  $3\text{CaO}, \text{CaI}_2 + 16\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$ , alcohol, and acids Sol in hydracids and in very dil  $\text{HNO}_3$  (Tassily, C R 1894, 119 372)

**Calcium oxysulphide,  $\text{Ca}_4\text{O}_3\text{S}_4 + 12\text{H}_2\text{O} = 3\text{CaO}, \text{CaS}_4 + 12\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  Not acted on by absolute alcohol (Schöne, Pogg 117 77)

According to Geuther (A 224 178) =  $\text{CaS}_3, 2\text{CaO} + 10$ , or  $11\text{H}_2\text{O}$  Sol in dil  $\text{HCl} + \text{Aq}$  with separation of S

$\text{Ca}_5\text{O}_4\text{S}_4 + 18\text{H}_2\text{O} = 4\text{CaO}, \text{CaS}_4 + 18\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$ , but not acted on by absolute alcohol (Schöne, Pogg 117 82)

According to Geuther (A 224 178) =  $\text{CaS}_3, 3\text{CaO} + 14$ , or  $15\text{H}_2\text{O}$

$\text{Ca}_6\text{O}_5\text{S}_5 + 20\text{H}_2\text{O} = 5\text{CaO}, \text{CaS}_5 + 20\text{H}_2\text{O}$  (Rose, Pogg 55 433)

Sol in 400 pts cold, decomp by boiling  $\text{H}_2\text{O}$  (Buchner), sl sol in cold, much more in hot  $\text{H}_2\text{O}$ , but it is not deposited on cooling Aqueous solution sat at  $6^\circ - 7^\circ 2'$  has sp gr = 1.0105 (Herschel), sol in alcohol (Gay-Lussac), insol in alcohol (Gmelin)

**Calcium phosphide,  $\text{CaP}$** 

Deliquescent Decomp in moist air or with  $\text{H}_2\text{O}$  Not attacked by conc  $\text{HNO}_3$ , but decomp by dil  $\text{HNO}_3 + \text{Aq}$  (Thénard, A ch (3) 14 14)

$\text{Ca}_3\text{P}_2$  Crystallized

Decomp by  $\text{H}_2\text{O}$

Not attacked by conc  $\text{H}_2\text{SO}_4$  Violently attacked by dil  $\text{H}_2\text{SO}_4$

Not attacked by abs alcohol, ether, benzene or oil of turpentine (Moissan, C R 1899, 128 792)

$\text{Ca}_2\text{P}_3$  Insol in liquid  $\text{CO}_2$  (Buchner, Z phys Ch 1906, 54 674)

**Calcium selenide,  $\text{CaSe}$** 

Sl sol in  $\text{H}_2\text{O}$  Very easily decomp (Fabre, C R 102 1469)

**Calcium silicide,  $\text{CaSi}_2$** 

Slowly decomp by  $\text{H}_2\text{O}$ , sol in conc  $\text{H}_2\text{SO}_4$  and dil  $\text{HNO}_3$  with evolution of  $\text{H}_2$  With conc  $\text{HCl}$  it gives  $\text{H}_2$ , Si and silicon hydride with dil  $\text{HCl}$ ,  $\text{H}_2$  and a yellow substance Sol in alkali + Aq or  $\text{NH}_3 + \text{Aq}$  with evolution of  $\text{H}_2$  (Moissan, C R 1902, 134 505)

Two modifications

(a) Only sl sol in  $\text{HNO}_3$ , decomp  $\text{H}_2\text{O}$  to give an insol ppt on addition of  $\text{HCl}$

(b) Easily sol in  $\text{HNO}_3$  and acetic acid, decomp  $\text{HCl}$  to give a ppt which is sol in  $\text{KOH} + \text{Aq}$  (de Chalmot, Am Ch J 1896, 18, 320)

$\text{Ca}_3\text{Si}_2$  Slowly decomp by  $\text{H}_2\text{O}$ , rapidly by dil acetic acid or by  $\text{H}_2\text{SO}_3 + \text{Aq}$  without evolution of spontaneously inflammable gas (Hönigschmid, M 1909, 30 497)

Decomp by dil min acids, with evolution

of spontaneously inflammable gas (Hackspill, Bull Soc 1908, (4) 3 619)

$\text{Ca}_6\text{Si}_{10}$  Insol in all solvents Decomp by boiling  $\text{H}_2\text{O}$ , by conc  $\text{HCl}$  and by acetic acid Sol in dil alkali and alkali carbonates + Aq Hardly attacked by conc  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$  (Kolb, Z anorg 1909, 64 349)

$\text{Ca}_{11}\text{Si}_{10}$  Easily decomp by boiling with  $\text{H}_2\text{O}$  Decomp by dil acetic acid, dil or conc  $\text{HCl}$  (Kolb, Z anorg 1909, 64 349 and 356)

**Calcium siliconitride,  $\text{CaSi}_2\text{N}_3$** 

(Kolb, Z anorg 1909, 64 363)

$\text{Ca}_2\text{Si}_3\text{N}_4$  Slowly decomp by boiling with  $\text{H}_2\text{O}$ , somewhat more rapidly with dil  $\text{NaOH} + \text{Aq}$  Slowly decomp by conc  $\text{HCl}$  (Kolb, l c)

$\text{Ca}_{11}\text{Si}_{10}\text{N}_1$  Completely decomp by  $\text{HCl}$  (Kolb, l c)

**Calcium sulphide,  $\text{CaS}$** 

500 pts  $\text{H}_2\text{O}$  dissolves 1 pt  $\text{CaS}$  completely, less  $\text{H}_2\text{O}$  dissolves out  $\text{CaS}_2\text{H}_2$  and leaves  $\text{CaO}_2\text{H}_2$  Very much  $\text{H}_2\text{O}$  decomposes completely into  $\text{CaO}_2\text{H}_2$  and  $\text{H}_2\text{S}$  (Béchamp, A ch (4) 16 222)

Not decomp by  $\text{H}_2\text{O}$ , and only sl sol therein at ordinary temp (Pelouze)

After 48 hours contact with  $\text{CaS}$ , 1 l  $\text{H}_2\text{O}$  contains at

10°	18°	40°	60°	90°
0 15	0 23	0 30	0 48	0 33 g $\text{CaS}$

After boiling for 2 hours, 0.27 g  $\text{CaS}$  is dissolved, addition of  $\text{NaCl}$  diminishes solubility, but  $\text{Na}_2\text{SO}_4$  increases it Lime-water dissolves at  $14^\circ$  0.18 g  $\text{CaS}$ , the same amount which  $\text{H}_2\text{O}$  dissolves at  $60^\circ$  Milk of lime dissolves 0.55 g at  $60^\circ$   $\text{H}_2\text{O}$  containing 3 to 79 g  $\text{Na}_2\text{O}$  per litre dissolves only traces of  $\text{CaS}$  at  $10^\circ$ , but at  $40 - 60^\circ$ , or by boiling, a large amount of  $\text{Na}_2\text{S}$  is formed (Kolb, A ch (4) 7 126)

Sol in 12,500 pts  $\text{H}_2\text{O}$  at  $12.6^\circ$  (Scheurer-Kestner, Répert chim appl 1862 331)

Sat  $\text{Na}_2\text{CO}_3 + \text{Aq}$  has scarcely any action on  $\text{CaS}$ , but a dilute solution has more action (Kolb)

Sol in  $\text{H}_2\text{O}$  and sulphur, forming  $\text{CaS}_4$

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

Insol in methyl acetate (Numann B 1909, 42 3790)

Insol in ethyl acetate (Numann B 1904, 37 3601)

Insol in methylal (Fidmann, C C 1899, II 1014)

Sol in 10 pts glycerine (Cup and Grout J Pharm (3) 26 81)

Sol in sugar + Aq (Stoll, C C 1900, I 1044)

**Calcium tetrasulphide,  $\text{CaS}_4$** 

Known only in solution

**Calcium pentasulphide,  $\text{CaS}_5$** 

Sol in  $\text{H}_2\text{O}$  and alcohol (Berzelius)  
 Exists only in aqueous solution (Schone,  
 Pogg 117 73)

**Calcium hydroxyl sulphide,  $\text{Ca}(\text{OH})\text{SH} + 3\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  with immediate decomp  
 and separation of  $\text{Ca}(\text{OH})_2$  Insol in alcohol,  
 but slowly decomp thereby (Divers and  
 Shumidzu, Chem Soc 45 270)

**Calcium stannic sulphide**

See Sulphostannate, calcium

**Calomel**

See Mercurous chloride

**Carbamic acid****Ammonium carbamate acid carbonate (commercial carbonate of ammonia)**

See Carbonate carbamate, ammonium hydrogen

— (salts of hartshorn),  $2\text{NH}_4\text{HCO}_3$ ,  
 $\text{NH}_4\text{CONH}_2$

See Carbonate carbamate, ammonium hydrogen

**Carbazote silicon,  $\text{C SiN}$** 

Insol in acids, even  $\text{HF}$ , also in boiling  
 $\text{KOH} + \text{Aq}$  (Schutzenberger and Colson,  
 C R 92 1508)

**Carbon, C**

Insol in all solvents

Diamond is unacted upon by  $\text{KClO}_3 + \text{fum}$   
 $\text{HNO}_3$ , graphite forms graphitic acid by  
 $\text{KClO}_3 + \text{fum}$   $\text{HNO}_3$ , amorphous carbon is  
 sol in  $\text{KClO}_3 + \text{fum}$   $\text{HNO}_3$  (Berthelot, A  
 ch (4) 19 399)

Diamond is sol in molten iron at  $1160^\circ$   
 Amorphous carbon is insol in molten iron at  
 $1160^\circ$ , but becomes sol therein by heating to  
 $1400^\circ$  (Hempel, B 18 998)

Insol in liquid  $\text{CO}_2$  (Buchner Z phys  
 Ch 1906 54 674)

Charcoal is sol in liquid  $\text{NH}_3$  (Gore  
 Am Ch J 1898 20 830)

The quantity of carbon dissolved by iron  
 diminishes by increasing phosphorus, falling  
 by about 0.5% for each additional 2.0% of  
 phosphorus (Fettweis, Metallurg 1906,  
 3 60)

Solubility in iron is reduced by the presence  
 of tin and of sulphur (Wust, Metallurg  
 1906 3 169)

The solubility of C in iron is increased by  
 the presence of chromium 9.2% C dissolved  
 when 62% Cr is present in the mixture  
 (Gorens, Metallurg 1907, 4 18)

**Carbon boride,  $\text{CB}_2$** 

Insol in boiling  $\text{HNO}_3 + \text{Aq}$  (Joly, R  
 97 456)

**Carbon suboxide,  $\text{C}_3\text{O}_2$** 

B-pt  $+7^\circ$  at 761 mm

Sol in  $\text{H}_2\text{O}$  with formation of malonic acid  
 Slowly decomp on standing in a sealed  
 tube (Diels, B 1906, 39 696)

**Carbon monoxide, CO**

Sol in 50 vols recently boiled  $\text{H}_2\text{O}$  (Davy)

Sol in 16 vols  $\text{H}_2\text{O}$  (de Saussure)

Sol in 27 vols  $\text{H}_2\text{O}$  (Dalton)

100 vols  $\text{H}_2\text{O}$  dissolve 6.2 vols CO at  $18^\circ$  (Davy)

Solubility of CO in  $\text{H}_2\text{O}$  1 vol  $\text{H}_2\text{O}$  at  
 dissolves V vols CO reduced to  $0^\circ$  and 761 mm

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	0.03287	7	0.02796	14	0.2466
1	0.03207	8	0.02739	15	0.2432
2	0.03131	9	0.02686	16	0.2402
3	0.03057	10	0.02635	17	0.2374
4	0.02987	11	0.02588	18	0.2350
5	0.02920	12	0.02544	19	0.2329
6	0.02857	13	0.02504	20	0.2312

(Bunsen's Gasometry, pp 287, 128, 16)

Coefficient of absorption = 0.032874

0.00081632t + 0.000016421t (Bunsen and  
 Pauli, A 93 16)

Solubility of CO in  $\text{H}_2\text{O}$

$\beta$  = Vol CO absorbed by 1 vol  $\text{H}_2\text{O}$  at a  
 partial pressure of 760 mm

$\beta'$  = Vol CO (reduced to  $0^\circ$  and 760 mm)  
 absorbed by 1 vol of  $\text{H}_2\text{O}$  under a total pres-  
 sure of 760 mm

q = g CO dissolved by 100 g  $\text{H}_2\text{O}$  at a  
 total pressure of 760 mm

t	$\beta$	$\beta'$	q
0	0.03537	0.03516	0.44
5	0.03149	0.03122	0.39
10	0.02816	0.02782	0.33
15	0.02543	0.02501	0.31
20	0.02319	0.02266	0.28
25	0.02142	0.02076	0.26
30	0.01998	0.01915	0.24
40	0.01775	0.01647	0.21
50	0.01615	0.01420	0.18
60	0.01488	0.01197	0.15
70	0.01440	0.00998	0.13
80	0.01430	0.00762	0.10
90	0.01420	0.00438	0.06
100	0.01410	0.00000	0.00

(Winkler, B 1901, 34 1416)

Solubility in H<sub>2</sub>O at various pressures

V = Volume of the absorbing liquid

P = Hg pressure in metres

 $\lambda$  = Coefficient of solubility

V	t°	P	$\lambda$
30 830 ccm	17 7	0 9202	0 02791
		1 1438	0 02787
		1 4624	0 02786
		1 7986	0 02783
		2 3659	0 02782
		2 8390	0 02776
		3 2622	0 02771
		4 0114	0 02770
		4 6017	0 02763
		5 1953	0 02761
		5 8717	0 02756
31 939 ccm	19 0	6 5462	0 02744
		7 0983	0 02738
		7 6470	0 02723
		8 0184	0 02715
		0 9176	0 02716
		1 1506	0 02717
		1 3897	0 02715
		1 7044	0 02712
		2 1239	0 02708
		2 7173	0 02701
		3 2576	0 02693
		3 9311	0 02689
		4 4584	0 02680
		5 2470	0 02673
		6 0346	0 02665
		6 6303	0 02654
		7 1842	0 02636
		7 9542	0 02617

(Cassuto, Phys. Zeit 1904, 5 236)

Coefficient of absorption of CO in H<sub>2</sub>O at 25° equals 0.0154 (Findlay and Creighton, Biochem J 1911, 5 294)

Cuprous chloride in an hydrochloric acid or ammoniacal solution, and ammoniacal solutions of cuprous salts absorb large amounts of CO (Tchiling, C R 30 488)

Cuprous chloride dissolved in HCl + Aq absorbs 15-20 vols CO (Berthelot, A ch (3) 51 66)

Absorbed by KOH, NaOH, Ba(OH)<sub>2</sub> and Cu(OH)<sub>2</sub> + Aq more readily by ether, alcohol, and wood spirit with formation of formic acid (Berthelot, A ch (3) 61 463)

Sol in HCN (Bottinger, B 10 1122)

1 vol alcohol absorbs 0.20443 vols CO gas at all temperatures between 0° and 25° (Carius, A 94 135)

100 vol alcohol (0.84 sp gr) dissolve 14 vols CO at 18° 100 vols rectified naphtha (0.784 sp gr) 20.0 vols CO at 18° 100 vol oil of lavender (0.88 sp gr) 15.6 vol CO at 18° 100 vols olive oil (0.915 sp gr) 14.2 vol CO at 18° 100 vols sat KCl + Aq (1.165 sp gr) 2 vols CO at 18° (de Saussure 1814)

1 vol oil of turpentine absorbs 0.16-0.20 vol CO (de Saussure)

Sol in ether (Regnault)

Insol in caoutchouc

Solubility in alcohol + Aq

% alcohol by weight	0 00	9 09	16 67	23 08
Solubility	2 41	1 87	1 75	1 68
% alcohol by weight	28 57	33 33	50 00	
Solubility	1 50	1 94	3 20	

(Lubarsch, W Ann 1889, 37 524)

Solubility of CO in organic solvents

Solvent	Solubility at 20° C	Solubility at 25° C
Glycerine	Not measurable	
Water	0 02404	0 02586
Aniline	0 05358	0 05055
Carbon bisulphide	0 08314	0 08112
Nitrobenzene	0 09366	0 09105
Benzene	0 1707	0 1645
Glacial acetic acid	0 1714	0 1689
Amyl alcohol	0 1714	0 1706
Xylene	0 1781	0 1744
Toluene	0 1808	0 1742
Ethyl alcohol (99.8%)	0 1921	0 1901
Chloroform	0 1954	0 1897
Methyl alcohol	0 1955	0 1830
Amyl acetate	0 2140	0 2108
Acetone	0 2225	0 2128
Isobutyl acetate	0 2365	0 2314
Ethyl acetate	0 2516	0 2419

(Just, Z phys Ch 1901, 37 361)

Solubility of CO in ether at 0° = 0.3618, and at 10° = 0.3842 (Christoff, Z phys Ch 1912, 79 459)

Solubility of CO in organic mixtures

CO in benzene and naphthalene at 25° C

Percent by weight of naphthalene	Percent by weight of benzene	* Solubility of CO
0	100	0 174
11 52	88 48	0 164
11 65	88 35	0 163
23 98	76 02	0 149
23 60	76 40	0 148
32 35	67 65	0 142
32 74	67 26	0 143
33 79	66 21	0 141

(Skirrow, Z phys Ch 1902 41 144)

\* See under Oxygen

CO in benzene and phenanthrene at 25° C

Percent by weight of phenanthrene	Percent by weight of benzene	Solubility of CO
0	100	0 174
10 48	89 52	0 144
10 48	89 52	0 144
19 22	80 78	0 132
18 99	81 01	0 133
27 04	72 96	0 128
27 39	72 61	0 127

(Skirrow)

CO in benzene and  $\alpha$  naphthol at 25° C

Per cent by weight of $\alpha$ naphthol	Per cent by weight of benzene	Solubility of CO
0	100	0 174
3 48	96 52	0 149
6 75	93 25	0 145
6 59	93 41	0 144
12 10	87 90	0 139
11 81	88 19	0 139

(Skirrow )

CO in benzene and  $\beta$ -naphthol at 25° C

Per cent by weight of $\beta$ naphthol	Per cent by weight of benzene	Solubility of CO
0	100	0 174
2 06	97 94	0 158
4 14	95 86	0 151
4 36	95 64	0 149

(Skirrow )

## CO in benzene and nitrobenzene at 25° C

Per cent by weight of nitrobenzene	Per cent by weight of benzene	Solubility of CO
0	100	0 174
14 5	85 5	0 162
14 12	85 88	0 162
28 18	71 82	0 152
28 14	71 86	0 152
40 58	59 42	0 140
40 63	59 37	0 140
54 9	45 1	0 126
54 9	45 1	0 127
83 33	16 67	0 101
83 2	16 8	0 102
100	0	0 093

(Skirrow )

## CO in benzene and aniline at 25° C

Per cent by weight of aniline	Per cent by weight of benzene	Solubility of CO
0	100	0 174
12 69	87 31	0 156
12 03	87 97	0 158
19 57	80 43	0 145
19 43	80 57	0 144
28 43	71 57	0 131
28 26	71 74	0 131
57 68	42 32	0 0945
57 38	42 62	0 0953
78 90	21 10	0 0689
78 80	21 20	0 0684
100	0	0 053

(Skirrow )

## CO in toluene and naphthalene at 25° C

Per cent by weight of naphthalene	Per cent by weight of toluene	Solubility of CO
0	100	0 18
7 13	92 87	0 16
7 10	92 9	0 1
15 10	84 9	0 16
15 13	84 87	0 16
22 75	77 25	0 11
22 58	77 42	0 11

(Skirrow )

## CO in toluene and phenanthrene at 25° C

Per cent by weight of phenanthrene	Per cent by weight of toluene	Solubility of CO
0	100	0 1
5 59	94 41	0 1
5 58	94 42	0 1
11 16	88 84	0 16
11 20	88 8	0 16
21 62	78 38	0 1
21 93	78 07	0 1

(Skirrow )

## CO in toluene and nitrobenzene at 25° C

Per cent by weight of nitrobenzene	Per cent by weight of toluene	Solubility of CO
0	100	0 1
8 86	91 14	0 16
8 87	91 13	0 16
18 27	81 73	0 16
18 19	81 81	0 16
26 82	73 18	0 1
26 76	73 24	0 1
49 14	50 86	0 1
49 02	50 98	0 1
76 31	23 69	0 16
76 31	23 69	0 16
100	0	0 09

(Skirrow )

## CO in toluene and aniline at 25° C

Per cent by weight of aniline	Per cent by weight of toluene	Solubility of CO
0	100	0 1
6 61	93 39	0 16
6 61	93 39	0 16
13 56	86 44	0 1
13 55	86 45	0 1
19 91	80 09	0 1
19 96	80 04	0 1
44 64	55 36	0 1
44 31	55 69	0 1
74 63	25 37	0 0 8
75 03	24 97	0 0 3
100	0	0 0

(Skirrow )

CO in toluene and  $\alpha$ -naphthol at 25° C

Per cent by weight of $\alpha$ naphthol	Per cent by weight of toluene	Solubility of CO
0	100	0 182
4 46	95 54	0 171
4 44	95 56	0 171
8 75	91 25	0 162
8 89	91 11	0 163

(Skirow)

## CO in acetone and naphthalene at 25° C

Per cent by weight of naphthalene	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229 6	0 238
13 31	86 69	212 4	0 199
27 40	72 60	196 6	0 187

(Skirow)

## CO in acetone and phenanthrene at 25° C

Per cent by weight of phenanthrene	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229 6	0 238
12 77	87 23	218	0 205
25 04	74 96	207 5	0 183

(Skirow)

CO in acetone and  $\beta$ -naphthol at 25° C

Per cent by weight of $\beta$ naphthol	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229 6	0 238
13 95	86 05	213	0 190
26 58	73 12	195	0 169

(Skirow)

## CO in acetone and nitrobenzene at 25° C

Per cent by weight of nitrobenzene	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229 6	0 238
21 59	78 4	201	0 207
20	80	152	0 157
100	0		0 093

(Skirow)

## CO in acetone and aniline at 25° C

Per cent by weight of aniline	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229 6	0 238
20 83	79 17	192	0 179
55 10	44 9	120	0 110
100	0		0 053

(Skirow)

## CO in acetic acid and nitrobenzene at 25° C

Per cent by weight of nitrobenzene	Per cent by weight of acetic acid	Solubility of CO
0	100	0 173
21 65	78 35	0 156
51 03	48 97	0 130
100	0	0 093

(Skirow)

## CO in acetic acid and aniline at 25° C

Per cent by weight of aniline	Per cent by weight of acetic acid	Solubility of CO
0	100	0 173
13 5	86 5	0 110
41 64	58 36	0 0699
60 77	39 23	0 0618
82 21	17 79	0 0580
100	0	0 053

(Skirow)

## CO in methyl alcohol and glycerine at 25° C

Per cent by weight of glycerine	Per cent by weight of methyl alcohol	Measured vapor pressure	Solubility of CO
0	100	122	0 196
39 6	60 4	106	0 0964
60 5	39 5	91	0 0515
77 1	22 9	63	0 0246
100	0		very small

(Skirow)

## CO in acetone and chloroform at 25° C

Per cent by weight of chloroform	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229 6	0 238
33 38	66 62	202	0 226
53 2	46 8	179	0 219
65 03	34 97	167	0 220
73 46	26 54	162	0 212
79 83	20 17	163	0 204
87 3	12 7	168	0 207
94 4	5 6	178	0 205
100	0	188	0 207

(Skirow)

## CO in acetone and carbon bisulphide at 25° C

Per cent by weight of carbon bisulphide	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229 6	0 238
8 18	91 82	306	0 236
18 02	81 98	367	0 236
49 46	50 54	443	0 227
62 6	37 4	457	0 210
74 05	25 95	457	0 187
85 51	14 49	433	0 144
96 42	3 58	382	0 114
100	0	356	0 0959

(Skirow)



Solubility in H<sub>2</sub>O at various pressures P = pressure in atmospheres

P	Vol gas in 1 ccm H O		P	Vol gas in 1 ccm H O	
	at 0°	at 12 43°		at 0°	at 12 43°
1	1 797	1 086	20	26 65	17 11
5	8 65	5 15	25	30 55	20 31
10	16 03	9 65	30	33 74	23 35
15	21 95	13 63		-	

(Wroblewski, C R 94 1355)

Absorption of CO<sub>2</sub> in H<sub>2</sub>O at various pressures P=pressure in mm, V=vols CO<sub>2</sub>, reduced to 0° and 760° mm, absorbed by 1 vol H<sub>2</sub>O

P	V	P	V
697 71	0 9441	2188 65	3 1764
809 03	1 1619	2369 02	3 4857
1289 41	1 8647	2554 00	3 7152
1469 95	2 1623	2738 33	4 0031
2002 06	2 9067	3109 51	4 5006

(Khanikoff and Longunne, A ch (4) 11 412)

C=coefficient of absorption in H<sub>2</sub>O at t° and 760 mm

t°	C	t°	C	t°	C
15 2	1 000	18 38	0 806	21	0 838
17 6	0 930	18 3	0 885	23	0 798

(Setschenow, Mém Acad St Petersb 22 Nos 6, 7)

Absorption coefficient of CO<sub>2</sub> in H<sub>2</sub>O at 0° = 1 7308 (Prytz and Holst, W Ann 1895, 54 136)

Absorption of CO<sub>2</sub> by H<sub>2</sub>O at t°  
a=coefficient of absorption

t°	a	t°	a
0	1 713	19	0 902
1	1 646	20	0 878
2	1 584	21	0 854
3	1 527	22	0 829
4	1 473	23	0 804
5	1 424	24	0 781
6	1 377	25	0 759
7	1 331	26	0 738
8	1 282	27	0 718
9	1 237	28	0 699
10	1 194	29	0 682
11	1 154	30	0 665
12	1 117	35	0 592
13	1 083	40	0 530
14	1 050	45	0 479
15	1 019	50	0 436
16	0 985	55	0 394
17	0 956	60	0 359
18	0 928		

(Bohr, W Ann 1899, 68 504)

Solubility in H<sub>2</sub>O at 25°=0 8255, at 15°=1 070 (Geffcken, Z phys Ch 1904, 49 273)  
75 cc H<sub>2</sub>O absorb 0 1381 g CO<sub>2</sub> at 15 5° and 720 mm (Christoff, Z phys Ch 1905, 53 329)

Absorption-coefficient of CO<sub>2</sub> in H<sub>2</sub>O at 20°=0 877, or 1000 g H<sub>2</sub>O dissolve 878 cc CO (Usher, Chem Soc 1910, 97 72)

Solubility of CO in H<sub>2</sub>O=1 158 at 12° and 0 825 at 25° (Findlay and Shenn, Chem Soc 1911, 99 1315)

Absorption of CO<sub>2</sub> by H<sub>2</sub>O at high pressure

Amount of H<sub>2</sub>O used { a=0 210 ccm  
b=0 102 ccm

V=ccm of CO<sub>2</sub> absorbed by H<sub>2</sub>O at t°, reduced to a pressure of 1 kg per sq cm

V<sub>1</sub>=ccm of CO<sub>2</sub> absorbed by 1 ccm of H<sub>2</sub>O

Pressure kg/sq cm	t°	V <sub>1</sub>	
		a	b
25	20°		17 77
30			19 77
40			21 52
50			23 09
55			29 75
30	35°	11 77	13 57
40		14 82	20 00
50		18 96	24 64
60		22 90	22 50
70		27 18	27 62
80	60°		32 85
40		10 88	9 798
50		12 24	13 72
60		14 46	15 28
70		16 80	17 46
80		19 74	22 67
90		22 74	21 16
100		26 21	27 85
110		28 92	28 79
120		30 20	33 90
60	100°	8 965	
70		10 11	6 39
80		11 05	9 591
90		12 63	10 85
100		15 65	12 40
110		14 85	16 51
120		16 40	15 78
130		17 93	16 89
140		19 56	17 71
150		20 58	17 49
160		22 07	
170		22 78	

(Sunder, Z phys Ch 1912, 78 557)



Solubility of carbon dioxide in water at 25°

P = Pressure in mm Hg

S = Solubility calculated according to formula for which see the original article (Findlay, Chem Soc 1910, 97 538)

P	S	P	S
743	0 816	1059	0 817
752	0 817	1064	0 819
800	0 815	1153	0 818
841	0 817	1243	0 819
955	0 816	1351	0 820
955	0 817	1351	0 820

(Findlay and Creighton, Chem Soc 1910, 97 538)

Solubility of carbon dioxide in water at 25°

P = Pressure in mm Hg

S = Solubility See above

P	S	P	S
755	0 826	1069	0 823
759	0 825	1084	0 825
836	0 825	1210	0 825
841	0 826	1211	0 825
927	0 826	1350	0 824
934	0 824	1350	0 826

(Findlay and Creighton, Chem Soc 1912, 101 1460)

Solubility of carbon dioxide in water at 25°

P = Pressure in mm Hg

S = Solubility See above

P	S	P	S
263	0 817	495	0 816
271	0 816	651	0 816
382	0 814	667	0 817
392	0 811	752	0 818
479	0 816	768	0 817

(Findlay and Creighton, Chem Soc 1913, 103 638)

Sl sol in HCl + Aq

100 vols H<sub>2</sub>SO<sub>4</sub> of 1.840 sp gr absorb 4.4 vol CO (de Saussure)

H<sub>2</sub>SO<sub>4</sub> of ordinary density at 1.506 and common pressure absorbs 94% of its vol of CO fuming H<sub>2</sub>SO<sub>4</sub> 125% the absorption for pure H<sub>2</sub>O under the same conditions being 98% (Rogers Am J Sci (2) 5 115)

H<sub>2</sub>SO<sub>4</sub> absorbs 7-10% CO (Hlasiwetz, W A B 20 193)

Coefficient of absorption by conc H<sub>2</sub>SO<sub>4</sub> = 0.932, which is the same as that by H<sub>2</sub>O, but this diminishes on diluting, and is at its lowest limit 0.666, when the composition of the solution is H<sub>2</sub>SO<sub>4</sub>, H<sub>2</sub>O, upon further dilution the coefficient of solubility gradually increases, and when 58 H<sub>2</sub>O are present to 1 H<sub>2</sub>SO<sub>4</sub>, the

coefficient of absorption is 0.857 (Set-schenow, J B 1876 46)

Absorption of CO<sub>2</sub> by H<sub>2</sub>SO<sub>4</sub> + Aq

Solution	Grams CO <sub>2</sub> absorbed by at 15.5° and 720 mm	cc
1/2-N H <sub>2</sub> SO <sub>4</sub>	0 1273	
1-N H <sub>2</sub> SO <sub>4</sub>	0 1179	
2-N H <sub>2</sub> SO <sub>4</sub>	0 1092	
4-N H <sub>2</sub> SO <sub>4</sub>	0 1003	

(Christoff, Z phys Ch 1905, 53 32)

Solution	Grams CO <sub>2</sub> absorbed by at 15.5° and 720 mm	cc
2 5% H <sub>2</sub> SO <sub>4</sub>	0 1282	
5% "	0 1179	
10% "	0 0833	
20% "	0 0755	
30% "	0 0751	
40% "	0 0713	
45% "	0 0725	
70% "	0 0918	
90% "	0 1433	

(Christoff, l c)

Coefficient of absorption for 96% H<sub>2</sub> O<sub>2</sub> = 0.926 at 20.2° (Bohr, Z phys Ch 1911, 71 48)

Absorption of CO<sub>2</sub> by acids

M = Content in gram-equivalents per liter  
S = Solubility (see under oxygen)

Absorption of CO<sub>2</sub> by HNO<sub>3</sub> + Aq

M	S	S <sub>10</sub>
0 472	0 8382	1 07
0 475	0 8366	1 07
0 557	0 8387	1 06
0 704	0 8447	1 08
1 382	0 8620	1 06
1 387	0 8622	1 06
1 860	0 8752	1 10
2 519	0 8839	1 10
2 539	0 8865	1 11

(Geffcken, Z phys Ch 1904, 49 27)

Absorption of CO by HCl + Aq

M	S	S <sub>10</sub>
0 499	0 8047	1 04
0 511	0 8074	1 04
1 212	0 7973	1 02
1 249	0 7984	1 02
2 080	0 7951	0 98
2 180	0 7951	1 00

(Geffcken)

Absorption of CO by  $\frac{\text{H}_2\text{SO}_4}{2} + \text{Aq}$ 

M	S <sub>2</sub>	S <sub>1</sub> °
0 512	0 7923	1 016
0 517	0 7936	1 016
0 995	0 7693	0 9772
1 039	0 7685	0 9775
1 067	0 7672	0 9756
1 956	0 7302	0 9175
2 088	0 7273	0 9143
3 790	0 6736	0 8354
3 800	0 6747	0 8385

(Geffcken)

In collecting CO<sub>2</sub> gas in pneumatic operations a saturated solution of common salt is better than H<sub>2</sub>O for filling the trough. This solution will only absorb about 1/3 of the amount of CO<sub>2</sub> absorbed by pure H<sub>2</sub>O (de Saussure 1 c)

100 vols of the following solutions at 18° and ordi nary pressure absorb vols CO<sub>2</sub>—

	Sp gr	Vols CO
Sat NaCl+Aq (containing 29% of NaCl)	1 212	32 9
Sat NH <sub>4</sub> Cl+Aq (containing 27 53% of NH <sub>4</sub> Cl)	1 078	75
Sat KCl+Aq (containing 26% of KCl)	1 168	61
Sat CaCl <sub>2</sub> +Aq (containing 40 2% of CaCl <sub>2</sub> )	1 402	26 1
Sat K <sub>2</sub> SO <sub>4</sub> +Aq (containing 9 42% of K <sub>2</sub> SO <sub>4</sub> )	1 077	62
Sat Na <sub>2</sub> SO <sub>4</sub> +Aq (containing 11 14% of Na <sub>2</sub> SO <sub>4</sub> )	1 105	58
Sat K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +Aq (containing 9 14% of K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +24H <sub>2</sub> O)	1 047	70
Sat KNO <sub>3</sub> +Aq (containing 20 6% of KNO <sub>3</sub> )	1 139	57
Sat NaNO <sub>3</sub> +Aq (containing 26 4% of NaNO <sub>3</sub> )	1 206	42
Sat H <sub>2</sub> C <sub>4</sub> H <sub>4</sub> O <sub>6</sub> +Aq (containing 53 37% of H <sub>2</sub> C <sub>4</sub> H <sub>4</sub> O <sub>6</sub> )	1 288	41
(de Saussure Gilberts Ann Phys 47 187)		

About half as sol in NaCl+Aq (15% NaCl) as in H<sub>2</sub>O

Much more sol in Na<sub>2</sub>HPO<sub>4</sub>+Aq or Na<sub>2</sub>CO<sub>3</sub>+Aq than in H<sub>2</sub>O, the quantity dissolved increasing with the amount of salt in the solution. The solubility in these solutions depends on the coefficient of solubility in H<sub>2</sub>O plus the product of a constant coefficient multiplied by the amount of salt in the solution, this constant being 0 0001 for Na<sub>2</sub>HPO<sub>4</sub>, and 0 005 for Na<sub>2</sub>CO<sub>3</sub>, Arch (3) 47 307)

Direct determinations are not accurate (I M.C.V., A Suppl 2 157)

1 mol Na<sub>2</sub>HPO<sub>4</sub> in dil Na HPO<sub>4</sub>+Aq absorbs 2 mols CO (Setschenow)

Solutions of salts of similar constitution are equivalent in regard to their power of absorption of CO, when they contain the same percentage of crystal water. Experiments were made with solutions of alum, MgSO<sub>4</sub>, 7H<sub>2</sub>O, and ZnSO<sub>4</sub>, 7H<sub>2</sub>O, containing 10% of the salts. The MgSO<sub>4</sub> solution absorbed the greatest proportional amount of CO<sub>2</sub>, and the alum the least. The further rule was deduced that with salts of similar constitution and the same amount of crystal water, the

absorptometric equivalents are identical with the chemical equivalents (Setschenow, B 6 1461)

Salts can be divided into two classes, according as CO<sub>2</sub> has chemical action on the salt or not. In the first case, i.e., when there is chemical combination or action of CO<sub>2</sub> on the salt in solution, the amount of CO<sub>2</sub> absorbed increases with increasing concentration of the solution, in the second case, however, the amount of CO<sub>2</sub> decreases with the strength of the solution. Several salts can be arranged in a series as regards their power of absorption, beginning with that which has the greatest, as follows Na<sub>2</sub>CO<sub>3</sub>, Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub>, Na<sub>2</sub>HPO<sub>4</sub>, Na<sub>2</sub>C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, Na<sub>2</sub>C<sub>2</sub>H<sub>3</sub>O<sub>7</sub>, Na<sub>2</sub>C<sub>2</sub>O<sub>4</sub>, NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, MnO<sub>2</sub>, MCl, M<sub>2</sub>SO<sub>4</sub>. The division between the two classes occurs in this series at Na<sub>2</sub>C<sub>2</sub>O<sub>4</sub>.

The matter is discussed at length in the original papers (Setschenow, Mémoires Acad St Petersb 22 No 6. Also further, Setschenow, ib 34 No 3, and 35 No 7. See also Ostwald, Allgemeine Chemie, 2<sup>te</sup> Aufl vol 1, p 629)

Solubility of CO<sub>2</sub> in salts+Aq at 15 2°

CO<sub>2</sub>=cc CO<sub>2</sub> (at 0° and 760 mm) dissolved per cc of salt solution

Salt	g salt per l	CO
NH <sub>4</sub> Cl	1	1 005
"	10	0 985
"	51 6	0 941
"	172	0 819
"	258	0 770
NH <sub>4</sub> NO <sub>3</sub>	2 8	1 013
"	11 2	1 002
"	55	0 989
"	101	0 962
"	202 1	0 911
"	404 3	0 807
"	810 4	0 612
(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	72 2	0 712
"	144 4	0 575
Ba(NO <sub>3</sub> ) <sub>2</sub>	62 7	0 922
Ca(NO <sub>3</sub> ) <sub>2</sub>	41	0 923
LiCl	16 72	1 035
"	50 15	0 808
"	125 4	0 596
"	250 8	0 497
"	501 5	0 120
MgSO <sub>4</sub>	26 5	0 901
"	79 5	0 669
"	159	0 441
"	318	0 188
KBi	83 9	0 908
"	167 7	0 519
"	251 5	0 748
"	503 1	0 579
KI	319 1	0 777
"	478 6	0 688
"	957 3	0 506
KSCN	326	0 691
"	489	0 590

Solubility of CO<sub>2</sub> in salts + Aq at 15 2°—Cont

Salt	g salt per l	CO
KSCN	978	0 387
KNO <sub>3</sub>	58 8	0 959
"	117 5	0 890
"	235 1	0 781
NaCl	12 9	0 978
"	64	0 760
"	128	0 580
"	192	0 466
NaBr	115 1	0 775
"	460 3	0 364
"	690 4	0 221
NaNO <sub>3</sub>	89 3	0 835
"	125	0 762
"	208 4	0 621
"	416 8	0 385
"	625 2	0 244
NaClO <sub>3</sub>	233 3	0 625
"	349 9	0 506
"	699 8	0 257
Na <sub>2</sub> SO <sub>4</sub>	14 2	0 950
"	94 8	0 620
"	284 4	0 234
ZnSO <sub>4</sub>	38 3	0 903
"	76 7	0 783
"	230	0 474
"	460	0 209

(Setschenow, A ch 1892, (6) 25 226)

CO<sub>2</sub> is not disengaged at ordinary temp from H<sub>2</sub>O, in which  $\frac{1}{1000}$  pt of CaCO<sub>3</sub> or MgCO<sub>3</sub> is held in solution thereby. These solutions have a great power of retaining CO<sub>2</sub> even at a boiling temp or with diminished pressure, and they also absorb CO<sub>2</sub> from the air in much larger quantity than pure H<sub>2</sub>O (Bineau).

BaCO<sub>3</sub> in H<sub>2</sub>O also retains CO<sub>2</sub> even after long boiling (Storer).

CO<sub>2</sub> is also absorbed from the air by Na<sub>2</sub>CO<sub>3</sub> or K<sub>2</sub>CO<sub>3</sub> + Aq, especially if dilute.

Absorption of CO<sub>2</sub> by NaCl + Aq at t°

$\alpha$  = Coefficient of absorption for a 6.52% NaCl solution

$\alpha_1$  = Coefficient of absorption for a 17.62% NaCl solution

t°	$\alpha$	$\alpha_1$
0	1 234	0 678
5	1 024	0 577
10	0 875	0 503
15	0 755	0 442
20	0 664	0 393
25	0 583	0 352
30	0 517	0 319
35	0 460	0 288
40	0 414	0 263
45	0 370	0 235
50	0 335	0 215
55	0 305	0 198
60		0 183

(Bohr, W Ann 1899, 68 504)

Absorption of CO<sub>2</sub> by CsCl + Aq

M = Content in g equiv per l

S = Solubility (See under Oxygen)

M	S <sub>25°</sub>	S <sub>15°</sub>
0 552	0 7771	1 001
0 554	0 7769	0 999

(Geffcken, Z phys Ch 1904, 49 273)

Absorption of CO<sub>2</sub> by KNO<sub>3</sub> + Aq

M	S <sub>25°</sub>	S <sub>15°</sub>
0 536	0 7832	1 002
0 537	0 7818	0 999
1 022	0 7452	0 943
1 033	0 7447	0 942

(Geffcken)

Absorption of CO<sub>2</sub> by KI + Aq

M	S <sub>25</sub>	S <sub>1°</sub>
0 559	0 7678	0 980
0 573	0 7676	0 983
1 043	0 7236	0 914
1 119	0 7166	0 909

(Geffcken)

Absorption of CO<sub>2</sub> by RbCl + Aq

M	S <sub>25</sub>	S <sub>1</sub>
0 479	0 7705	0 990
0 481	0 7698	0 991
1 007	0 7190	0 921
1 012	0 7157	0 920

(Geffcken)

## Absorption of CO by KBr + Aq

M	S <sub>2</sub>	S <sub>1</sub>
0 550	0 7621	0 978
0 565	0 7619	0 976
1 056	0 7030	0 910
1 064	0 7068	0 906

(Geffcken)

Absorption of CO<sub>2</sub> by KCl + Aq

M	S	S <sub>1</sub>
0 423	0 7695	0 989
0 432	0 7667	0 986
1 045	0 6920	0 887
1 058	0 6961	0 891

(Geffcken)

Absorption of CO<sub>2</sub> by salts + Aq

Salt	Grams CO <sub>2</sub> absorbed by 75 cc of salt solution at 15° and 720 mm
1-N KBr	0 1280
1-N KNO <sub>3</sub>	0 1231
1-N KCl	0 1213
1-N KI	0 1204
1-N LiCl	0 1087
1-N NaCl	0 1050
1-N (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	0 1093
1-N (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> · Fe <sub>2</sub> SO <sub>4</sub> · 24H <sub>2</sub> O	0 0991
1-N K <sub>2</sub> SO <sub>4</sub>	0 1002
1-N K <sub>2</sub> SO <sub>4</sub> · Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> · 24H <sub>2</sub> O	0 1054
<sup>2</sup> / <sub>3</sub> -N K <sub>2</sub> SO <sub>4</sub>	0 1140
<sup>1</sup> / <sub>2</sub> -N MgSO <sub>4</sub>	0 1209
1-N MgSO <sub>4</sub>	0 1047
2-N MgSO <sub>4</sub>	0 0656
4-N MgSO <sub>4</sub>	0 0527
2-N CuSO <sub>4</sub>	0 0751
2-N ZnSO <sub>4</sub>	0 0720
<sup>2</sup> / <sub>3</sub> -N KHSO <sub>4</sub>	0 1017
2-N KHSO <sub>4</sub>	0 0999
1-N KH <sub>2</sub> AsO <sub>4</sub>	0 0808
1-N KH <sub>2</sub> PO <sub>4</sub>	0 0852
<sup>1</sup> / <sub>3</sub> -N K <sub>2</sub> HAsO <sub>4</sub>	0 1111
<sup>1</sup> / <sub>2</sub> -N K <sub>2</sub> HPO <sub>4</sub>	0 4989
<sup>1</sup> / <sub>40</sub> -N Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0 2205
<sup>1</sup> / <sub>5</sub> -N Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0 5317
<sup>1</sup> / <sub>4</sub> -N Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0 8511
<sup>1</sup> / <sub>4</sub> -N NaBO <sub>3</sub>	0 8124
<sup>1</sup> / <sub>4</sub> -N NH <sub>4</sub> HB <sub>2</sub> O <sub>4</sub>	0 7672
N-Na <sub>2</sub> PO <sub>4</sub> · 12H <sub>2</sub> O	0 5828
N-Na <sub>2</sub> P <sub>2</sub> O <sub>7</sub> · 10H <sub>2</sub> O	0 8457
N-NaPO <sub>3</sub>	0 2081
N-KPO <sub>3</sub>	0 2618

(Christoff, Z phys Ch 1905, 53 338-340)

Solubility of CO in KCl + Aq at 25°

Concentration, 7.45 g in 100 cc of solution, sp gr = 1.043

Pressure 756 850 953 1116 1249 1362  
Solubility 0.694 0.693 0.688 0.700 0.709 0.710

Concentration 5 g in 100 cc of solution, sp gr = 1.031

Pressure 756 832 901 1050 1150 1223  
Solubility 0.731 0.727 0.724 0.726 0.735 0.736

Concentration, 2.56 g in 100 cc of solution, sp gr = 1.016

Pressure 756 852 981 1079 1190 1362  
Solubility 0.767 0.761 0.761 0.763 0.768 0.766

(Findlay and Craghton, Chem Soc 1910, 97 557)

Solubility of CO<sub>2</sub> in NH<sub>4</sub>Cl + Aq at 25°

Concentration (C) denotes number of grams of solute in 100 cc of solution

Density (D) equals the specific gravity of the solution

Solubility (S) calculated by formula given in the original article

C	D	S
2 35	1 005	0 791
5 05	1 013	0 754
8 24	1 022	0 732
10 02	1 027	0 712
17 09	1 045	0 665

(Findlay and Shenn, Chem Soc 1912, 101 1461)

Solubility of CO<sub>2</sub> in KCl + Aq at 25°

C	D	S
1 84	1 008	0 792
3 05	1 017	0 764
4 58	1 026	0 749
7 46	1 044	0 701

(Findlay and Shenn)

Solubility of CO<sub>2</sub> in BaCl<sub>2</sub> + Aq at 25°

C	D	S
2 80	1 018	0 789
5 81	1 040	0 741
8 15	1 054	0 710
9 97	1 070	0 676

(Findlay and Shenn)

Solubility of CO in (NH<sub>4</sub>)<sub>2</sub>Fe(SO<sub>4</sub>)<sub>2</sub> + Aq at 25°

C	D	S
9 51	1 052	0 641
10 26	1 057	0 629
22 47	1 124	0 460

(Findlay and Shenn)

Solubility of CO<sub>2</sub> in solutions of sucrose at 25°

C	D	S
2 63	1 009	0 813
5 16	1 018	0 798
9 68	1 038	0 767
12 33	1 051	0 744

(Findlay and Shenn)

Solubility of CO in solutions of chloral hydrate at 25°

C	D	S
5 08	1 019	0 815
10 12	1 041	0 795

(Findlay and Shenn)

100 vols alcohol (0.803 sp gr) at 18° absorb 260 vols CO<sub>2</sub>  
 100 vols alcohol (0.840 sp gr) at 18° absorb 186 vols CO (de Saussure l c)

Solubility of CO<sub>2</sub> in alcohol 1 vol alcohol at t° and 760 mm dissolves V vols CO<sub>2</sub> gas reduced to 0° and 760 mm

t°	V	t°	V	t	V
0	4 3295	9	3 5844	18	3 0402
1	4 2368	10	3 5140	19	2 9921
2	4 1466	11	3 4461	20	2 9465
3	4 0589	12	3 3807	21	2 9034
4	3 9736	13	3 3178	22	2 8628
5	3 8908	14	3 2573	23	2 8247
6	3 8105	15	3 1993	24	2 7890
7	3 7327	16	3 1438		
8	3 6573	17	3 0908		

(Bunsen's Gasometry, pp 287, 128, 153)

Coefficient of absorption = 4 32955—  
 0.09395t + 0.00124t<sup>2</sup> (Bunsen)

Much less sol in 30% alcohol than in pure alcohol or pure H<sub>2</sub>O (Muller, W Ann 37 24)

Solubility of CO in 99% alcohol at t°

$\alpha$  = Coefficient of absorption, i.e., the no of cem of CO<sub>2</sub> measured at 0° and 760 mm which are absorbed at the given temp and at an absorption pressure of 760 mm by 1 cem alcohol

$\alpha_1$  = Coefficient of absorption corrected for increase in the volume of the alcohol used due to absorption of CO

t°	$\alpha$	$\alpha_1$
-65	38 41	35 93
-25	8 75	8 61
-20	7 51	7 41
-15	6 59	6 51
-10	5 75	5 69
-5	5 01	4 96
0	4 44	4 40
+5	3 96	3 91
10	3 57	3 55
15	3 25	3 23
20	2 98	2 96
25	2 76	2 74
30	2 57	2 56
35	2 41	2 39
40	2 20	2 19
45	2 01	2 00

(Bohr, W Ann 1900, (4) 1 249)

Solubility in 98.7% alcohol at t°

$\alpha$  = Coefficient of absorption

$\alpha_1$  = Coefficient of absorption corrected for increase in volume of the alcohol used due to absorption of CO.

t°	$\alpha$	$\alpha_1$
0	4 35	4 31
-10	5 43	5 38
-20	7 25	7 16
-30	9 97	9 79
-40	14 25	13 89
-50	21 28	20 49
-60	31 25	29 59
-65	39 89	37 22
-67	44 07	40 83

(Bohr, W Ann 1900, (4) 1 253)

Solubility in alcohol + Aq at t°

t°	% by wt of alcohol in the solvent	Solubility of CO <sub>2</sub> in alcohol + Aq	Solubility of CO <sub>2</sub> in H <sub>2</sub> O
1 4	6 325	1 5864	1 69
3 2	4 464	1 4878	1 56
9 2	7 276	1 1829	1 22
13 8	2 870	1 0268	1 03

(Langer, C C 1904, I, 1583)

Solubility of CO<sub>2</sub> in ethyl alcohol at 25°

Concentration 2.95 g alcohol in 100 cc of solution Sp gr 25°/15° = 0.99308  
 Pressure 737 836 929 1073 1213 38  
 Solubility 0.812 0.813 0.812 0.811 0.813 0 11

Concentration 3.01 g alcohol in 100 cc of solution Sp gr 25°/15° = 0.99295  
 Pressure 745 823 937 1083 1226 57  
 Solubility 0.814 0.812 0.815 0.813 0.812 0 12

Concentration 8.83 g alcohol in 100 cc of solution Sp gr 25°/15° = 0.98342  
 Pressure 747 846 942 1090 1231 60  
 Solubility 0.786 0.786 0.784 0.785 0.786 0 88  
 (Findlay and Shenn, Chem Soc 1911, 19 1315)

Solubility of CO in organic solvents at various temperatures

Solvent Ethyl alcohol

t = -75 sp gr = 0.872

Pressure	Coefficient of absorption	Solubility
100	111 8	68 4
200	115 7	69 5
400	123 8	71 4
700	138 6	74 7

Solubility of CO<sub>2</sub> in organic solvents at low temperatures—*Continued*

t = -59° sp gr = 0.856		
Pressure	Coefficient of absorption	Solubility
100	40.85	27.27
200	41.00	27.16
400	42.35	27.65
700	44.15	28.10

## Solvent Methyl alcohol

t = -78° Sp gr = 0.884		
Pressure	Coefficient of absorption	Solubility
50	194.0	120.5
100	195.0	119.6
200	202.9	120.1
400	221.5	122.2
500	226.4	
740	260.0	126.8

t° = -59° sp gr = 0.866		
Pressure	Coefficient of absorption	Solubility
100	63.0	42.5
200	64.2	42.7
400	66.3	43.1
700	69.0	43.3

## Solvent Acetone

t = -78° sp gr = 0.900		
Pressure	Coefficient of absorption	Solubility
50	311	196.6
100	322	198.1
200	344.5	201.5
400	400	208.8
640	487	215.7
700	545.5	

t = -19° sp gr = 0.879		
Pressure	Coefficient of absorption	Solubility
100	97.5	67.2
200	101.2	68.0
400	106.6	72.3
700	115.8	72.8

## Solvent—Ethyl acetate

t = -78° sp gr = 1.017		
Pressure	Coefficient of absorption	Solubility
50	250.2	177.5
100	255.6	177.1
200	271.5	179.2
400	310.9	183.2
650	386.9	191.2

Solubility of Co in organic solvents at low temperatures—*Continued*

t = -59° sp gr = 0.994		
Pressure	Coefficient of absorption	Solubility
100	85.3	65.6
200	86.3	65.3
400	91.6	66.7
700	101.5	69.7

## Solvent Methyl acetate

t = -78° sp gr = 1.056		
Pressure	Coefficient of absorption	Solubility
50	304.9	224.1
100	315.0	224.3
200	337.4	223.1
400	389.3	225.6
650	498.1	231.2

t = -19° sp gr = 1.032		
Pressure	Coefficient of absorption	Solubility
100	94.3	75.8
200	98.45	77.1
400	103.6	77.6
700	112.9	79.0

(Stern, Z phys Ch 1912, 81 468)

Solubility of CO<sub>2</sub> in ether at 0° = 7.33, at 10° = 6.044, at 15° = 5.46 (Christoff, Z phys Ch 1912 79 459)

Coefficient of absorption in chloroform is 0.20376 at 36.57 mm, and 4.43757 at 762 mm pressure (Woukoloff, C R 109 62)

100 vols of following liquids absorb vols CO <sub>2</sub> at 15° —		
	Sp gr	Vols CO
Ether	0.727	217
Rectified naphtha	0.784	169
Oil of turpentine	0.860	166
Oil of lavender (freshly distilled)	0.850	191
Oil of thyme	0.890	185
Linseed oil	0.940	156
Olive oil	0.910	151
Cum. arabic + Aq (containing 25% of the gum)	1.092	7
Cane sugar + Aq (containing 2% of sugar)	1.104	72

(de Saussure, l c)

1 vol oil of turpentine absorbs 17-19 vols CO (Saussure)

1 vol spirit at 10° absorbs 2 vols CO (de Saussure)

1 vol olive oil at 10° absorbs 1 vol CO (de Saussure)

1 vol oil of turpentine at 10° absorbs 2 vols CO

(Bergman)

1 vol caoutchouc absorbs 11 vols CO (Bergman)

Coefficient of absorption for petroleum is 1.17 at 20° and 1.31 at 10° (Gniewasz and Walfisz, Zeit phys Ch 1 70)

100 vols petroleum absorb 70 vols CO<sub>2</sub> at 10° (Robinet, C R 58 608)

Solubility of CO<sub>2</sub> in  $\frac{N}{2}$  solutions of various organic substances at 20°

Substance	Sp gr of $\frac{N}{2}$ solution	Coeff of absorption	cc CO <sub>2</sub> dissolved in 1000 g H <sub>2</sub> O
Dextrose	1 0328	0 792	841
Mannite	1 03031	0 782	833
Glycerine	1 01413	0 843	864
Pyrogallol	1 01718	0 853	894
Hydrochmon	1 00946	0 887	928
Resorcin	1 00958	0 901	945
Pyrocatechin	1 0107	0 868	908
Urethane	1 0037	0 869	907
Carbamide	1 00715	0 864	884
Thiocarbamide	1 00917	0 859	885
Antipyrine	1 01339	0 859	935
Acetamide	1 005	0 879	906
Acetic acid	1 0026	0 868	893
N Propylic acid	0 9939	0 869	902

(Usher, Chem Soc 1910, 97 73)

Absorption of CO<sub>2</sub> by ethyl alcohol

Amount of alcohol used = 0 093 ccm  
 V = ccm of CO<sub>2</sub> absorbed by the solvent at t°, reduced to a pressure of 1 kg per sq cm  
 V<sub>1</sub> = ccm of CO<sub>2</sub> absorbed by 1 ccm of the solvent

Pressure kg/sq cm	t°	Gas volume ccm	V	V <sub>1</sub>
30	20°	57 31	9 462	104 8
40			15 15	149 7
50			23 04	188 8
30	35°	60 05	7 114	77 87
40			10 52	113 1
50			14 73	144 5
60			19 63	173 0
70			27 39	210 8
40	60°	64 44	6 429	72 82
50			9 023	97 09
60			12 27	122 5
70			15 64	145 2
80			19 11	167 9
90			20 64	180 7
100			23 88	195 7
50	100°	72 19	3 809	42 49
60			6 034	66 05
70			8 374	88 67
80			10 76	111 2
90			13 06	129 0
100			14 90	145 7
110			16 22	155 0
120			18 93	174 6
130			20 48	182 6
140			20 61	186 0

(Sander, Z phys Ch 1912, 78 524)

Absorption of CO<sub>2</sub> by propyl alcohol  
 Amount of alcohol used = 0 103 ccm  
 V and V<sub>1</sub> See under absorption of CO<sub>2</sub> by ethyl alcohol

Pressure kg/sq cm	t°	Gas volume ccm	V	V <sub>1</sub>
20	20°	60 59	4 867	6 16
30			8 472	6 62
40			13 46	2 1
50			21 62	4 6
20	35°	62 96	3 493	0 00
30			6 307	4 08
40			9 296	8 16
50			13 99	2 8
60			18 90	9 9
70			35 03	8 2
80			49 23	9 6
20	60°	68 08	2 602	4 73
30			4 722	7 68
40			6 723	4 65
50			9 810	8 54
60			13 05	1 5
70			17 15	4 4
80			19 61	9 2
90			24 75	3 3
100			30 19	3 9
40	100°	76 27	2 592	6 50
50			5 669	4 19
60			8 025	7 51
70			10 44	32 17
80			13 13	37 7
90			15 72	32 3
100			17 10	44 7
110			20 95	3 5
120			23 55	75 4

(Sander)

Absorption of CO<sub>2</sub> by ether  
 Amount of ether used = 0 131 ccm  
 V and V<sub>1</sub> See under absorption of CO<sub>2</sub> by alcohol

Pressure kg/sq cm	t°	Gas volume ccm	V	V <sub>1</sub>
45	35°	62 06	42 62	35 6
56			46 81	17 3
60			57 83	41 6
50	60°	67 11	28 49	71 6
60			35 24	35 4
70			42 01	10 0
80			46 64	21 4
90			50 72	35 0
100			56 63	48 7
60	100°	71 03	12 57	01 0
70			20 00	34 6
80			26 34	42 8
90			32 16	66 4
100			35 70	75 4

(Sander)

Absorption of CO<sub>2</sub> by benzene  
Amount of benzene used = 0.080 ccm  
V and V<sub>1</sub> See under absorption of CO<sub>2</sub> by ethyl alcohol

Pressure kg/sq cm	t°	Gas volume ccm	V	V <sub>1</sub>
15	20°	55.14	2.728	46.89
20			4.845	71.16
30			9.618	125.3
40			18.70	192.4
50			30.10	264.3
15	35°	58.17	2.225	39.94
20			3.373	48.65
30			6.879	94.39
40			11.56	138.3
50			17.09	186.6
60	60°	61.86	25.73	243.1
70			35.80	269.0
20			2.140	34.57
30			3.880	55.97
40			6.699	88.71
50	100°	73.75	10.28	128.5
60			13.57	156.6
70			17.71	184.6
80			22.50	215.0
90			28.09	246.6
100			33.76	284.4
40	100°	73.75	2.822	46.52
50			3.981	58.46
60			6.440	91.27
70			8.398	119.0
80			11.96	155.8
90	100°	73.75	14.57	182.5
100			17.79	212.9
110			20.60	237.7
120			23.98	258.2

(Sander)

Absorption of CO<sub>2</sub> by chlorbenzene  
Amount of chlorbenzene used = 0.106 ccm  
V and V<sub>1</sub> See under absorption of CO<sub>2</sub> by ethyl alcohol

Pressure kg/sq cm	t°	Gas volume ccm	V	V <sub>1</sub>
20	20°	61.03	5.813	62.61
30			10.25	95.22
40			17.17	137.3
50			26.59	187.5
20	35°	64.16	4.650	46.66
30			7.705	72.73
40			11.81	101.5
50			16.83	137.3
60			22.82	168.3
70	60°	69.38	32.83	205.5
20			3.685	35.86
30			5.510	53.94
40			7.982	73.69

Absorption of CO<sub>2</sub> by chlorbenzene —Cont

Pressure kg/sq cm	t°	Gas volume ccm	V	V <sub>1</sub>
50			11.16	99.06
60			13.74	118.1
70			16.65	134.5
80			19.50	149.3
90			22.23	165.5
110	100°	77.73	31.64	204.4
30			3.562	33.65
40			5.008	48.16
50			7.106	63.78
60			8.701	77.24
70	100°	77.73	10.37	91.02
80			12.05	103.00
90			13.88	121.2
100			14.89	121.5
110			16.35	130.7
120	100°	77.73	17.77	140.7
130			18.54	146.8

(Sander)

Absorption of CO<sub>2</sub> by brombenzene  
Amount of brombenzene used = 0.113 ccm  
V and V<sub>1</sub> See under absorption of CO<sub>2</sub> by ethyl alcohol

Pressure kg/sq cm	t°	Gas volume ccm	V	V <sub>1</sub>
20	20°	60.84	4.531	50.83
30			7.793	82.29
40			12.22	121.1
50			17.37	160.0
20	35°	63.96	3.947	43.38
30			5.782	62.69
40			8.508	90.43
50			11.96	116.4
60			16.00	146.0
70	60°	69.16	22.56	184.1
80			41.26	233.9
20			2.650	30.58
30			3.714	46.15
40			5.971	62.64
50	100°	77.48	7.406	77.19
60			9.718	98.73
70			10.27	108.4
80			13.99	131.4
90			16.70	144.3
100	100°	77.48	20.06	169.7
110			23.13	190.6
30			2.970	30.56
40			4.032	41.49
50			5.833	59.64
60	100°	77.48	7.239	72.64
70			8.330	82.56
80			9.714	92.86
90			11.14	107.1
100			12.79	118.0
110	100°	77.48	13.80	125.3
120			15.50	140.7

(Sander)



Absorption of CO<sub>2</sub> by nitrobenzene  
Amount of nitrobenzene used = 0.164 ccm  
V and V<sub>1</sub> See under absorption of CO<sub>2</sub>  
by ethyl alcohol

Pressure kg/sq cm	t°	Gas volume ccm	V	V <sub>1</sub>
15	20°	57.65	5.459	41.60
20			7.354	57.12
30			12.14	92.50
40			15.93	115.9
50			21.71	155.9
20	35°	59.86	5.644	44.48
30			8.658	68.23
40			11.98	94.39
50			15.59	113.4
60			19.94	145.1
70			25.57	179.6
80			34.95	227.0
20	60°	64.73	3.787	31.38
30			4.519	38.23
40			6.308	52.26
50			7.750	64.21
60			8.887	72.15
70			10.15	82.40
80			10.80	85.03
20	100°	75.52	2.749	24.67
30			4.162	41.00
40			5.393	50.36
50			6.832	63.80
60			7.763	70.85
70			9.048	75.75
80			10.65	86.86

(Sander)

Absorption of CO<sub>2</sub> by toluene  
Amount of toluene used = 0.114 ccm  
V and V<sub>1</sub> See under absorption of CO  
by ethyl alcohol

Pressure kg/sq cm	t°	Gas volume ccm	V	V <sub>1</sub>
20	20°	59.97	7.420	57.91
30			13.31	103.3
40			23.25	155.9
50			45.10	235.8
20	35°	63.05	6.018	49.60
30			10.13	82.63
40			16.03	118.8
50			23.34	155.8
60			31.39	192.1
70			44.17	225.5
30	60°	68.17	6.735	54.67
40			9.885	78.67
50			13.98	104.6
60			18.00	128.1
70			22.66	150.1
80			26.60	171.9
90			31.66	191.5
100			38.86	210.0

Absorption of CO<sub>2</sub> by toluene — *Contd.*

Pressure kg/sq cm	t°	Gas volume ccm	V	V <sub>1</sub>
30	100°	76.37	3.356	2.68
40			5.945	4.25
50			8.703	6.93
60			11.18	8.98
70			13.72	10.7
80			16.30	11.6
90			18.88	13.6
100			21.85	14.0
110			24.86	16.9
120			26.80	17.8
130			28.21	17.7

(Sander)

Absorption of CO<sub>2</sub> by ethyl acetate  
Amount of ethyl acetate used = 0.157 ccm  
V and V<sub>1</sub> See under absorption of CO<sub>2</sub>  
by ethyl alcohol

Pressure kg/sq cm	t°	Gas volume ccm	V	V <sub>1</sub>
25	20°	60.30	29.43	15.6
30			37.91	18.2
40			51.26	22.9
30	35°	63.40	26.54	14.2
40			38.69	18.4
50			48.35	21.9
60			51.88	21.8
30	60°	68.55	18.12	10.0
40			25.67	14.5
50			33.21	16.2
60			40.12	18.7
70			45.47	20.1
80			49.16	22.4
40	100°	76.80	12.76	8.70
50			18.80	11.1
60			24.12	13.0
70			28.99	15.0
80			32.96	16.3
90			36.92	17.1
100			42.75	19.5

(Sander)

Absorption of CO by CH<sub>3</sub>COOH + CCl<sub>4</sub>

Solvent	α CO absorbed
1 mol CH <sub>3</sub> COOH	58.5
0.8 " CH <sub>3</sub> COOH +	
0.2 " CCl <sub>4</sub>	61.0
0.5 " CH <sub>3</sub> COOH +	
0.5 " CCl <sub>4</sub>	62.4
0.2 " CH <sub>3</sub> COOH +	
0.8 " CCl <sub>4</sub>	60.2
1 " CCl <sub>4</sub>	57.6

(Christoff, J phys Ch 1905, 53 38)

Absorption of CO<sub>2</sub> by C<sub>2</sub>H<sub>4</sub>Cl<sub>2</sub> + CS<sub>2</sub>

Solvent	cc CO <sub>2</sub> absorbed
1 mol C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub>	209 7
0 8 " C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> +	
0 2 " CS <sub>2</sub>	173 4
0 5 " C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> +	
0 5 " CS <sub>2</sub>	140 0
0 2 " C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> +	
0 8 " CS <sub>2</sub>	71 9
1 " CS <sub>2</sub>	19 9

(Christoff)

Solubility of CO<sub>2</sub> in organic solvents

$\frac{ds}{dt}$  = change of solubility for 1° increase in temp

Solvent	Solubility at 20° C	Solubility at 20° C	Solubility at 15° C	$\frac{ds}{dt}$
Glycerine	0 0302			
Water	0 8256			
Carbon bisulphide	0 8699	0 8888	0 9446	-0 00747
Iodobenzene	1 301	1 371	1 440	-0 0139
Aniline	1 324	1 434	1 531	-0 0207
o Toluidine	1 381	1 473	1 539	-0 0158
m Toluidine	1 438	1 581	1 730	-0 0244
Fugenol	1 539	1 653	1 762	-0 0223
Benzotrithloride	1 643			
Cumene	1 782	1 879	1 978	-0 0196
Carvene	1 802	1 921	2 034	-0 0232
Dichlorhydrin	1 810	1 917	2 020	-0 0210
Amyl alcohol	1 831	1 941	2 058	-0 0227
Brombenzene	1 842	1 964	2 092	-0 0250
Isobutyl alcohol	1 849	1 964	2 088	-0 0239
Benzyl chloride	1 938	2 072	2 180	-0 0242
m Xylene	2 090	2 216	2 346	-0 0256
Ethylene bromide	2 157	2 294	2 424	-0 0267
Chlorobenzene	2 265	2 420	2 581	-0 0316
Carbon tetrachloride	2 294	2 502	2 603	-0 0309
Propylene bromide	2 301	2 453	2 586	-0 0281
Toluene	2 305	2 426	2 557	-0 0256
Benzene	2 425	2 540	2 710	-0 0285
Nitrobenzene	2 456	2 638	2 803	-0 0348
Propyl alcohol	2 498	2 655	2 845	-0 0389
Carbol	2 498			
1 thyl alcohol (97%)	2 706	2 690	2 914	-0 0416
Benzaldehyde	2 841	3 057	3 130	-0 0424
Amyl chloride	2 910	3 127	3 303	-0 0453
Isobutyl chloride	3 105	3 388	3 659	-0 0554
Chloroform	3 430	3 681	3 956	-0 0526
Butyric acid	3 478	3 767	4 084	-0 0606
1 thyl chloride	3 522	3 795	4 061	-0 0536
1 yridine	3 656	3 862	4 291	-0 0635
Methyl alcohol	3 837	4 204	4 606	-0 0769
Amyl formate	4 026	4 329	4 646	-0 0620
1 ropionic acid	4 078	4 417	4 787	-0 0709
Amyl acetate	4 119	4 411	4 850	-0 0731
1 laudric acid	4 679	5 129	5 614	-0 0935
Isobutyl acetate	4 691	4 968		-0 014
Acetic anhydride	5 206	5 720	6 218	-0 1012
Acetone	6 295	6 921		-0 1232
Methyl acetate	6 494			

(Just, / phys Ch 1901 37 354)

Absorption of CO<sub>2</sub> by organic substances + Aq at 15°

P = % of the organic substance in the solvent

 $\beta_{15}^{\circ}$  = Coefficient of absorption at 15° $S_{15}^{\circ}$  = Solubility at 15°

Organic substance used	P	$\beta_{15}^{\circ}$	$S_{15}^{\circ}$
Chloral hydrate	0	0 996	
	0	0 992	1 056
	0	1 012	
	17 7	0 885	0 935
	21 8	0 860	0 908
	31 6	0 803	0 848
	37 0	0 790	0 834
	38 3	0 781	0 825
	49 8	0 760	0 802
	51 1	0 769	0 812
	52 6	0 764	0 807
	57 1	0 765	0 808
	61 1	0 780	0 824
	68 8	0 797	0 842
	71 0	0 812	0 857
Glycerine	74 6	0 848	0 895
	79 4	0 903	0 953
	0	1 003	1 064
	0	1 013	
	26 11	0 785	0 829
	27 69	0 800	0 845
	43 72	0 639	0 675
	46 59	0 620	0 655
	62 14	0 511	0 540
	73 36	0 449	0 474
	77 75	0 430	0 454
	87 74	0 422	0 446
	90 75	0 404	0 427
	96 64	0 415	0 438
	99 26	0 410	0 438

(Hammel, Z phys Ch 1915, 90 123)

## Solubility of carbon dioxide in solutions of aniline at 25°

I Concentration, 0 206 g aniline in 100 cc of solution

P = Pressure

S = Solubility calc according to formula given in original article

P	S	P	S
748	0 865	1053	0 855
808	0 855	1159	0 862
920	0 857	1243	0 860

II Concentration, 0 425 g aniline in 100 cc of solution

P	S	P	S
760	0 909	1150	0 897
816	0 897	1236	0 902
921	0 897	1380	0 908

Solubility of carbon dioxide in solutions of aniline at 25°—*Continued*

III Concentration, 0.566 g aniline in 100 c c of solution

P	S	P	S
760	0.935	1082	0.923
823	0.929	1223	0.924
941	0.925	1341	0.930

IV Concentration, 0.743 g aniline in 100 c c of solution

P	S	P	S
760	0.953	1063	0.940
895	0.941	1223	0.940
983	0.940	1302	0.942

(Findlay and Creighton, Chem Soc 1910, 97 555)

Solubility of CO<sub>2</sub> in CS<sub>2</sub> increases approximately with the pressure. The absorption is greater at lower temp and less at higher temp than is required by Dalton's law (Woukoloff, C R 1889, 108 674)

Absorption of CO<sub>2</sub> by sugar + Aq

Sugar + Aq	Grams CO absorbed by 75 cc of solution at 15.5° and 720 mm
1/10-N sugar solution	0.1225
1/1-N " "	0.1089
1-N " "	0.0931

(Christoff, Z phys Ch 1905, 53 329)

Absorption of CO<sub>2</sub> in sugar + Aq at 20°

Conc of solution	Sp gr	Coefficient of absorption
1/8 mol per l	1.01518	0.846
1/4 " " "	1.03125	0.815
1/2 " " "	1.06372	0.756
1 " " "	1.12809	0.649

(Usher, Chem Soc 1910, 97 72)

*Liquid*—Not miscible with H<sub>2</sub>O, though slightly sol therein, or with fatty oils, miscible with alcohol, ether, CS<sub>2</sub>, and the essential oils (Thilorier, Mitchell)

Unacted upon by H<sub>2</sub>O, sol in alcohol, ethers, petroleum, oil of turpentine, and CS<sub>2</sub> (Mareska and Donny)

Petroleum dissolves 5 to 6 vols liquid CO<sub>2</sub> (Caillaud, C R 75 1271)

Sl sol in CS<sub>2</sub> (Caillaud)

*Solid*—When immersed in H<sub>2</sub>O, rapidly volatilizes and dissolves. With alcohol or ether it forms a semi-fluid mixture (Channing, Am J Sci (2) 5 186)

Only slightly sol in anhydrous ether, but may be mixed therewith to a paste (Thilorier)

Sol in methyl chloride below -65° at the point of sat without decomp (Villard, C R 1895, 120 1413)  
+6H<sub>2</sub>O (Villard, C R 1894, 119 59)

**Carbon selenide, C<sub>4</sub>Se**

Sol only in hot conc H<sub>2</sub>SO<sub>4</sub> (Villard, Ch Z 1906, 30 810)

C<sub>2</sub>Se Insol in H<sub>2</sub>O, CS<sub>2</sub>, and ether. Easily sol in hot conc H<sub>2</sub>SO<sub>4</sub>, sol in conc NaOH + Aq from which it is pptd by HCl (V Bartsch)

**Carbon silicide CSi**

(*Carborundum*) Not attacked by any acids, even HF, sl attacked by caustic alkalis or carbonates (Acheson, C R 1898, 179)

Not attacked by KOH + Aq (Schlenker, C R 114 1089)

**Carbon monosulphide, CS**

Insol in H<sub>2</sub>O, alcohol, oil of turpentine, or benzene, somewhat sol in CS<sub>2</sub> or ether sol in warm HNO<sub>3</sub>, sol in conc KOH Aq (Sidot, C R 81 32)

Readily absorbed by alcohol and a little (Deninger, J pr 1895, (2) 51 349)

**Carbon disulphide, CS<sub>2</sub>**

Very sl sol in H<sub>2</sub>O  
1 l H<sub>2</sub>O dissolves 2-3 g CS<sub>2</sub> (Chandrasekhar, Soc 43 562), 3.5-4.52 g (Peligot, ib 43 563)  
30 ccm CS<sub>2</sub> shaken with 8690 ccm H<sub>2</sub>O at 20-23° for 18 days decreased 11 ccm in 14 days and 1.4 ccm in the next 3 days by daylight, and 0.6 ccm in the last 5 days (no light). Part of the CS<sub>2</sub> was decomp and 7.8 ccm were dissolved, therefore H<sub>2</sub>O dissolves 1/1000 of its weight CS (Sestini, Gazz ch 1 473)

Solubility of CS<sub>2</sub> in H<sub>2</sub>O

100 pts H <sub>2</sub> O dissolve	0.203 pts CS <sub>2</sub> at 13°
" "	0.191 " " 16°
" "	0.168 " " 27°
" "	0.145 " " 33°

(Page, C N 41 195)

Solubility of CS in H<sub>2</sub>O at t°  
1000 cm solution at t°

a	t	a	t	a	t
2.04	0	1.79	20	1.11	40
1.99	5	1.69	25	0.70	45
1.94	10	1.55	30	0.14	49
1.87	15	1.37	35		

(Chancel and Parmentier, C R 100 43)

100 g H<sub>2</sub>O dissolve at t°

t°	0	10	20	30
	0.258	0.239	0.201	0.195 g CS

(Rex, Z phys Ch 1906, 55 365)

Absorption of CS<sub>2</sub> vapor by H<sub>2</sub>O at t°

t	Coefficient of absorption
0	3 573
10	2 189
20	1 346
30	0 799

Calc from data of Chancel and Parmentier, C R 100 733)

(Winkler, Z phys Ch 1906, 55 352)

Vapors of CS<sub>2</sub> are most easily absorbed by alcoholic solution of KOH. Sl absorbed by KOH+Ag, and very slowly by CuSO<sub>4</sub>, Pb(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>+Ag, conc H<sub>2</sub>SO<sub>4</sub>, or CaCl<sub>2</sub> in HCl+Ag (Berthelot, A ch (3) 51 74)

Solubility in alcohol S=strength of alcohol in per cent by weight, P=pts CS<sub>2</sub> which dissolve in 10 ccm alcohol at 17°

S	P	S	P
100	∞	91 37	5 00
98 5	18 20	84 12	3 00
98 15	13 20	76 02	2 00
96 95	10 00	48 40	0 20
93 54	7 00	47 90	0 00

(Tuchschmidt and Follenius, B 4 583)

Miscible with absolute alcohol, ether, ethereal and fatty oils, and liquid CO<sub>2</sub>

*Ironcarbon disulphide*, C<sub>3</sub>S<sub>2</sub>

Insol in H<sub>2</sub>O, easily sol in alcohol ether, chloroform, benzene, and CS<sub>2</sub>. The alcoholic and ethereal solutions decomp on standing (Lengyel, B 26 2960)

Sol in alcohol with decomp. Sol in CS<sub>2</sub> and in benzene (Stock, B 1912, 45 3575)

*Solid modification* Insol in H<sub>2</sub>O and ordinary solvents. Sol in KOH+Ag (Lengyel)

*Carbon sulphoselenide*, CS<sub>2</sub>Se

Mpt -55°, bpt +84°

Decomp by light. Not attacked by H<sub>2</sub>O

Sol in hot conc HNO<sub>3</sub>. Decomp by Bi<sub>2</sub> to oil. Sol in alcohol with decomp. Miscible with CS<sub>2</sub> (Stock, B 1914, 47 150)

*Carbon sulphotelluride*, CS<sub>2</sub>Te

Mpt -4° Very unstable

Miscible with CS<sub>2</sub> and benzene without decomp (Stock, B 1914, 47 142)

*Carbonatochloroplatindiamine carbonate chloroplatindiamine nitrate*

CO<sub>3</sub> [Pt N<sub>2</sub>H<sub>6</sub>]<sub>2</sub> (CO<sub>3</sub>)<sub>2</sub>, Cl<sub>2</sub>Pt(N<sub>2</sub>H<sub>6</sub>NO<sub>3</sub>)<sub>2</sub>

Precipitate (Cleve, J B 1867 321)

*Carbonatotrinitratoplatin diamine carbonate*

ate, (NO<sub>3</sub>)<sub>2</sub> [Pt(N<sub>2</sub>H<sub>6</sub>)<sub>2</sub>](CO<sub>3</sub>)<sub>2</sub>

Sol in boiling H<sub>2</sub>O (Cleve)

*Carbonatotetramine cobaltic bromide*, Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>3</sub>Br

Much less sol than chloride (Jorgensen, Z anorg 2 279)

— *carbonate*, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>3</sub>]<sub>2</sub>CO<sub>3</sub>+3H<sub>2</sub>O  
Very sol in H<sub>2</sub>O (Jorgensen)

— *chloraurate*, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>3</sub>]<sub>2</sub>AuCl<sub>4</sub>+  
½H<sub>2</sub>O

Somewhat sol in H<sub>2</sub>O, nearly absolutely insol in alcohol (Jorgensen)

— *chloride*, Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>3</sub>Cl

Easily sol in H<sub>2</sub>O, insol in alcohol (Jorgensen)

— *chloroplatinate*, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>3</sub>]<sub>2</sub>PtCl<sub>6</sub>+  
2H<sub>2</sub>O

Nearly insol in H<sub>2</sub>O and alcohol (Jorgensen)

— *chloroplatinite*, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>3</sub>]<sub>2</sub>PtCl<sub>4</sub>

Nearly insol in H<sub>2</sub>O, wholly in alcohol (Jorgensen)

— *dithionate*, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>3</sub>]<sub>2</sub>S<sub>2</sub>O<sub>6</sub>  
Ppt (Jorgensen)

— *iodide*, Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>3</sub>I

Much less sol than bromide or chloride (Jorgensen)

— *nitrate*, Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>3</sub>NO<sub>3</sub>+½H<sub>2</sub>O

Sol in about 15 pts cold H<sub>2</sub>O, insol in alcohol (Jorgensen)

— *sulphate*, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>3</sub>]<sub>2</sub>SO<sub>4</sub>+3H<sub>2</sub>O

Considerably less sol in H<sub>2</sub>O than the nitrate (Jorgensen)

*Carbonic acid*, H<sub>2</sub>CO<sub>3</sub>

See Carbon dioxide

*Carbonates*

Carbonates of Na, K, Rb, and Cs are easily sol in H<sub>2</sub>O, carbonates of Li and H are much less sol, other carbonates are nearly or quite insol. All carbonates are sol to some extent in H<sub>2</sub>O containing CO<sub>2</sub>. All carbonates, except those of NH<sub>4</sub>, Rb, and Cs, are insol in alcohol.

Sol in those acids which are themselves sol in H<sub>2</sub>O, except HCN and H<sub>3</sub>BO<sub>3</sub>.

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 824)

**Aluminum carbonate, basic**

$5\text{Al}_2\text{O}_3, 6\text{CO}_2 + 37\text{H}_2\text{O} = 3\text{Al}(\text{OH})_3, \text{Al}_2(\text{CO}_3)_3 + 14\text{H}_2\text{O}$  (Seubert, Z anorg 1893, 4 67)

$\text{Al}_2\text{O}_3, \text{CO}_2$  (Parkmann, Sill Am J (2) 34 324)

$3\text{Al}_2\text{O}_3, 2\text{CO}_2 + 16\text{H}_2\text{O}$  (Muspratt and Danson, A 72 120)

$3\text{Al}_2\text{O}_3, 2\text{CO}_2 + 9\text{H}_2\text{O}$  (Wallace, Chem Gaz 1858 410)

$5\text{Al}_2\text{O}_3, 3\text{CO}_2 + 18\text{H}_2\text{O}$  (Bley, J pr 39 11)

$2\text{Al}_2\text{O}_3, \text{CO}_2 + 6\text{H}_2\text{O} = 10\text{Al}(\text{OH})_3, \text{Al}_2(\text{CO}_3)_3 + 3\text{H}_2\text{O}$  Sol in cold dil acids (Schlumberger Bull Soc 1895, (3) 13 46)

$+8\text{H}_2\text{O}$  (Urban and Renoul J Pharm (4) 30 340)  $= 10\text{Al}(\text{OH})_3, \text{Al}_2(\text{CO}_3)_3 + 9\text{H}_2\text{O}$  (Seubert Z anorg 1893 4 67)

$8\text{Al}_2\text{O}_3, 3\text{CO}_2 + 40\text{H}_2\text{O}$  (Langlois, A ch (3) 48 505)

All are precipitates, insol in  $\text{H}_2\text{O}$ , sol in acids, and give off  $\text{CO}_2$  at slight heat

There are no definite carbonates of aluminum (Cameron, J phys Chem 1908, 12 572)

**Aluminum ammonium carbonate,  $\text{Al}_2\text{O}_3, \text{CO}_2, (\text{NH}_4)_2\text{CO}_3 + 4\text{H}_2\text{O}$** 

Precipitate (Rose, Pogg 91 460)

**Aluminum sodium carbonate,  $\text{Al}_2\text{O}_3, \text{CO}_2, 2\text{Na}_2\text{CO}_3 + 24\text{H}_2\text{O}$** 

Precipitate Sol in cold dil acids (Bley, J pr 39 22)

**Ammonium carbonate,  $(\text{NH}_4)_2\text{CO}_3 + \text{H}_2\text{O}$** 

Sol at  $15^\circ$  in its own weight  $\text{H}_2\text{O}$  Solution in  $\text{H}_2\text{O}$  gives off gas at  $70-75^\circ$ , and boils at  $75-80^\circ$  Sl sol in cold dil  $\text{NH}_4\text{OH} + \text{Aq}$ , more sol at ordinary temp Insol in conc  $\text{NH}_4\text{OH} + \text{Aq}$  (Divers, Chem Soc (2) 8 171, 259, and 364)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 826)

Insol in alcohol  
Insol in  $\text{CS}_2$  (Aictowski, Z anorg 1894, 6 257)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

100 g pure glycerine dissolve 20 g  $(\text{NH}_4)_2\text{CO}_3$  at  $15^\circ$  (Ossendowski, Pharm J 1907, 79 575)

**Ammonium hydrogen carbonate,  $\text{NH}_4\text{HCO}_3$** 

Sol at  $15^\circ$  in about 8 pts  $\text{H}_2\text{O}$  (Berthollet, J Phys 66 168)

Sol at  $128^\circ$  in about 6 pts  $\text{H}_2\text{O}$  (J Davy, N Ednib J 16 245)

Solution decomp on air or by gentle heat or by addition of the solid salt (Berthollet)

100 pts  $\text{H}_2\text{O}$  dissolve at  $0^\circ$ , 11.9 pts, at  $10^\circ$ , 15.85 pts, at  $20^\circ$ , 21 pts, at  $30^\circ$ , 27 pts  $\text{NH}_4\text{HCO}_3$  (Dibbitts J pr (2) 10 417)

**Solubility of  $\text{NH}_4\text{HCO}_3$  in  $\text{NH}_4\text{Cl} - 1$ , sat with  $\text{CO}_2$ , at  $t^\circ$** 

t	g per 100 g $\text{H}_2\text{O}$		Sp gr sol	of saturation
	$\text{NH}_4\text{Cl}$	$\text{NH}_4\text{HCO}_3$		
$0^\circ$	0 29 08	11 9 3 6	1	77
$15^\circ$	0 2 99 6 06 8 51 11 68 18 30 26 93 33 25 34 35	18 64 16 29 14 22 12 69 11 68 9 33 7 73 6 64 6 42	1 1 1 1 1 1 1 1 1	64 63 62 62 65 69 76 85 85
$30^\circ$	0 39 7	27 0 9 1		

(Fedotieff, Z phys Ch 1904, 49 1 )

**Solubility of  $\text{NH}_4\text{HCO}_3$  in  $\text{NaHCO}_3 + \text{Aq}$ , sat with  $\text{CO}_2$  at  $t^\circ$** 

t	g per 100 g $\text{H}_2\text{O}$		Sp gr sol	of saturation
	$\text{NaHCO}_3$	$\text{NH}_4\text{HCO}_3$		
$0^\circ$	0 4 82	11 90 10 94	1	2
$15^\circ$	0 5 92	18 64 17 06	1 1	4 10
$30^\circ$	0 7 0	27 0 23 0		

(Fedotieff, Z phys Ch 1904, 49 16 )

**Solubility of  $\text{NH}_4\text{HCO}_3$  in  $\text{NH}_4\text{NO}_3 + \text{A}$  at  $t^\circ$** 

t	g per 100 g $\text{H}_2\text{O}$		Sp gr sol	of saturation
	$\text{NH}_4\text{NO}_3$	$\text{NH}_4\text{HCO}_3$		
$0^\circ$	0 118	11 90 4 52	1	25
$15^\circ$	0 23 26 49 82 103 4 128 9 166 9	18 64 12 91 10 33 8 25 7 79 7 49	1 1 1 1 1 1	4 3 4 2 9 2
$30^\circ$	0 231 9	26 96 12 57		

(Fedotieff and Koltunoff, Z anorg 191, 251) , 85

Insol in alcohol (J Davy)

Insol in acetone (Eidmann, C C 899, II 1014, Naumann, B 1904, 37 4329)

**Ammonium dihydrogen carbonate,**  
 $(\text{NH}_4)_2\text{H}_2(\text{CO}_3)_3 + \text{H}_2\text{O}$ 

Sol in 5 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , decomp by more  $\text{H}_2\text{O}$  or by heat (Divers, Chem Soc (2) 8 171, 359, and 364)

Sl sol in alcohol

**Ammonium hydrogen carbonate carbamate,**  
 $2\text{NH}_4\text{HCO}_3, \text{NH}_4\text{CONH}_2$  (*Salis of harts-horn*)

1 pt salt dissolves at

$13^\circ$  in 4 pts  $\text{H}_2\text{O}$

$16\ 7^\circ$  " 3 " "

$32\ 2^\circ$  " 2 " "

$40\ 6^\circ$  " 2 " "

$49^\circ$  " 2 " "

(J Davy, N Edinb J 16 245)

Strong alcohol dissolves out carbamate, and the carbonate remains undissolved

$\text{NH}_4\text{HCO}_3, \text{NH}_4\text{CO}_2\text{NH}_2$  (*Commercial carbonate of ammonia*)

Sol at  $15^\circ$  in 4 pts  $\text{H}_2\text{O}$ , at  $65^\circ$  in  $1\frac{1}{2}$  pts  $\text{H}_2\text{O}$  (Divers)

30 pts salt + 100 pts  $\text{H}_2\text{O}$  lower temp from  $15\ 3^\circ$  to  $3\ 2^\circ$  (Rudorff, B 2 68)

Sol in 1 667 pts cold and 0 833 pt hot  $\text{H}_2\text{O}$  (Fourcroy)

100 pts  $\text{H}_2\text{O}$  at  $13^\circ$  dissolve 25 pts

$17^\circ$  30

$37^\circ$  37

$41^\circ$  40

$49^\circ$  50

(Berzelius)

100 pts  $\text{H}_2\text{O}$  at  $1\ 5^\circ$  dissolve 33 pts at  $100^\circ$  100 pts (Ure's Dict.)

Sol in 2 pts  $\text{H}_2\text{O}$  at  $15\ 5^\circ$  and in less than 1 pt boiling  $\text{H}_2\text{O}$  sat solution at  $15\ 5^\circ$  contains 33 3% and sat boiling solution 50% (Abl)

Sat aqueous solution at 10 contains 15 7% (Eller)

Sat aqueous solution at (?) contains 6 1% (Muscrobrock)

cold as sat sol % (Fourcroy)  
solves out first and  $\text{NH}_4\text{HCO}_3$  later (Scanlan)

Sp gr of carbonate of ammonia + Aq at  $12^\circ$

Deg Tw	Sp gr at $12^\circ$	% Carb ammon	Change of sp gr for $1^\circ\text{C}$
1	1 005	1 66	0 0002
2	1 010	3 18	0 0002
3	1 015	4 66	0 0003
4	1 020	6 04	0 0003
5	1 025	7 49	0 0003
6	1 030	8 93	0 0004
7	1 035	10 35	0 0004
8	1 040	11 86	0 0004
9	1 045	13 36	0 0005
10	1 050	14 83	0 0005
11	1 055	16 16	0 0005
12	1 060	17 70	0 0005
13	1 065	19 18	0 0005
14	1 070	20 70	0 0005
15	1 075	22 25	0 0006
16	1 080	23 78	0 0006
17	1 085	25 31	0 0006

Sp gr of carbonate of ammonia + Aq at  $12^\circ$ —*Continued*

Deg Tw	Sp gr at $12^\circ$	% Carb ammon	Change of sp gr for $1^\circ\text{C}$
18	1 090	26 82	0 0007
19	1 095	28 33	0 0007
20	1 100	29 93	0 0007
21	1 105	31 77	0 0007
22	1 110	33 45	0 0007
23	1 115	35 08	0 0007
24	1 120	36 88	0 0007
25	1 125	38 71	0 0007
26	1 130	40 34	0 0007
27	1 135	42 20	0 0007
28	1 140	44 29	0 0007
29	1 144	44 90	0 0007

(Lunge, Chem Ind 1883 2)

Sp gr of aqueous solution of salt with composition 31 3%  $\text{NH}_3$ , 56 6%  $\text{CO}_2$ , 12 1%  $\text{H}_2\text{O}$  100 pts of solution contain—

6 58 9 96 14 75 19 83 25 71 pts salt  
1 0219 1 0337 1 0497 1 0672 1 0863 sp gr

29 74 35 85 40 23 44 90 pts salt

1 0995 1 1174 1 1297 1 1414 sp gr

(J H Smith, Chem Ind 1883 3)

Conc alcohol dissolves out carbamate and leaves carbonate (Hunefeld, J pr 7 25)

Insol in acetone (Naumann, B 1904, 37 4328)

**Ammonium cerous carbonate,  $(\text{NH}_4)_2\text{CO}_3,$**   
 $\text{Ce}_2(\text{CO}_3)_3 + 6\text{H}_2\text{O}$ 

Ppt Very sl sol in conc  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Meyer Z anorg 1904, 41 104)

**Ammonium chromous carbonate,  $(\text{NH}_4)_2\text{CO}_3,$**   
 $\text{CrCO}_3 + \text{H}_2\text{O}$ 

Decomp by moist air, sol in dil  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$  (Baugé, C R 1896, 122 476)

**Ammonium cobaltous carbonate,  $(\text{NH}_4)_2\text{CO}_3,$**   
 $\text{CoCO}_3 + 4\text{H}_2\text{O}$ 

Permanent Sol in  $\text{H}_2\text{O}$  (Deville, A ch (3) 35 460)

$(\text{NH}_4)_2\text{O} 2\text{CoO}, 4\text{CO}_2 + 9\text{H}_2\text{O}$  Quickly decomp on air, sol in  $\text{H}_2\text{O}$  (Deville)  
+  $12\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

**Ammonium didymum carbonate,  $(\text{NH}_4)_2\text{CO}_3,$**   
 $\text{D}_2(\text{CO}_3)_3 + 3\text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$  (Clevé)

**Ammonium dysprosium carbonate,**  
 $\text{NH}_4\text{Dy}(\text{CO}_3)_3 + \text{H}_2\text{O}$ 

Only sl sol in  $\text{H}_2\text{O}$  (Jantsch, B 1911, 44 1277)

**Ammonium glucinum carbonate**,  $2(\text{NH}_4)_2\text{CO}_3$ ,  $3\text{GIC}_3(?)$

Very sol in cold decomp by hot  $\text{H}_2\text{O}$   
Nearly insol in alcohol (Debray)

Composition is  $(\text{NH}_4)_2\text{CO}_3$ ,  $2\text{GIC}_3$ ,  
 $\text{Gl}(\text{OH})_2 + 2\text{H}_2\text{O}$  (Humpidge, Royal Soc  
Proc **39** 1)

**Ammonium lanthanum carbonate**,  $\text{La}_2(\text{CO}_3)_3$ ,  
 $(\text{NH}_4)_2\text{CO}_3 + 4\text{H}_2\text{O}$

Ppt (Meyer, Z anorg 1904, **41** 102)

**Ammonium magnesium carbonate**,  
 $(\text{NH}_4)_2\text{Mg}(\text{CO}_3)_2 + 4\text{H}_2\text{O}$

Sol in 71 pts  $\text{H}_2\text{O}$  with decomp, more  
sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Divers, Chem Soc **51**  
196)

$\text{H}_2\text{O}$  containing  $(\text{NH}_4)_2\text{CO}_3$  dissolves very  
slightly, more sol in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{Cl}$   
(Favre, A ch (3) **10** 473)

**Ammonium magnesium hydrogen carbonate**,  
 $(\text{NH}_4)_2\text{Mg}_2\text{H}_2(\text{CO}_3)_4 + 8\text{H}_2\text{O}$ , or  $12\text{H}_2\text{O}$

Decomp on air (Deville, A ch (3) **35**  
454)

**Ammonium neodymium carbonate**,  
 $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{Nd}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$

Ppt Sl sol in conc  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$   
(Meyer, Z anorg 1904, **41** 106)

**Ammonium nickel carbonate**,  $\text{NH}_4\text{HCO}_3$ ,  
 $\text{NiCO}_3 + 4\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Deville, A ch (3) **35** 452)

**Ammonium praseodymium carbonate**,  
 $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{Pr}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$

Ppt Insol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Meyer  
Z anorg 1904, **41** 105)

**Ammonium samarium carbonate**,  $(\text{NH}_4)_2\text{CO}_3$ ,  
 $\text{Sm}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$

Ppt

**Ammonium scandium carbonate**,  $(\text{NH}_4)_2\text{CO}_3$ ,  
 $2\text{Sc}_2(\text{CO}_3)_3 + 6\text{H}_2\text{O}$

Difficultly sol in  $\text{H}_2\text{O}$  Sol in cold alkali-  
carbonate + Aq, less sol in hot (R Meyer,  
Z anorg 1910, **67** 410)

**Ammonium tin (stannous) carbonate**,  
 $(\text{NH}_4)_2\text{CO}_3$ ,  $2\text{SnCO}_3 + 3\text{H}_2\text{O}$

Decomp by cold  $\text{H}_2\text{O}$  (Deville, A ch (3)  
**35** 456)

**Ammonium uranyl carbonate**,  $2(\text{NH}_4)_2\text{CO}_3$ ,  
 $\text{UO}_2\text{CO}_3$

Sol at  $15^\circ$  in 20 pts  $\text{H}_2\text{O}$  more abundantly  
in  $\text{H}_2\text{O}$  containing  $(\text{NH}_4)_2\text{CO}_3$  (Ebelmen)

Insol in pure  $\text{H}_2\text{O}$ , sol in  $\text{H}_2\text{O}$  containing  
 $(\text{NH}_4)_2\text{CO}_3$  Solution is decomp by boiling  
(Berzelius)

Sol in  $\text{SO}_2 + \text{Aq}$  (Berthier A ch (3) **7**  
76)  
 $3(\text{NH}_4)_2\text{CO}_3$ ,  $2(\text{UO}_2)\text{CO}_3 + 4\text{H}_2\text{O}$  S in  
 $\text{H}_2\text{O}$  (Giollitti C C **1905**, II 227)

**Ammonium vanadyl carbonate**,  $3(\text{NH}_4)_2\text{O}$ ,  
 $7\text{VO}_2$ ,  $5\text{CO}_2 + 16\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$

Sol in acids and alkalies (Kopp, Z  
anorg **1905**, **45** 350)

**Ammonium yttrium carbonate**,  $(\text{NH}_4)_2\text{CO}_3$ ,  
 $\text{Y}_2(\text{CO}_3)_3 + 2\text{H}_2\text{O}$

Insol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Mosand)

**Ammonium zinc carbonate, basic**,  $\text{NH}_4\text{OH}$ ,  $2\text{CO}_2 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Kassner, Arch Pharm (3)  
**27** 673)

**Ammonium zinc carbonate**,  $(\text{NH}_4)_2\text{CO}_3$ ,  
 $\text{ZnCO}_3$

Insol in  $\text{H}_2\text{O}$  (Deville)

Quite sol in  $\text{H}_2\text{O}$ , more sol than  
 $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{MgCO}_3$  Tolerably perm  
ent in the air Slowly decomp by cold, r  
idly by hot  $\text{H}_2\text{O}$

Very sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  Not att  
ked by alcohol (Favre, A ch (3) **10** 481)

**Barium carbonate**,  $\text{BaCO}_3$

Sol in 4304 pts cold, and 2304 pts b ling  
 $\text{H}_2\text{O}$  (Fourcroy)

Sol in 47 620 pts  $\text{H}_2\text{O}$  (Bineau, A ch  
(3) **51** 290)

Sol in 14,137 pts  $\text{H}_2\text{O}$  at  $16-20^\circ$  and  
15,421 pts at  $100^\circ$  (Fresenius)

Sol in 12 027 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Kre  
Pogg **85** 247)

Calculated from electrical conductivity of  
solution, 1 pt  $\text{BaCO}_3$  is sol in 64,070 pts  $\text{H}_2\text{O}$   
at  $8.8^\circ$  and 45,566 pts at  $24.2^\circ$  (Holler  
un, Z phys Ch **12** 125)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	g sol in 100 g H <sub>2</sub> O
14	$4.32 \times 10^{-1}$
18	$4.57 \times 10^{-1}$
25	$4.89 \times 10^{-1}$
27	$5.22 \times 10^{-1}$
32	$5.69 \times 10^{-1}$
38	$6.27 \times 10^{-1}$

(Weissenberger, Z phys Ch **1914**, **88** 10)

"Solubility product" =  $8.1 \times 10^{-10}$  m l  
(McCoy and Smith, J Am Chem Soc **31**,  
**33** 473)

Sol in  $\text{H}_2\text{CO}_3 + \text{Aq}$  (See barium hydrogen  
carbonate)

Easily sol in dil acids Not acted up by  
conc  $\text{HNO}_3 + \text{Aq}$

Not decomp by 1 pt  $\text{H}_2\text{SO}_4 + 6$  pt ab-  
solute alcohol Slowly decomp by pt

$\text{HNO}_3$  + 6 pts absolute alcohol Slowly decomp by 1 pt  $\text{H}_2\text{C}_2\text{O}_4$  + 6 pts absolute alcohol

Not decomp by absolute alcoholic solutions of racemic, tartaric, citric, or glacial acetic acids (Babington and Phillips, 1816)

Almost completely insol in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3$  when digested in such a solution and allowed to stand 1 pt  $\text{BaCO}_3$  dissolves in 141 000 pts of such a solution (Fresenius)

Not more sol in  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Karsten)

Sol in cold  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4$  succinate + Aq (Vogel, J pr 7 453)

2 mols  $\text{NH}_4\text{Cl}$  dissolved in  $\text{H}_2\text{O}$  dissolve 1 mol  $\text{BaCO}_3$  by continued boiling (Smith, Phil Mag J 9 540)

Solubility in  $\text{H}_2\text{O}$  increases by addition of  $\text{NH}_4\text{Cl}$ , at first strongly, then less strongly and finally strongly again (D'Agustino and Pellegrino, Gazz ch it 1908 38 (1) 532)

Somewhat sol in  $\text{K}_2\text{CO}_3 + \text{Aq}$  (Wackenroder, A 24 30)

Solubility of  $\text{BaCO}_3$  in  $\text{KCl} + \text{Aq}$  at bpt of solution

g $\text{KCl}$ per 100 g solution	g $\text{BaCO}_3$ per 1000 cc sat solution
0 15	0 0847
1	0 1781
3	0 2667
10	0 4274
30	0 5550

(Cantoni and Goguelia, Bull Soc 1905, (3) 33 13)

Solubility of  $\text{BaCO}_3$  in  $\text{NaCl} + \text{Aq}$  at bpt of solution

g $\text{NaCl}$ per 100 g solution	g $\text{BaCO}_3$ per 1000 cc sat solution
0 15	0 0587
1	0 0787
3	0 1056
10	0 1575
30	0 2784

(Cantoni and Goguelia, l c)

Solubility of  $\text{BaCO}_3$  in 10%  $\text{KCl} + \text{Aq}$  at  $t^\circ$

$t^\circ$	g $\text{BaCO}_3$ per 1000 cc sat solution
10	0 2175
20	0 2408
40	0 2972
60	0 3491
80	0 4049

(Cantoni and Goguelia, l c)

Solubility of  $\text{BaCO}_3$  in 10%  $\text{NaCl} + \text{Aq}$  at  $t^\circ$

$t^\circ$	g $\text{BaCO}_3$ per 1000 cc sat solution
10	0 1985
20	0 1126
40	0 1231
60	0 1303
80	0 1418

(Cantoni and Goguelia, l c)

Slowly sol in conc  $\text{Na}_2\text{SO}_4$ ,  $\text{MgSO}_4$ ,  $\text{ZnSO}_4$ ,  $\text{Ca}(\text{NO}_3)_2$ , or  $\text{CaCl}_2 + \text{Aq}$ , but insol in  $\text{ZnCl}_2 + \text{Aq}$  (Karsten)

SI decomp by boiling  $\text{K}_2\text{SO}_4 + \text{Aq}$

SI decomp in the cold by 1 pt  $\text{K}_2\text{SO}_4 + 2$  pts  $\text{Na}_2\text{SO}_4 + \text{Aq}$

Decomp by salts of Al, Mn, Cr, Fe, U, Bi, Cd, Cu, Hg, Pb, Sn<sup>II</sup>, Sn<sup>IV</sup>, Hg<sub>2</sub>, Rh, Ir, Au, with pptn of oxide of metal (Rose, Tr)

Pptn of  $\text{BaCO}_3$  is hindered by presence of alkali citrates or metaphosphates

Sol in solutions of various salts, as in the case of calcium carbonate (see *Calcium carbonate*) The solvent power of these solutions for barium carbonate is somewhat less than for calcium carbonate

Insol in acetone (Naumann B 1904, 37 4329)

Insol in methyl acetate (Naumann, B B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3602)

Insol in acetone and in methylal (Eidmann, C C 1899, II 1014)

Min *Witherite*

**Barium hydrogen carbonate,  $\text{BaH}_2(\text{CO}_3)_2$  (?)**

100 pts  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  dissolve 0 079 pt  $\text{BaCO}_3$  (Bineau)

100 pts  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  dissolve 0 17 pt  $\text{BaCO}_3$  (Lassaigne)

100 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  under a pressure of 4-6 atmospheres dissolve 0 725 pt  $\text{BaCO}_3$  Upon evaporating,  $\text{BaCO}_3$  is deposited (Wagner, Z anal 6 167)

$\text{BaCO}_3$  is sol in 833 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  at  $10^\circ$  (Lassaigne)

$\text{BaCO}_3$  is sol in 830 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  at  $10^\circ$  (Fourcroy)

$\text{BaCO}_3$  is sol in 1550 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  at  $10^\circ$  (Bergman)

100 cc  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  dissolve 0 73 g  $\text{BaH}(\text{CO}_3)_2$  (McCoy and Smith, J Am Chem Soc 1911, 33 473)

**Barium calcium carbonate,  $\text{BaCO}_3$ ,  $\text{CaCO}_3$**

Min *Barytocalcite* *Bromilite* Sol in dil acids

**Barium uranyl carbonate,  $\text{BaUO}_4 \cdot 2\text{UO}_3 \cdot 2\text{CO}_2 + 5\text{H}_2\text{O}$**  Decomp by  $\text{H}_2\text{O}$  (Blinkoff Dissert 1900)

+ 8H<sub>2</sub>O Decomp by  $\text{H}_2\text{O}$  (Blinkoff)



**Bismuth carbonate, basic,  $(\text{BiO})_2\text{CO}_3 + \frac{1}{2}\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , sol in acids Insol in  $\text{CO}_2 + \text{Aq}$  (Bergman)

Completely sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , sl sol in  $\text{K}_2\text{CO}_3 + \text{Aq}$ , insol in  $\text{Na}_2\text{CO}_3 + \text{Aq}$  (Lau-gier)

Absolutely insol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  unless  $\text{H}_3\text{PO}_4$  or  $\text{H}_3\text{AsO}_4$  are present (Berzelius)

Insol in  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{K}_2\text{CO}_3$ , or  $\text{Na}_2\text{CO}_3 + \text{Aq}$  (Rose)

Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Wackenroder) Insol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett)

Sol in  $\text{CaCl}_2 + \text{Aq}$  (Pearson)

Min *Bismuthosphaerite*

$3\text{Bi}_2\text{O}_3$ ,  $\text{CO}_2$  Min *Bismuthite* Easily sol in acids

$4\text{Bi}_2\text{O}_3$ ,  $3\text{CO}_2 + 4\frac{1}{2}\text{H}_2\text{O}$  Min *Bismuth spar* Easily sol in acids

**Bismuth potassium carbonate,  $\text{Bi}_2\text{OK}_4(\text{CO}_3)_4 + \text{H}_2\text{O}$** 

Decomp by large quantities of  $\text{H}_2\text{O}$  (Reynolds, Chem Soc 1898, 73 266)

**Cadmium carbonate,  $\text{CdCO}_3$** 

Insol in  $\text{H}_2\text{O}$ , easily sol in acids, insol in  $\text{K}_2\text{CO}_3$ , and  $\text{Na}_2\text{CO}_3 + \text{Aq}$ , very sl sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Fresenius)

Easily sol in  $\text{NH}_4$  sulphate, nitrate, and succinate +  $\text{Aq}$  (Wittstein)

Sol in  $\text{KCN} + \text{Aq}$ , sol in cold  $\text{NH}_4\text{Cl} + \text{Aq}$ , less sol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett, 1837)

Not prevented from pptn by non-volatile organic substances (Rose)

Not pptd from solutions containing sodium citrate (Spiller)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 827)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Insol in acetone (Naumann, B 1904, 37 4329)

$+ \frac{1}{2}\text{H}_2\text{O}$  (Lefort, J B 1847 346)

(Kraut, Z anorg 1897, 13 14)

**Cadmium carbonate hydrazine,  $\text{CdCO}_3 \cdot 2\text{N}_2\text{H}_4$** 

Easily sol in cold  $\text{NH}_4\text{OH} + \text{Aq}$  (Franzen, Z anorg 1908, 60 281)

**Cæsium carbonate,  $\text{Cs}_2\text{CO}_3$** 

Very deliquescent, and sol in  $\text{H}_2\text{O}$

100 pts absolute alcohol dissolve 11.1 pts  $\text{Cs}_2\text{CO}_3$  at  $19^\circ$ , 20.1 pts  $\text{Cs}_2\text{CO}_3$  at boiling temp (Bunsen)

**Cæsium hydrogen carbonate,  $\text{CsHCO}_3$** 

Not deliquescent Sol in  $\text{H}_2\text{O}$

**Calcium carbonate basic,  $\text{CaO} \cdot \text{CaCO}_3 + \text{H}_2\text{O}$** 

Hardened by  $\text{H}_2\text{O}$ , but not dissolved (Raoult, C R 92 189)

**Calcium carbonate,  $\text{CaCO}_3$** 

More sol in cold than in hot  $\text{H}_2\text{O}$  (Gmelin) When recently pptd sol in 8834 pts boiling water 10 601 pts cold  $\text{H}_2\text{O}$  much less sol in  $\text{H}_2\text{O}$  (NH<sub>4</sub>OH and (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>: 65 246 pts of which 1 pt  $\text{CaCO}_3$  (Fresenius (1846) A 59 122) Sol in 16 000 pts pure  $\text{H}_2\text{O}$  (Brandes 1 5) Sol in 12 858 pts pure  $\text{H}_2\text{O}$  at  $15^\circ$  (Krem 85 247) Sol in 16 000–24 000 pts pure  $\text{H}_2\text{O}$  (Buehler 2)

1 l  $\text{H}_2\text{O}$  dissolves 34 mg  $\text{CaCO}_3$  (Hevallet, Z anal 8 91, Hoffmann, Z anal 414)

1 l  $\text{H}_2\text{O}$  may contain 0.016 g  $\text{CaCO}_3$  (Birch 1 pt is sol in 62 500 pts  $\text{H}_2\text{O}$  (Birch 3) 51 290)

1 l  $\text{H}_2\text{O}$  dissolves 0.02 g  $\text{CaCO}_3$ , 1 pt  $\text{CaCO}_3$  is sol in 50 000 pts  $\text{H}_2\text{O}$  (Ligot)

Solubility is much affected by  $\text{CO}_2$  of the air 1 l  $\text{H}_2\text{O}$  at  $16^\circ$  dissolves 13.1 mg  $\text{CaCO}_3$  (Schlesinger, C R 74 1552)

Calculated from electrical conductivity of  $\text{CaCO}_3 + \text{Aq}$ , 1 pt  $\text{CaCO}_3$  is sol in 99,000 pts  $\text{H}_2\text{O}$  at  $8^\circ$ , and 80,040 pts at  $23.8^\circ$  (Holle-mann, Z phys Ch 12 125)

By continued boiling  $\text{CaH}_2(\text{CO}_3)_2$ ,  $\text{CaCO}_3$  remains in solution (Weltzien, 136 165)

**Solubility in  $\text{H}_2\text{O}$  at different pressures**

Pressure in atmos	Solubility
1	1079
2	1403
4	1820
6	2109

(Engel, C R 101 949)

100 pts  $\text{H}_2\text{O}$  dissolve 0.0005 pt (calculated as  $\text{CaO}$ ) from pptd  $\text{CaCO}_3$  and 0.0007 pt from calcspar (Lubavin, J russ S 389)

1 l  $\text{H}_2\text{O}$  dissolves 13 mg  $\text{CaCO}_3$  (Kohlrausch, Z phys Ch 1893, 12 24)

1 l  $\text{CO}_2$  free water dissolves 17.4 mg  $\text{CaO}$  or 31.0 mg  $\text{CaCO}_3$  (Gothé Ch Z 1915, 39 305)

$\text{CaCO}_3$  dissolves in 9662 pts  $\text{H}_2\text{O}$  (Pollacci C C 1896, II 946)

1 l  $\text{H}_2\text{O}$  free from  $\text{CO}_2$  dissolves 9 mg  $\text{CaCO}_3$  (McCoy and Smith J Am Soc 1911, 33 473)

Found dissolved in 10,000 pts seawater (Davy)

Pptd amorphous  $\text{CaCO}_3$  dissolves in 1600 pts seawater Pptd crystalline  $\text{CaCO}_3$  dissolves in 8000 pts seawater (Irving and Young, Chem Soc 56 344)

Artificial sea water sat with  $\text{CO}_2$  dissolves  $\text{CaCO}_3$  corresponding to 57.27 mg of combined  $\text{CO}_2$  per litre at  $15^\circ$

Sea water which contains 52–55 mg nitril combined  $\text{CO}_2$  per litre must be sat with  $\text{CaCO}_3$  (Cohen Chem Soc 1900, 2) 725)

For action of  $\text{H}_2\text{CO}_3 + \text{Aq}$ , see *Calcium hydrogen carbonate*

Sol in  $\text{H}_2\text{SO}_4$ , even when native Sol in acids generally When treated with acids in closed vessels effervescence ceases on increase of pressure, but is renewed at once on removing it (Link, 1814)

Unacted upon by conc  $\text{HNO}_3$ , even when boiling, as  $\text{Ca}(\text{NC}_3)_2$  is insol in conc  $\text{HNO}_3$

Not decomp by mixture of 1 pt  $\text{H}_2\text{SO}_4$  and 6 pts absolute alcohol, but immediately by  $\text{HNO}_3$ +absolute alcohol

Not decomp by absolute alcoholic solutions of oxalic, racemic, tartaric, citric, or glacial acetic acids (Babington and Phillips, 1816)

Unacted upon by glacial  $\text{HC}_2\text{H}_3\text{O}_2$ , even when boiling

Freshly pptd  $\text{CaCO}_3$  is sol in cold  $\text{NH}_4\text{Cl}$ +Aq, but the solution becomes cloudy on exposure to air, a portion, however, of  $\text{CaCO}_3$  remains dissolved, which cannot be pptd even by boiling If ppt is washed and allowed to stand 24 hours, it is not as sol in  $\text{NH}_4\text{Cl}$  as at first, but natural  $\text{CaCO}_3$  is not wholly insol in  $\text{NH}_4\text{Cl}$ +Aq, it is, however, much less sol than  $\text{MgCO}_3$  (Vogel, J pr 7 453)

Sol in boiling  $\text{NH}_4\text{Cl}$ +Aq with evolution of  $\text{NH}_3$  (Demarcay, 1834)

When  $\text{NH}_4\text{OH}$ +Aq, incompletely sat with  $\text{CO}_2$ , is mixed with  $\text{CaCl}_2$ +Aq, no ppt occurs even during several days if kept in a closed vessel, and only a slight ppt if the mixture is exposed to the air, but  $\text{CaCO}_3$  is pptd if the solution is boiled

$\text{NH}_4\text{OH}$ +Aq wholly sat with  $\text{CO}_2$  produces ppt when mixed with  $\text{CaCl}_2$ +Aq, but pptn is not complete until heat is applied Also when an excess of  $\text{CaCl}_2$ +Aq is added to a solution of crystallized carbonate of ammonia, only a portion of the  $\text{CaCO}_3$  is pptd until the solution is boiled (Vogel, 1814)

When  $\text{CaCl}_2$ +Aq mixed with  $\text{NH}_4\text{OH}$ +Aq is exposed to an atmos of pure  $\text{CO}_2$ , no ppt occurs for several hours, but  $\text{CaCO}_3$  is completely pptd in several days (Vogel)

When recently pptd, readily sol in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{NO}_3$ +Aq (Brett 1837, Wackenroder, A 41 315)

When recently pptd, readily sol in  $(\text{NH}_4)_2\text{CO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{NO}_3$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4$  succinate+Aq (Wittstein)

Sol in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ +Aq (Thomson)

More sol in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3$ +Aq, or in neutral potassium, or sodium salts+Aq than in  $\text{H}_2\text{O}$  (Fresenius)

From solutions in  $\text{NH}_4$  salts,  $\text{NH}_4\text{OH}$ , and  $(\text{NH}_4)_2\text{CO}_3$ +Aq precipitate  $\text{CaCO}_3$  more completely than  $\text{BaCO}_3$  (Fresenius)

When boiled with  $\text{NH}_4\text{Cl}$ +Aq,  $\text{CaCO}_3$  is dissolved, and  $(\text{NH}_4)_2\text{CO}_3$  given off (D Smith)

$\text{CaCl}_2$ +Aq prevents pptn of  $\text{CaCO}_3$  in the cold as do also  $\text{NH}_4\text{Cl}$ ,  $\text{KCl}$ , or  $\text{NaCl}$ +Aq, but it is pptd when boiled, if the latter solutions are not too conc  $\text{K}_2\text{SO}_4$ ,  $\text{KNO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , or  $\text{Na}_2\text{SO}_4$ +Aq have a similar effect A large excess of  $(\text{NH}_4)_2\text{CO}_3$ +Aq when quickly added to  $\text{CaCl}_2$ +Aq produces

no ppt in the cold  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3$ +Aq act likewise (Storer, Am J Sci (2) 25 41)

1 g  $\text{CaCO}_3$  requires 13.98 g  $\text{NH}_4\text{Cl}$ , 8.380 g  $(\text{NH}_4)_2\text{SO}_4$ , or 14.438 g  $\text{NH}_4\text{NO}_3$  to effect solution (Bertrand, Monit Sci (3) 10 477)

Less sol in Na than in  $\text{NH}_4$  salts, but more than in K salts (Berthelot)

When  $\text{NH}_4\text{OH}$ +Aq, partially neutralized by  $\text{CO}_2$ , is mixed with  $\text{CaO}_2\text{H}_2$ +Aq, no cloudiness appears until the mixture is boiled, when more  $\text{CO}_2$  has been added to  $\text{NH}_4\text{OH}$ +Aq a ppt appears at first, which disappears and only reappears on addition of much  $\text{CaO}_2\text{H}_2$ +Aq, but  $\text{NH}_4\text{OH}$ +Aq does not dissolve pptd  $\text{CaCO}_3$  (Vogel)

#### Solubility in $\text{NH}_4$ salts+Aq at 25°

$\text{NH}_4$ salt	Millimols $\text{NH}_4$ salt per l	Millimols $\text{CaO}$ dis- solved per l
$\text{NH}_4\text{Cl}$	1000	6 770
	500	5 008
	250	3 724
	125	2 743
$\text{NH}_4\text{NO}_3$	500	5 267
	250	3 830
	125	2 779
	62.5	2 004
Triammonium citrate	500	66 87
	250	39 80
	125	22 64
	62.5	14 92

(Rindell, Z phys Ch 1909, 70 454)

#### Solubility of $\text{CaCO}_3$ in $\text{NH}_4\text{Cl}$ +Aq at 12–18° Time, 98 days

g per l of sat solution	
$\text{NH}_4\text{Cl}$	$\text{CaCO}_3$
53.5	0.423
100	0.609
200	0.645

(Cantoni and Goguelia, Bull Soc 1905, (3) 33 27)

#### Solubility of $\text{CaCO}_3$ in $\text{NH}_4\text{NO}_3$ +Aq at 15°

g per l of sat solution	
$\text{NH}_4\text{NO}_3$	$\text{CaCO}_3$
0	0.131
5	0.211
10	0.258
20	0.340
40	0.462
80	0.584

(Berju and Kosminiko, Landw Vers Sta 1904, 60 422)

$\text{CaO}_2\text{H}_2 + \text{Aq}$  dissolves a little  $\text{CaCO}_3$  (Welter and Berthollet, 1789)

$\text{CaO}_2\text{H}_2 + \text{Aq}$  retains a little  $\text{CaCO}_3$  in solution at ordinary temperature, which is pptd on boiling (Eliot and Storer, Proc Am Acad 1860, 5 63)

$\text{CaO}_2\text{H}_2 + \text{Aq}$ , mixed with dil  $\text{NaOH}$ ,  $\text{KOH}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ , gives no immediate ppt when  $\text{CO}_2$  is passed through it, unless boiled. Sol in boiling  $\text{MgCl}_2 + \text{Aq}$  even when dilute (Cousté)

Not decomp when boiled with  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{CaSO}_4$ ,  $\text{MgSO}_4$ , and  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$ , but partially decomp by boiling with  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_3$ ,  $(\text{NH}_4)_2\text{SO}_3$ ,  $\text{Na}_2\text{HPO}_4$ ,  $(\text{NH}_4)_2\text{HPO}_4$ ,  $\text{K}_2\text{HPO}_3$ ,  $\text{Na}_2\text{HPO}_3$ ,  $(\text{NH}_4)_2\text{HPO}_3$ ,  $\text{K}_2\text{HASO}_4$ ,  $\text{Na}_3\text{AsO}_4$ ,  $\text{K}_2\text{C}_2\text{O}_4$ ,  $(\text{NH}_4)_2\text{C}_2\text{O}_4$ ,  $\text{NaF}$ , and  $\text{K}_2\text{CrO}_4 + \text{Aq}$ . With the  $\text{NH}_4$  salts the decomposition is complete (Dulong, A ch 82 286)

Not decomp by alkali sulphates + Aq (Malaguti)

Precipitation of  $\text{CaCO}_3$  is much hindered by alkali citrates or metaphosphates

#### Solubility in $\text{KCl} + \text{Aq}$ at $25^\circ$

Sp gr $25^\circ/25^\circ$	% $\text{KCl}$	% $\text{CaCO}_3$
1 000	0 00	0 0013
1 024	3 90	0 0078
1 046	7 23	0 0078
1 072	11 10	0 0076
1 092	13 82	0 0072
1 101	15 49	0 0076
1 122	18 21	0 0070
1 133	19 84	0 0072
1 179	26 00	0 0060

(Cameron and Robinson, J phys Chem 1907, 11 578)

Solubility in  $\text{NaCl} + \text{Aq}$  in contact with  $\text{CO}_2$  free air at  $25^\circ$

Sp gr $25^\circ/25^\circ$	g per 100 g $\text{H}_2\text{O}$	
	$\text{NaCl}$	$\text{CaCO}_3$
1 0079	1 60	0 0079
1 0314	5 18	0 0086
1 0466	9 25	0 0094
1 0734	11 48	0 0104
1 0949	16 66	0 0106
1 1346	22 04	0 0115
1 1794	30 50	0 0119

(Cameron, Bell and Robinson, J phys Chem 1907, 11 396)

#### Solubility of $\text{CaCO}_3$ in $\text{NaOH} + \text{Aq}$

Solvent	1 litre dissolves	
	at 18	at $95-100$
$\text{H}_2\text{O}$	125 mg $\text{CaCO}_3$	207 mg $\text{CaCO}_3$
(a 0.0001 n $\text{NaOH}$	87	96
(a 0.001 n $\text{NaOH}$	42	69
(a 0.01 n $\text{NaOH}$	43	7

(Le Blanc, Z anorg 1906, 51 185)

#### Solubility in $\text{K}_2\text{SO}_4 + \text{Aq}$ at $25^\circ$

Sp gr $25^\circ/25^\circ$	% $\text{K}_2\text{SO}_4$	% $\text{C}$	$\text{O}_3$
1 010	1 60	0 04	
1 021	3 15	0 16	
1 033	4 73	0 32	
1 048	6 06	0 48	
1 061	7 85	0 68	
1 069	8 88	0 92	
1 083	10 18	0 92	
1 084	10 48	0 88	

(Cameron and Robinson, J phys Chem 1907, 11 578)

The solubility of  $\text{CaCO}_3$  in  $\text{Na}_2\text{S} + \text{Aq}$  in equilibrium with air steadily increases with increasing amounts of  $\text{CaSO}_4$  in the solution up to saturation point of the  $\text{CaSO}_4$ . In the presence of solid  $\text{CaSO}_4$  the solubility of  $\text{CaCO}_3$  is much decreased (Cameron and Seidell, J phys Chem 1902, 6 56)

See under  $\text{CaH}_2(\text{CO}_3)$

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  in contact with  $\text{CO}_2$  free air at  $25^\circ$

g per 100 g $\text{H}_2\text{O}$	
$\text{Na}_2\text{SO}$	$\text{CaCO}$
0 97	0 0151
1 65	0 0180
4 90	0 0262
12 69	0 0313
14 55	0 0322
19 38	0 0346
23 90	0 0360

(Cameron, Bell and Robinson, J phys Chem 1907, 11 396)

#### Solubility in salts + Aq

g salt added per litre	mg $\text{CaCO}_3$ dissolved per litre
0 000	17 4
0 585 g $\text{NaCl}$	20 0
1 17 g "	24 9
2 93 g "	31 1
0 85 g $\text{NaNO}_3$	24
1 70 "	27 7
4 25 "	34 5
0 805 g $\text{Na}_2\text{SO}_4$ , 10H $_2\text{O}$	25 9
1 61 g "	31 1
4 03 g "	40 7
0 53 g $\text{Na}_2\text{CO}_3$	5 4
1 06 g "	7 2
2 65 g "	4 4
0 55 g $\text{CaCl}_2$ , 6H $_2\text{O}$	9 0
1 10 g "	5 4
2 75 g "	8 4

The solubility of  $\text{CaCO}_3$  in  $\text{CO}_2$ -free water

is therefore increased by the addition of NaCl, NaNO<sub>3</sub> or Na<sub>2</sub>SO<sub>4</sub>, 10H<sub>2</sub>O, but decreased by the addition of Na<sub>2</sub>CO<sub>3</sub> or CaCl<sub>2</sub>, 6H<sub>2</sub>O

(Gothe, Ch Z 1915, 39 306)

Sol in ferric chloride or nitrate + Aq with evolution of CO<sub>2</sub> and pptn of Fe<sub>2</sub>O<sub>3</sub>·H<sub>2</sub>O (Fuchs, 1831), also in chlorides or nitrates of Al, Mn, Cr, or U, but not in FeCl<sub>3</sub> + Aq

Sol in cold SnCl<sub>4</sub> + Aq with pptn of SnO<sub>2</sub>  
Insol in conc Na<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, BaCl<sub>2</sub>, MgCl<sub>2</sub>, Pb(NO<sub>3</sub>)<sub>2</sub>, or AgNO<sub>3</sub> + Aq (Karssten)

Abundantly sol when freshly precipitated in CaCl + Aq, and MgSO<sub>4</sub> + Aq (Hunt)

Absolutely insol at 15-19° in BaO<sub>2</sub>H<sub>2</sub> + Aq, also on boiling

1 l H<sub>2</sub>O containing 3-4 g MgSO<sub>4</sub> dissolves 1-2 g CaCO<sub>3</sub>, and also 1 g MgCO<sub>3</sub> (Hunt, Am J Sci (2) 26 109)

100 pts NaCl + Aq (2.525% NaCl) dissolve 0.0037 pt (calculated as CaO) pptd CaCO<sub>3</sub>, and 0.0053 pt calc spar (Lubavin, J russ Soc 24 389)

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 827)

Insol in liquid CO. (Buchner, Z phys Ch 1906, 54 674)

Alcohol dissolves traces of CaCO<sub>3</sub> (Grischow)

Sol in Na citrate + Aq (Spiller)

Sol in Ca succinate + Aq (Barreswill)

Insol in acetone (Naumann, B 1904, 37 4329)

Insol in acetone and in methylal (Eidmann, C C 1899, 11 1014)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

*Amorphous* Solubility in H<sub>2</sub>O cannot be determined because of its instability (Kendall Phil Mag 1912, (6) 23 972)

*Mineral* In contact with air free from CO<sub>2</sub> 1 l H<sub>2</sub>O dissolves at

25°                      50°                      100°  
0.01433    0.01504    0.01779 g calcite

(Kendall, Phil Mag 1912, (6) 23 964)

In contact with air containing 3.7 pts CO<sub>2</sub> per 10,000 the solubility of calcite in H<sub>2</sub>O was found to be 0.04608 g per l at 25° and 0.02925 g per l at 50° (Kendall, Phil Mag 1912 (6) 23 973)

*Min Aragonite* In contact with air free from CO<sub>2</sub> 1 l H<sub>2</sub>O dissolves at

25°                      50°                      100°  
0.01528    0.01617    0.01902 g aragonite

(Kendall, Phil Mag 1912, (6) 23 964)

+5H<sub>2</sub>O Efflorescent

+6H<sub>2</sub>O (Pelouze)

Calcium hydrogen carbonate, CaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>

Known only in aqueous solution

CaCO<sub>3</sub> dissolves in CO<sub>2</sub> + Aq

CaCO<sub>3</sub> is sol in 1428 pts H<sub>2</sub>O sat with CO at 0° and 1136 pts at 10° (Lassaigne J ch med 4 312)

Bineau could dissolve even rarer quantities of H<sub>2</sub>O sat with CO only 1/5 (CO to form CaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>)

Chalk dissolves in 994.5 pts H<sub>2</sub>O sat with CO<sub>2</sub> while Iceland spar requires 3149 pts (Bischof)

CaCO<sub>3</sub> is sol in 1015 pts H<sub>2</sub>O sat with CO at 21° and 748.3 mm (Warrington Chem Soc 6 296)

Solubility of CaCO<sub>3</sub> in CO<sub>2</sub> + Aq at p pressure in atmospheres CaO + CO<sub>2</sub> = mg CO<sub>2</sub> and CaC dissolved, corresponding to CaCO<sub>3</sub> = mg CaCO<sub>3</sub>

p	CaO + CO <sub>2</sub>	CaCO <sub>3</sub>
0 000504	60 96	74 6
0 000808	72 11	85 0
0 00333	123	137 2
0 03187	218 4	223 1
0 0282	310 4	296 5
0 05008	408 5	360
0 1422		533
0 2538	1072	663 4
0 4167	1500	787 5
0 5533	1846	885 5
0 7297	2270	972
0 9841	2864	1086

(Schlosing, C R 74 1522)

With high pressure, 1 l H<sub>2</sub>O containing CO<sub>2</sub> dissolves at most 3 g CaCO<sub>3</sub>. This maximum is reached at 5° under 4 atmospheres' pressure, at 10-13° under 5 atmospheres, and at 20° under 7 atmospheres (Caro, Arch Pharm (3) 4 145)

CaCO<sub>3</sub> is sol in about 1000 pts H<sub>2</sub>CO<sub>3</sub> + Aq, and solubility is considerably increased by Na<sub>2</sub>SO<sub>4</sub> or MgSO<sub>4</sub>

1000 pts H<sub>2</sub>O sat with CO<sub>2</sub> dissolve pts Carrara marble at t°, and B = height of barometer in millimetres

t°	B	Pts CaCO <sub>3</sub>	t	B	Pts CaCO <sub>3</sub>
7 5	754	1 224	22 0	746	0 920
8 5	752	1 202	26 0	740	0 875
9 5	754	1 115	26 5	743	0 860
20 5	741	0 975	27 0	741	0 885
21 5	744	0 935	28 0	737	0 770

Or, from 7.5-9.5°, 1000 pts H<sub>2</sub>O sat with CO<sub>2</sub> dissolve 1.181 pts CaCO<sub>3</sub>, from 20.5-22°, 0.9487 pt CaCO<sub>3</sub>, from 26-28°, 0.855 pt CaCO<sub>3</sub>

Other varieties of  $\text{CaCO}_3$  are dissolved as follows in 1000 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$

Variety	t°	B	Pts $\text{CaCO}_3$
Lunenburg chalk	18	740	0 835
Pptd $\text{CaCO}_3$	18	740	0 950
Iceland spar	18	735	1 970
Calcite	12	754	1 223
Traversella	12	754	212
Dolomite, semi-transparent	11 5	749	0 654
Dolomite, opaque, in small crystals	11 5	755	0 725
Dolomite, opaque, in large crystals	11	746	224
Dolomite, transparent, in large crystals	11	749	1 073
Oolitic limestone	15	747	252
Dolomitic limestone	15 5	740	573

(Cossa, Z anal 8 145)

Solubility of  $\text{CaCO}_3$  in  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  at various pressures

$\text{CO}_2$ pressure in atm	1	2	4	6
Solubility	1079	1403	1820	2109

(Engel, C R 1885, 101 951)

1 l  $\text{H}_2\text{O}$  dissolves 0.3850 g  $\text{CaH}_2(\text{CO}_3)_2$  at 15° (Treadwell, Z anorg 1898, 17 186)

1 l of sat  $\text{CaH}_2(\text{CO}_3)_2 + \text{Aq}$ , obtained from pure or impure limestone, contains 1.13-1.17 g  $\text{CaCO}_3$  at 15° (Treadwell, Z anorg 1898, 17 189)

Solubility of  $\text{CaH}_2(\text{CO}_3)_2$  in  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  at 15°

% carbonic acid in gas at 0 and 760 mm	Hg partial pressure mm	Free carbonic acid mg	mg $\text{CaH}_2(\text{CO}_3)_2$ in 100 cc of the solution	mg Ca
8.94	67.9	157.4	187.2	46.2
6.04	45.9	86.3	175.5	43.3
5.45	41.4	52.8	159.7	39.4
2.18	16.6	48.5	154.0	38.0
1.89	14.4	34.7	149.2	36.8
1.72	13.1	24.3	133.1	32.9
0.79	6.0	14.5	124.9	30.8
0.41	3.1	4.7	82.1	20.3
0.25	1.9	2.9	59.5	14.7
0.08	0.6		40.2	9.9
			38.5	9.5
			38.5	9.5
			38.5	9.5

(Treadwell and Reuter, Z anorg 1898, 17 185)

1 l  $\text{H}_2\text{O}$  sat with carbonic acid dissolves 1.30 g  $\text{CaCO}_3$  at 13.2°, 1.45 g at 2.8° (Treadwell, Z anorg 1898, 17 189)

At 30° C in equilibrium with the more than 3 per cent of the calcium is combined as  $\text{CaCO}_3$ . At lower temperatures and lesser concentrations the percentage of normal carbonate is even less, and practically all the calcium present is combined as  $\text{Ca}(\text{HCO}_3)_2$  (Cameron and Briggs, J phys Chem 1901, 5 549)

With pressures less than 4.5 atmospheres of  $\text{CO}_2$  no other than normal calcium carbonate or a hydrate of the normal carbonate can exist as the solid phase at 0° (Cameron, J phys Chem 1908, 12 566)

Solubility in  $\text{H}_2\text{O}$  in contact with air containing  $\text{CO}_2$  with varying partial pressures at t°

P = partial pressure of  $\text{CO}_2$

P	g per l	
	t = 15	
	$\text{CaCO}_3$	$\text{CO}_2$
0.8	0.193	0.11
1.5	0.193	0.15
1.7	0.238	0.15
6.8	0.445	0.35
9.9	0.627	0.45
13.6	0.723	0.56
14.6	0.686	0.65
31.6	1.050	1.11

P	g per l	
	t = 25	
	$\text{CaCO}_3$	(O)
0.7	0.159	0.09
1.6	0.177	0.11
4.6	0.341	0.20
7.8	0.446	0.30
16.5	0.539	0.52
30.1	0.743	0.71
35.5	0.755	0.80

P	g per l	
	t = 40	
	$\text{CaCO}_3$	(O)
0.6	0.136	0.07
1.7	0.143	0.08
2.9	0.175	0.10
3.5	0.232	0.16
7	0.284	0.23
14.9	0.354	0.29
22.2	0.427	0.33
31.7	0.480	0.47

Similar results at 20°, 30°, and 35° are also given

(Leather and Sen, Mem Dept Agric (India) Chem Ser 1909, 1 117, Seidell, Solubilities, 1919)

Solubility of calcite in  $H_2O$  at  $25^\circ$ , in contact with  $CO_2$  under varying pressures

P = approximate pressure of  $CO_2$  in atmospheres

P	g per l sat solution		Solid phase
	$HCO_3$	$Ca(HCO_3)_2$	
0 1	0 22	0 67	$CaCO_3$
1 1	2 3	1 58	"
9 9	20 6	3 62	"
13 2	27 5	4 04	"
16 3	34 1	4 21	$Ca(HCO_3)_2$
25 4	53 2	4 22	"

(McCoy and Smith, J Am Chem Soc 1911, 33 468)

1 l  $H_2O$  dissolves 2 3374 g  $CaCO_3$  at  $5^\circ$  under a  $CO_2$  pressure of 2 atmos (Ehlert, Z Elektrochem 1912, 18 727)

Solubility data for calcite in  $H_2O$  containing  $CO_2$ , with and without the presence of salts are given by Seyler and Lloyd (Chem Soc 1909, 95 346)

A critical analysis and recalculation of results of Schloesing and others is given by Johnston (J Am Chem Soc 1915, 37 2001)

$CaCO_3$  is not dissolved by  $CO_2$  and  $H_2O$  in presence of  $MgCO_3$  (Leather and Sen, C A 1915 181)

1 l of 1/10-normal  $NaCl + Aq$  dissolves 0 3320 g  $CaH_2(CO_3)_2$  at  $15^\circ$  (Treadwell and Ruter Z anorg 1898, 17 193)

Solubility of  $CaH_2(CO_3)_2$  in  $NaCl + Aq$  sat with carbonic acid at  $15^\circ$ , containing 5 g  $NaCl$  per l of  $NaCl + Aq$

% carbonic acid in sat at 0 and 760 mm	mm Hg = partial pressure	mg $CaCO_3$ free	mg $CaH_2CO_3$ in the solution	mg $Ca$
16 9	128 8	132 5	218 4	53 9
11 47	87 2	110 1	214 3	52 9
6 07	46 1	23 5	149 2	36 8
3 16	24 0	13 5	118 3	29 2
0 50	3 5	2 7	73 9	18 2
0 41	3 4	0 3	49 0	12 1
			34 9	8 6
			33 7	8 3
			32 9	8 1
			33 2	8 2

(Treadwell and Ruter, Z anorg 1898, 17 193)

Solubility in  $NaCl + Aq$  at  $25^\circ C$  and in equilibrium with air

$Ca(HCO_3)_2$		$NaCl$	
Grams per liter	Reacting wts per liter	Grams per liter	Reacting wts per litre
0 1046	0 00065	0 000	0 000
0 1770	0 00110	9 720	0 168
0 2051	0 00128	21 010	0 362
0 2152	0 00134	30 301	0 522
0 2252	0 00140	50 620	0 872
0 2212	0 00138	69 370	1 195
0 2172	0 00135	98 400	1 695
0 1971	0 00123	147 400	2 540
0 1569	0 00095	234 500	4 040
0 1227	0 00076	262 300	4 520

(Cameron and Seidell, J phys Chem 1902, 6 51)

Solubility in various salts +  $Aq$  under a  $CO_2$  pressure of 2 atmos at  $5^\circ$

Salt	g salt per 1000 g $H_2O$	g $CaCO_3$ sol in 1 l of solvent
$H_2O$		2 3374
$MgCl_2 + 6H_2O$	6 08	2 3518
	50 0	3 4045
	86 0	4 0826
	350 0	3 3009
	700 0	2 7357
	1150 0	2 2054
	1725 0	1 7058
	2300 (sat)	1 4060
$NaCl$	27 96	3 2796
	50 0	3 7399
	86 0	3 7828
	106 9	3 6900
	175 6	3 3495
	263 4	2 8107
	351 2	2 1625 at $8^\circ$
$MgSO_4 + 7H_2O$	105 3 ( $14^\circ$ ) sat at $14^\circ$	2 1768 0 91356
$Na_2SO_4 + 10H_2O$	137 7 ( $14^\circ$ ) sat at $14^\circ$	1 4060 1 9199

(Ehlert and Hempel, Z Elektrochem 1912, 18 727)

Solubility of  $CaCO_3$  in  $KCl + Aq$  at  $25^\circ$  sat with  $CO_2$  at atmospheric pressure

% $KCl$	% $CaCO_3$
3 90	0 145
7 23	0 150
11 10	0 166
13 82	0 165
15 49	0 167
18 21	0 154
19 84	0 140
26 00	0 126

(Cameron and Robinson, J phys Chem 1907, 11 579)

Solubility in NaCl+Aq in contact with CO<sub>2</sub>  
at atmospheric pressure at 25°

g per 100 g H <sub>2</sub> O	
NaCl	CaCO <sub>3</sub>
1 45	0 150
5 69	0 160
11 08	0 174
15 83	0 172
19 62	0 159
29 89	0 123
35 85	0 103

(Cameron, Bell and Robinson, J phys Ch  
1907, 11 396)

Solubility in K<sub>2</sub>SO<sub>4</sub>+Aq, sat with CO<sub>2</sub> at  
atmospheric pressure and 25° temp

% SO <sub>2</sub>	% CaO
0 69	0 69
1 37	0 69
1 67	0 47 *
2 18	0 30 *
2 99	0 24 *

\* Solid phase, CaSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>  
(Cameron and Robinson)

Solubility in Na<sub>2</sub>SO<sub>4</sub>+Aq at 24° in equi-  
librium with air

Total Ca calc as Ca(HCO <sub>3</sub> ) <sub>2</sub> Grams per liter	Ca actually dissolved as Ca(HCO <sub>3</sub> ) <sub>2</sub> Grams per liter	Na <sub>2</sub> SO <sub>4</sub> Grams per liter
0 0925	0 0925	0 000
0 1488	0 1488	2 800
0 1729	0 1729 +	5 235
0 2330	0 2210	11 730
0 3240	0 3020	36 860
0 3960	0 3440	74 010
0 4580	0 3660	116 100
0 5630	0 3940	184 200
0 5910	0 4060	213 700
0 6650	0 4300	255 900

(Cameron and Seidell, J phys Chem 1902,  
6 53)

Data are also given for solubility of CaCO<sub>3</sub>  
in NaCl+Na<sub>2</sub>SO<sub>4</sub>+Aq, and CaCO<sub>3</sub>+CaSO<sub>4</sub>  
in NaCl+Na<sub>2</sub>SO<sub>4</sub>+Aq (Cameron, Bell and  
Robinson)

**Calcium copper uranium carbonate**, CaCO<sub>3</sub>,  
3CuCO<sub>3</sub>, 4U(CO<sub>3</sub>)<sub>2</sub>+24H<sub>2</sub>O  
Sol in acids

**Calcium lead carbonate**, xCaCO<sub>3</sub>, yPbCO<sub>3</sub>  
Min *Plumbocalcite*

**Calcium magnesium carbonate**, CaCO<sub>3</sub>,  
MgCO<sub>3</sub>

Min *Dolomite* 1 l H<sub>2</sub>O sat with CO<sub>2</sub> at  
18° and 750 mm dissolves 0.31 g dolomite  
(Cossa, B 2 697)

Not obtained by evaporating solution but  
can be crystallized from CO<sub>2</sub>+Aq between  
100° and 200° (Hoppe-Seyler)

Dolomite is dissolved by CO<sub>2</sub> and H<sub>2</sub>O,  
but solution is prevented partially by CaCO<sub>3</sub>,  
and wholly by MgCO<sub>3</sub> (Leather and Sen,  
C A 1915 181)

Insol in cold dil acids (Dolomite, J  
Phys 39 1)

Insol in cold acetic acid (Forchhammer)

**Calcium potassium carbonate**, CaK<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>

Decomp by H<sub>2</sub>O (Reynolds, Chem Soc  
1898, 73 265, Butschli, C A 1907 23)  
2CaCO<sub>3</sub>, 3K<sub>2</sub>CO<sub>3</sub>+6H<sub>2</sub>O (Butschli)

**Calcium sodium carbonate**, CaNa<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>

*Anhydrous* Decomp by H<sub>2</sub>O  
+2H<sub>2</sub>O (Butschli, C A 1907 222)  
+5H<sub>2</sub>O Min *Gaylussite* Sparngl sol  
in H<sub>2</sub>O

**Calcium uranyl carbonate**, CaCO<sub>3</sub>, UO<sub>2</sub>C  
+20H<sub>2</sub>O

Min *Liebigite* Sol in HCl+Aq  
+xH<sub>2</sub>O Decomp by H<sub>2</sub>O (Blinkoff,  
Dissert 1900)

2CaO, 4UO<sub>3</sub>, 3CO<sub>2</sub>+24H<sub>2</sub>O Decomp by  
H<sub>2</sub>O (Blinkoff, Dissert 1900)

**Calcium carbonate chloride**, CaCO<sub>3</sub>, CaCl<sub>2</sub>+  
6H<sub>2</sub>O

Sol in H<sub>2</sub>O with immediate decomp  
(Fritzsche, J pr 83 213)

**Cerous carbonate**, Ce(CO<sub>3</sub>)<sub>3</sub>+5, and 9H<sub>2</sub>O

Insol in H<sub>2</sub>O, and solution of CO<sub>2</sub> in H<sub>2</sub>O  
(Vauquelin)

Somewhat sol in (NH<sub>4</sub>) CO<sub>3</sub>+Aq (John)

Insol in neutral salt solutions and neutral  
alkali carbonates+Aq, easily sol in HCl+Aq  
(Berthier A ch (3) 7 77)

**Ceric carbonate**, Ce(CO<sub>3</sub>)<sub>3</sub>+12H<sub>2</sub>O

Precipitate (Hisinger, A ch 94 108)

Insol in H<sub>2</sub>O Sol in slight trace in  
Na<sub>2</sub>CO<sub>3</sub>+Aq, sl sol in NaHCO<sub>3</sub>+Aq, and  
in (NH<sub>4</sub>) CO<sub>3</sub>+Aq (Rosc)

**Cerous lanthanum carbonate fluoride**

Min *Bathasite*, *Hamantite* *Hydrofluorite*  
Slowly decomp by HCl+Aq easily by  
H<sub>2</sub>SO<sub>4</sub>

**Cerous potassium carbonate**, Ce(CO<sub>3</sub>)<sub>3</sub>,  
K CO<sub>3</sub>+3H<sub>2</sub>O

Ppt (John)

Ce<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub>, K CO<sub>3</sub>+12H<sub>2</sub>O Ppt

Sol in 30% K<sub>2</sub>CO<sub>3</sub>+Aq (Meyer, Z  
anorg 1904, 41 103)

**Percevic potassium carbonate**,  $\text{Ce}_2\text{O}_3(\text{CO}_3)_3$ ,  $4\text{K}_2\text{CO}_3 + 12\text{H}_2\text{O}$

*Crystalline* Sl sol in  $\text{H}_2\text{O}$  containing  $\text{K}_2\text{CO}_3$ , sol in dil  $\text{H}_2\text{SO}_4$  with decomp (Job, C R 1899, 128 1098)

**Cerous sodium carbonate**,  $\text{Ce}_2(\text{CO}_3)_3$ ,  $2\text{Na}_2\text{CO}_3 + 2\text{H}_2\text{O}$

Ppt (John)  
 $2\text{Ce}_2(\text{CO}_3)_3$ ,  $3\text{Na}_2\text{CO}_3 + 24\text{H}_2\text{O} (?)$  Ppt  
Easily decomp (Meyer, Z anorg 1904, 41 103)

**Chromous carbonate**,  $\text{CrCO}_3$

Sol in much  $\text{H}_2\text{O}$ , sl sol in  $\text{KHCO}_3 + \text{Aq}$  (Moberg, J pr 44 328, Moissan, A ch (5) 21 199)

**Chromic carbonate, basic**,  $\text{Cr}_2\text{O}_3$ ,  $2\text{CO}_2$

Precipitate (Parkmann, Sil Am J (2) 34 321)

$\text{Cr}_2\text{O}_3$ ,  $\text{CO}_2 + 4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in acids, when freshly pptd is sol in  $\text{K}_2\text{CO}_3$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , and still more sol in  $\text{KOH} + \text{Aq}$  (Meissner)

Insol in ethyl acetate (Naumann, B 1910, 43 314), methyl acetate (Naumann, B 1909, 42 3790)

$2\text{Cr}_2\text{O}_3$ ,  $\text{CO}_2 + 6\text{H}_2\text{O}$  Precipitate (Langlois, A ch (3) 48 502)

**Chromous potassium carbonate**,

$\text{CrCO}_3$ ,  $\text{K}_2\text{CO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  when freshly prepared, slowly polymerizes stable in dry air, decomp in moist air sol in acids with decomp (Baugé, C R 1895, 126 1568)

**Chromous sodium carbonate**,  $\text{CrNa}_2(\text{CO}_3)_2 + \text{H}_2\text{O}$

Decomp when heated In Aq solution, passes into the hydrate containing 10 mols  $\text{H}_2\text{O}$  (Baugé, C R 1897 125 1179)

+10  $\text{H}_2\text{O}$  Very sol in cold  $\text{H}_2\text{O}$ , Aq solution decomp below  $100^\circ$  effloresces in the air, sol in  $\text{HCl} + \text{Aq}$  and  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Baugé, C R 1897, 125 1178)

**Cobaltous carbonate, basic**,  $\text{CoCO}_3$ ,  $2\text{CO} + 4\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  sol in  $(\text{NH}_4)_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{NH}_4\text{NO}_3$ , and  $\text{NH}_4\text{Cl} + \text{Aq}$

Sol in cold  $\text{NH}_4\text{NO}_3$  and  $\text{NH}_4\text{Cl} + \text{Aq}$  (Beutt 1837)

Sol in  $\text{CO} + \text{Aq}$  and acid alkali carbonates + Aq from which it is pptd on boiling Very sol in conc  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3 + \text{Aq}$ , largely sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , and partly sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Berzelius)

Not pptd from solutions containing  $\text{Na}$  citrate (Spillier)

$4\text{CoO}$ ,  $\text{CO} + 4\text{H}_2\text{O}$  Ppt (Beetz)

+  $31\frac{1}{2}\text{H}_2\text{O}$  (Meigen, C C 1905, I 1363)

**Cobaltous carbonate, basic**,  $3\text{CoO}$ ,  $\text{CO}_2 + 2\text{H}_2\text{O}$

(Meigen, C C 1905, I 1363)

$3\text{H}_2\text{O}$  (Rose, Pogg 84 551)

$3\text{CoO}$ ,  $2\text{CO}_2 + 4\text{H}_2\text{O}$  (Bratun, Z anal 6 76)

$2\text{CoO}$ ,  $\text{CO}_2 + 3\frac{1}{2}\text{H}_2\text{O}$  Converted into  $5\text{CoO}$ ,  $2\text{CO} + 4\text{H}_2\text{O}$  by  $\text{H}_2\text{O}$  (Beetz)

**Cobaltous carbonate**,  $\text{CoCO}_3$

*Anhydrous* Not attacked by cold conc  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$  (Senarmont, A ch (3) 30 129)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 827)

Min *Sphaerocobaltite* Sl attacked by cold  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$

+  $\frac{2}{3}\text{H}_2\text{O}$  Sol in acids (Dewille, A ch (3) 33 95)

+  $6\text{H}_2\text{O}$  (Dewille)

Decomp by  $\text{H}_2\text{O}$  with formation of a basic carbonate (Berzelius)

**Cobaltous potassium carbonate**,  $\text{CoCO}_3$ ,  $\text{K}_2\text{CO}_3 + 4\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Dewille, A ch (3) 33 90)

Ppt Decomp by  $\text{H}_2\text{O}$  (Reynolds, Chem Soc 1898, 73 264)

$\text{CoCO}_3$ ,  $\text{KHCO}_3 + 4\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Dewille)

**Cobaltous sodium carbonate**,  $\text{CoCO}_3$ ,  $\text{Na}_2\text{CO}_3 + 4\text{H}_2\text{O}$ , and  $10\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Dewille, A ch (3) 33 75)

**Cupric carbonate, basic**

The compounds produced by pptn of copper solutions by carbonates are unstable and possess varying solubilities in solutions of  $\text{CO}_2$ . On treatment with solutions of  $\text{CO}$  these subst mcs pass over into an apparently stable compound possessing a definite solubility in solutions of  $\text{CO}$  of definite concentration, which solubility increases with the concentration of  $\text{CO}_2$ . Solubility of this compound in various salts—Aq is recorded (Fric, J Am Chem Soc 1908, 30 1374)

$8\text{CuO}$ ,  $\text{CO} + 5\text{H}_2\text{O}$  (Dewille, A ch (3) 33 75)

$6\text{CuO}$ ,  $\text{CO}$  (Fridl, Chem Soc 14 70)

$3\text{CuO}$ ,  $\text{CO} + 2\text{H}_2\text{O}$  (Fric, A ch (3) 10 119)

$5\text{CuO}$ ,  $2\text{CO}_2 + 6\text{H}_2\text{O}$  (Straube)

$2\text{CuO}$ ,  $\text{CO}_2 + \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , easily sol in acids, even  $\text{H}_2\text{SO}_3 + \text{Aq}$ , sl sol in  $\text{H}_2\text{CO}_3 + \text{Aq}$ , 30,720 pts of the solution containing 1 pt of  $\text{CuO}$  (John) Sol in 4690 pts  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat at 4–6 atmos pressure (Wagner) Sol in 3833 pts sat  $\text{H}_2\text{CO}_3 + \text{Aq}$  (Lussaigne, J ch med 4 312)

Sol in  $\text{NH}_4$  salts + Aq Partially sol in  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3 + \text{Aq}$ , and more sol in



$\text{NaHCO}_3$ , or  $\text{KHCO}_3 + \text{Aq}$ , sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Favre, A ch (3) 10 18)

Less sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  than  $\text{CuO}$  in  $\text{NH}_4\text{OH} + \text{Aq}$  (Thomson, 1831) Sol in  $\text{KCN} + \text{Aq}$  (Berzelius) Sol in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett)

Sol in ferric salts with pptn of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$   
Insol in liq  $\text{NH}_3$  (Franklin and Kraus, Am Ch J 1898, 20 827)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Insol in acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

Sol in ethyl amine carbonate + Aq (Wurtz)

Sol in cane sugar + Aq (Pescher, Repert 1820, 6 85)

Not pptd from solutions containing sodium citrate (Spiller)

Insol in pyridine (Schroeder, Dissert 1901)

Min *Malachite* Sol in acids, and  $\text{NH}_4\text{OH} + \text{Aq}$

+  $2\text{H}_2\text{O}$  (Favre)

$8\text{CuO}$ ,  $5\text{CO}_2 + 7\text{H}_2\text{O}$  (Groger, Z anorg 1900, 24 137)

$3\text{CuO}$ ,  $2\text{CO}_2 + \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , also in hot conc  $\text{NaHCO}_3 + \text{Aq}$

Min *Azurite*

**opper potassium carbonate, basic**,  $8\text{CuO}$ ,  $2\text{K}_2\text{CO}_3$ ,  $7\text{CO}_2 + 17\text{H}_2\text{O}$

Ppt, decomp by  $\text{H}_2\text{O}$  (Groger, B 1901, 34 430)

Mixture (Wood and Jones, C A 1907 2667)

$5\text{CuO}$ ,  $4\text{CO}_2$ ,  $\text{K}_2\text{CO}_3 + 10\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Deville, A ch (3) 33 102)

**Cupric potassium carbonate**,  $\text{CuCO}_3$ ,  $\text{K}_2\text{CO}_3$   
Decomp by  $\text{H}_2\text{O}$  (Wood and Jones, C A 1907 2667)

+  $\text{H}_2\text{O}$  (Wood and Jones)

+  $4\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Reynolds, Chem Soc 1898, 73 263)

Could not be obtained (Wood and Jones)  
 $2\text{CuCO}_3$ ,  $\text{K}_2\text{CO}_3 + 4\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Wood and Jones)

**Cupric sodium carbonate**,  $\text{CuCO}_3$ ,  $\text{Na}_2\text{CO}_3$

Not decomp by cold  $\text{H}_2\text{O}$  (Debray, C R 49 218)

+  $3\text{H}_2\text{O}$

**Cupric zinc carbonate**,  $2\text{CuO}$ ,  $3\text{ZnO}$ ,  $2\text{CO}_2 + 3\text{H}_2\text{O}$ , or  $3\text{CuO}$ ,  $9\text{ZnO}$ ,  $4\text{CO}_2 + 8\text{H}_2\text{O}$

Min *Aurichalcite* Easily sol in  $\text{HCl} + \text{Aq}$

**Cupric carbonate ammonia (cuprammonium carbonate)**,  $\text{CuCO}_3$ ,  $2\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  Insol in alcohol and ether Sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Favre, A ch (3) 10 116)

**Didymium carbonate**,  $\text{D}_{12}(\text{CO}_3)_3 + \text{H}_2\text{O}$ , or  $6\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Only traces dissolve in  $\text{CO}_2 + \text{Aq}$  Insol in solutions of alkali carbonates or bicarbonates + Aq (Marignac, A ch (3) 38 166) Very sl sol in conc  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rose)

Insol in acetone (Naumann, B 1904, 7 4329)

+  $8\text{H}_2\text{O}$  (Cleve, Bull Soc (2) 43 363)

**Didymium potassium carbonate**,  $\text{D}_{12}(\text{CO}_3)_3$ ,  $\text{K}_2\text{CO}_3 + 4\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Cleve, Bull Soc (2) 3 363)

+  $12\text{H}_2\text{O}$  (Cleve)

**Didymium sodium carbonate**,  $2\text{D}_{12}(\text{CO}_3)_3$ ,  $3\text{Na}_2\text{CO}_3 + 9\text{H}_2\text{O}$

Ppt (Cleve)

$\text{D}_{12}(\text{CO}_3)_3$ ,  $2\text{Na}_2\text{CO}_3 + 8\text{H}_2\text{O}$  Ppt (Cleve)

**Dysprosium carbonate**,  $\text{Dy}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Jantsch, B 1911, 4 1277)

**Erbium carbonate**,  $\text{Er}_2\text{O}_3$ ,  $2\text{CO}_2 + 2\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Hoglund)

**Erbium sodium carbonate**,  $\text{Er}_2(\text{CO}_3)_3$ ,  $5\text{Na}_2\text{CO}_3 + 36\text{H}_2\text{O}$

Efflorescent Decomp by  $\text{H}_2\text{O}$

**Gadolinium carbonate, basic**,  $\text{Gd}(\text{OH})\text{CO}_3 + \text{H}_2\text{O}$

Ppt (Benedicks, Z anorg 1900, 22 41)

**Glucinum carbonate, basic**,  $3\text{GdO}$ ,  $\text{CO}_2$ ,  $4\text{GdO}$ ,  $\text{CO}_2$ ,  $5\text{GdO}$ ,  $\text{CO}_2 + 5\text{H}_2\text{O}$ , etc

Not perceptibly sol in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{CO}_3 + \text{H}_2\text{O}$

Decomp by boiling  $\text{H}_2\text{O}$  Easily sol in  $\text{NH}_4\text{OH}$

Sol in  $\text{NH}_4$  salts, and  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$

Sol in alkali carbonates, especially  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Vauquelin) Sl sol in  $\text{K}_2\text{CO}_3 + \text{Aq}$  When solution in  $(\text{NH}_4)_2\text{CO}_3$  is boiled, a more basic carbonate is pptd (Rose)

**Glucinum carbonate**,  $\text{GdCO}_3 + 4\text{H}_2\text{O}$

Efflorescent Sol in 278 pts  $\text{H}_2\text{O}$  (Klatz, J pr 106 242)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 828)

No definite carbonate of glucinum exists (Cameron, J phys Chem 1908, 12 572)

**Glucinum potassium carbonate**,  $3\text{GICO}_3 \cdot 2\text{K}_2\text{CO}_3$

Easily sol in  $\text{H}_2\text{O}$ , but decomp by boiling (Debray) Less easily sol in alcohol

**Indium carbonate**,  $\text{In}_2(\text{CO}_3)_3$

Ppt Insol in  $\text{K}_2\text{CO}_3$ , or  $\text{Na}_2\text{CO}_3 + \text{Aq}$   
Sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Winkler, J pr 94 1)

**Iron (ferric) carbonate, basic**

$9\text{Fe}_2\text{O}_3 \cdot \text{CO}_2 + 12\text{H}_2\text{O}$  (Wallace, Chem Gaz 1858 410)  
 $3\text{Fe}_2\text{O}_3 \cdot \text{CO}_2 + 4\text{H}_2\text{O}$ , and  $8\text{H}_2\text{O}$  (Barrat, C N 1 110)  
 $+ 6\text{H}_2\text{O}$  (Wallace)  
 $2\text{Fe}_2\text{O}_3 \cdot \text{CO}_2 + 1\frac{1}{2}\text{H}_2\text{O}$  (Rother, Pharm J Trans (3) 4 576)  
 $\text{Fe}_2\text{O}_3 \cdot \text{CO}_2$  (Parkmann, Sill Am J (2) 34 321)

These and other similar basic salts are ppts, easily decomp on standing into  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$

**Iron (ferrous) carbonate,  $\text{FeCO}_3$**

Insol in  $\text{H}_2\text{O}$   
Sol in acids, even in  $\text{H}_2\text{CO}_3 + \text{Aq}$   
See **Carbonate, ferrous hydrogen**  
Min *Siderite Spathic ore* SI attacked by dil acids Sol in  $\text{H}_2\text{CO}_3 + \text{Aq}$  under pressure  
Insol in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett)  
 $+ \text{H}_2\text{O}$  SI sol in  $\text{H}_2\text{O}$ , easily sol in acids, sol in  $\text{H}_2\text{CO}_3 + \text{Aq}$   
Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  Sol in ferric salts + Aq with evolution of  $\text{CO}_2$  and pptn of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$   
Soluble in an aqueous solution of cane sugar

Solubility in salts + Aq free from  $\text{CO}_2$

Salt	g salt per 1000 g $\text{H}_2\text{O}$	1 l of solvent dissolves g $\text{FeCO}_3$
$\text{NaCl}$	351 2	0 35042
$\text{MgCl}_2 + 6\text{H}_2\text{O}$	2300 0	4 2049
$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	137 7 sat at $+14^\circ$	0 70085 0 93444
$\text{MgSO}_4 + 7\text{H}_2\text{O}$	105 3 sat at $+18^\circ$	1 4667 2 9334

(Fhlert, Z Elektrochem 1912, 18 728)

**Iron (ferrous) hydrogen carbonate**,  
 $\text{FeH}_2(\text{CO}_3)_2(?)$

known only in aqueous solution  
By conducting  $\text{CO}_2$  at ordinary pressure through  $\text{H}_2\text{O}$ , in which Fe is suspended, a solution containing 9 l pts  $\text{FeCO}_3$  to 10,000 pts  $\text{H}_2\text{O}$  is obtained (v Hauer, J pr 81 391)

100 pts  $\text{H}_2\text{CO}_3 + \text{Aq}$  dissolve 0 72 pt  $\text{FeCO}_3$  (Wagner)

$\text{FeCO}_3$  dissolves in 1381 pts  $\text{H}_2\text{O}$  saturated with  $\text{CO}_2$ , under a pressure of 4-6 atmospheres (Wagner, J B 1867 135)

1 l  $\text{H}_2\text{O}$  dissolves 6 1907 g  $\text{FeCO}_3$  (pure) under a  $\text{CO}_2$  pressure of 2 atmos (Ehlert, Z Elektrochem 1912, 18 728)

Solubility in various salts + Aq in presence of  $\text{CO}_2$  under pressure of 2 atmos

Salt	With $\text{CO}_2$ of 2 atmos pressure	
	g salt per 1000 g $\text{H}_2\text{O}$	1 l of solvent dissolves g $\text{FeCO}_3$
$\text{H}_2\text{O}$		6 1907
$\text{NaCl}$	50 106 9 175 6 263 4 351 2	
$\text{MgCl}_2 + 6\text{H}_2\text{O}$	86 9 700 0 1150 0 1437 5 1725 0 2300 0	5 8403 4 5553 4 4587 4 6934 5 3975 9 0524
$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	137 7 sat at $+14^\circ$	7 9428 9 5780
$\text{MgSO}_4 + 7\text{H}_2\text{O}$	105 3 sat at $+18^\circ$	6 2423 7 3922

(Ehlert, Z Elektrochem 1912, 18 728)

A bicarbonate of ferrous iron is not formed under pressures of  $\text{CO}_2$  up to 5 atmospheres at  $0^\circ$  (Cameron, J phys Chem 1908, 12 571)

**Iron (ferrous) magnesium carbonate**,  $\text{FeCO}_3$ ,  $\text{MgCO}_3$

Min *Pistomesite*  
 $\text{FeCO}_3, 2\text{MgCO}_3$  Min *Mesitite*

**Iron (ferrous) potassium carbonate**,  
 $\text{FeK}(\text{CO}_3)_2 + 4\text{H}_2\text{O}$

Ppt Decomp by  $\text{H}_2\text{O}$  (Reynolds Chem Soc 1898, 73 265)

**Lanthanum carbonate**,  $\text{La}(\text{CO}_3)_3 + \text{H}_2\text{O}$ ,  
 $3\text{H}_2\text{O}$ , and  $8\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$   $\text{CO}_2 + \text{Aq}$  dissolves traces  
Insol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$

Insol in acetone (Naumann, B 1904, 37 4329)

Min *Lanthanite*

**Lanthanum potassium carbonate,  $\text{La}_2(\text{CO}_3)_3$ ,  $\text{K CO}_3 + 12\text{H}_2\text{O}$** 

Sol in 30%  $\text{K}_2\text{CO}_3 + \text{Aq}$  (Meyer, Z anorg 1904, 41 101)

**Lanthanum sodium carbonate,  $2\text{La}_2(\text{CO}_3)_3$ ,  $3\text{Na}_2\text{CO}_3 + 20\text{H}_2\text{O} (?)$** 

Ppt Easily decomp (Meyer, Z anorg 1904, 41 102)

**Lead carbonate, basic,  $2\text{PbCO}_3$ ,  $\text{PbO}_2\text{H}_2$ ,  $5\text{PbCO}_3$ ,  $3\text{PbO}_2\text{H}_2$ ,  $3\text{PbCO}_3$ ,  $\text{PbO}_2\text{H}_2$ ,  $5\text{PbCO}_3$ ,  $\text{PbO}_2\text{H}_2$** 

*White Lead* Insol in  $\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{CO}_3 + \text{Aq}$ , even under pressure Sol in dil, insol in conc  $\text{KOH} + \text{Aq}$  Insol in normal, or acid alkali carbonates + Aq (Bottger)

Sol in cold dil  $\text{NH}_4\text{Cl} + \text{Aq}$  (Brett)  
 $\text{PbCO}_3$ ,  $\text{PbO}_2\text{H}_2$  Very sl sol in  $\text{H}_2\text{O}$  (Yorke)

$2\text{PbCO}_3$ ,  $\text{PbO}_2\text{H}_2$   
Solubility is less than 0.0002 millimol Pb in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$  (Pleissner, C C 1907, II 1056)

When not exposed to air, sol in 32,000 pts  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (0.2 g per l), 26,000 pts  $\text{KNO}_3 + \text{Aq}$  (0.2 g per l), 23,000 pts  $\text{CaCl}_2 + \text{Aq}$  (0.2 g per l), 4600 pts  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (0.2 g per l), 4300 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$ .

When exposed to air in beakers, sol in 43,000 pts  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (0.2 g per l), 43,000 pts  $\text{KNO}_3 + \text{Aq}$  (0.2 g per l), 26,000 pts  $\text{CaCl}_2 + \text{Aq}$  (0.2 g per l), 26,000 pts  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (0.2 g per l), 4300 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  (0.2 g per l) (Muir, Chem Soc 31 664)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

$3\text{PbO}$ ,  $4\text{PbCO}_3 + 2\text{H}_2\text{O}$  Ppt (Stromholm, Z anorg 1904, 38 446)

**Lead carbonate,  $\text{PbCO}_3$** 

Sol in 50,551 pts  $\text{H}_2\text{O}$  at ordinary temp

Sol in 23,450 pts  $\text{H}_2\text{O}$  with little ammonium acetate, carbonate and free ammonia, and in somewhat less  $\text{H}_2\text{O}$ , containing much ammonium nitrate with carbonate and free ammonia (Fresenius, A 59 124)

Calculated from electrical conductivity of  $\text{PbCO}_3 + \text{Aq}$ , 1 l  $\text{H}_2\text{O}$  dissolves 3 mg  $\text{PbCO}_3$  at  $10^\circ$  (Kohlrausch and Rose, Z phys Ch 12 241)

Solubility is 0.0002 millimol Pb in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$  (Pleissner, C C 1907, II 1056)

Sl sol in  $\text{H}_2\text{O}$   $1.5 \times 10^{-4}$  g are contained in 1 l of sat solution at  $20^\circ$  (Bottger, Z phys Ch 1903, 46 604)

Easily sol in acids, even  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$ , but not decomp by conc  $\text{HNO}_3 + \text{Aq}$  on account of insolubility of  $\text{Pb}(\text{NO}_3)_2$  in  $\text{HNO}_3 + \text{Aq}$  Insol in a mixture of 1 pt  $\text{H}_2\text{SO}_4$  and 6 pts absolute alcohol, or in an alcoholic solution of racemic or tartaric acids

Insol in  $\text{H}_2\text{CO}_3 + \text{Aq}$  (Jahn, A 28 117)  
Very sl sol in  $\text{H}_2\text{CO}_3 + \text{Aq}$ , but soln is prevented by traces of various salts (Lassaigne, J ch méd 4 312)  
Sol in 7144 pts sat  $\text{H}_2\text{CO}_3$  ( $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  under 4-6 atmos pressure dissolve only traces of Pb, 1000 pts of solution containing 0.5 pt  $\text{PbCO}_3$  (Wagner, Z anal 6 17)

Solubility of  $\text{PbCO}_3$  in  $\text{H}_2\text{CO}_3 + \text{Aq}$  is 18%

mg per l	
$\text{CO}$	$\text{PbCO}_3$
0	1 75
2 8	6
5 4	7
14 4	8 2
26	9 9
43 5	10 9
106	15 4

(Pleissner, C C 1907, II 1056)

Sol in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ , and  $\text{NH}_4\text{Cl}$  Aq (Weppen, 1837) Sol in  $\text{KOH} + \text{Aq}$ , n ab- s of  $\text{K}_2\text{CO}_3$ , or  $\text{Na}_2\text{CO}_3 + \text{Aq}$ , and still more sl at  $100^\circ$ , but absolutely insol in  $\text{NaCl}$ ,  $\text{KHCO}_3$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Rose) nsol in  $\text{NH}_4\text{OH} + \text{Aq}$ , sol in  $\text{KOH}$  or  $\text{NaOH}$  Aq, decomp by boiling  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  (Fresenius)

Sl decomp (Persoz), not at all decomp (Malaguti) by alkali sulphates + Aq

Partially decomp by boiling with  $\text{H}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{CaSO}_4$ ,  $\text{MgSO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $\text{NaNH}_4\text{HPO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{N}_2\text{SO}_3$ ,  $(\text{NH}_4)_2\text{SO}_3$ ,  $\text{Na}_2\text{HPO}_4$ ,  $\text{Na}_2\text{B}_4\text{O}_7$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_3\text{AsO}_4$ ,  $\text{K}_2\text{C}_2\text{O}_4$ ,  $\text{Na}_2\text{C}_2\text{O}_4$ ,  $\text{NaF}$ , and  $\text{K CrO}_4 + \text{Aq}$  With the  $\text{NH}_4$  salts the decomp is complete (Dulong, A C 82 290)

Easily sol in hot  $\text{NH}_4\text{Cl} + \text{Aq}$  (Fresenius, Rose)

When 1 mol  $\text{PbCO}_3$  is boiled with 1 mol  $\text{K}_2\text{C}_2\text{O}_4$ , 15% of the  $\text{PbCO}_3$  is decomp with 1 mol  $\text{K CO}_3$ , 93.28% is decomp (Malaguti)

Not decomp by  $\text{K SO}_4 + \text{Aq}$  (Rose)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Sol in an aqueous solution of acetates (Murett, 1844)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Not pptd in presence of  $\text{NaCl}$  acetate (Spiller)

Min (Fresenius)

**Lead sodium carbonate,  $4\text{PbCO}_3$ ,  $\text{Na}_2\text{CO}_3$** 

Insol in  $\text{H}_2\text{O}$  (Fresenius, Pogg 47 19)

**Lead carbonate bromide,  $\text{PbCO}_3$ ,  $\text{PbBr}$** 

Insol in  $\text{H}_2\text{O}$  (Storer & Diet)

**Lead carbonate chloride,  $\text{PbCO}_3$ ,  $\text{PbCl}_2$** 

Insol in  $\text{H}_2\text{O}$  (Miller, Chem Soc (2) 8 37)

Min *Phosgenite* Easily sol in acids

**Lead carbonate iodide,  $\text{PbCO}_3$ ,  $\text{PbI}_2$** 

Insol in  $\text{H}_2\text{O}$  (Poggiale)

**Lead carbonate sulphate,  $\text{PbCO}_3$ ,  $\text{PbSO}_4$** 

Min *Lanarkite* Sol in  $\text{HNO}_3 + \text{Aq}$  with residue of  $\text{PbSO}_4$   
 $3\text{PbCO}_3$ ,  $\text{PbSO}_4$  Min *Leadhillite* As above

**Lithium carbonate,  $\text{Li}_2\text{CO}_3$** 

100 pts  $\text{H}_2\text{O}$  dissolve 1 pt  $\text{Li}_2\text{CO}_3$  (Vauquelin, A ch 7 284)

100 pts  $\text{H}_2\text{O}$  at  $13^\circ$  dissolve 0.769 pt  $\text{Li}_2\text{CO}_3$ , at  $102^\circ$ , 0.778 pt  $\text{Li}_2\text{CO}_3$  (Kremers, Pogg 99 48)

100 pts  $\text{H}_2\text{O}$ , cold or hot, dissolve 1.2 pts  $\text{Li}_2\text{CO}_3$  (Troost, A ch (3) 51 103)

100 pts  $\text{H}_2\text{O}$  dissolve 1.4787 pts at  $15^\circ$ , 0.7162 pt at  $100^\circ$  (Draper, C N 55 169)

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{Li}_2\text{CO}_3$  at  $t^\circ$

t	Pts $\text{Li}_2\text{CO}_3$	$t^\circ$	Pts $\text{Li}_2\text{CO}_3$
0	1 539	75	0 866
10	1 406	100	0 728
20	1 329	102	0 796
50	1 181		

0.796 pt is dissolved at  $102^\circ$  in less than  $\frac{1}{4}$  hour, and 0.955 in 1 hour (Beketow, J russ Soc 1884 591)

Sat solution at  $15^\circ$  has sp gr 1.014, and contains 1 g  $\text{Li}_2\text{CO}_3$  to 70 g  $\text{H}_2\text{O}$ , while solution sat at  $0^\circ$  has sp gr 1.0168 and contains 1 g  $\text{Li}_2\text{CO}_3$  in 64.6 g  $\text{H}_2\text{O}$ . By long spontaneous evaporation at  $15^\circ$  a solution can be obtained of 1.0278 sp gr containing 1 g  $\text{Li}_2\text{CO}_3$  in 45.57 g  $\text{H}_2\text{O}$  (Flückiger, Arch Pharm (3) 25 549)

By boiling for an instant with  $\text{H}_2\text{O}$  a solution is obtained, which has sp gr 1.0074 and contains 1 g  $\text{Li}_2\text{CO}_3$  to 139 g  $\text{H}_2\text{O}$  (Flückiger, Arch Pharm (3) 26 543)

0.1687 mol is sol in 11  $\text{H}_2\text{O}$  at  $25^\circ$  (Rothmund, Z phys Ch 1909, 69 531)

Sat  $\text{Li}_2\text{CO}_3 + \text{Aq}$  contains at

$95^\circ$        $75^\circ$   
 0.723      0.833% by wt  $\text{Li}_2\text{CO}_3$

(Schugriff, Z anorg 1914, 86 159)

Sat solution boils at  $102^\circ$  (Kremers)

More sol in  $\text{CO} + \text{Aq}$  than in  $\text{H}_2\text{O}$  100

pts sat  $\text{CO}_2 + \text{Aq}$  dissolve 5.25 pts  $\text{Li}_2\text{CO}_3$  (Troost) See  $\text{LiHCO}_3$   
 Sol in  $\text{NH}_4$  salts +  $\text{Aq}$

Solubility in salts +  $\text{Aq}$  at  $25^\circ$

C = concentration of salt solution in g-equiv per l

S = solubility of  $\text{Li}_2\text{CO}_3$  in g-equiv per l

Salt	C	S
$\text{KNO}_3$	0 25	0 3647
	0 50	0 3688
	0 75	0 3676
	1 00	0 3656
	1 50	0 3490
	2 00	0 3268
$\text{KCl}$	0 10	0 3553
	0 25	0 3590
	0 50	0 3782
	0 75	0 3832
	1 00	0 3835
	1 50	0 3731
$\text{NaCl}$	2 00	0 3558
	0 10	0 3569
	0 25	0 3691
	0 50	0 3867
	0 75	0 3956
	1 00	0 3946
$\text{K}_2\text{SO}_4$ 2	1 50	0 3901
	2 00	0 3776
	0 25	0 4028
	0 50	0 4356
	1 00	0 4860
$\text{Na}_2\text{SO}_4$ 2	0 50	0 4411
	1 00	0 4926
	2 00	0 5534
$\text{NH}_4\text{Cl}$	0 10	0 3902
	0 25	0 4677
	0 50	0 5659
	0 75	0 6270
	1 00	0 6810
	1 50	0 7463
$(\text{NH}_4)_2\text{SO}_4$ 2	2 00	0 7739
	4 00	0 7881
	0 25	0 5059
	0 50	0 7863
	1 00	0 9804
	1 50	1 109
$\text{KClO}_4$	2 00	1 174
	0 1	0 3500
	0 2	0 3570
	0 4	0 3616

(Griffiths, Z anorg 1905, 43 198)

Insol in liquid  $\text{NH}_3$  (Franklin Am Ch J 1898, 20 828)

Solubility in organic compds + Aq at 25°  
Solubility in H<sub>2</sub>O at 25° = 0.1687 mols/litre

Organic compd	Normality of the solution	Mol L <sub>2</sub> CO <sub>3</sub> sol in 1 l
Methyl alcohol	0.250	0.1604
	0.5	0.1529
	1.0	0.1394
Ethyl alcohol	0.125	0.1614
	0.250	0.1555
	0.5	0.1417
	1.0	0.1203
Propyl alcohol	0.125	0.1604
	0.250	0.1524
	0.5	0.1380
	1.0	0.1097
Tertiary amyl alcohol	0.125	0.1564
	0.250	0.1442
	0.5	0.1224
	1.0	0.0899
Acetone	0.125	0.1600
	0.250	0.1515
	0.5	0.1366
	1.0	0.1104
Ether	0.125	0.1580
	0.250	0.1476
	0.5	0.1300
Formaldehyde	0.125	0.1668
	0.250	0.1653
	0.5	0.1606
	1.0	0.1531
Glycol	0.125	0.1660
	0.250	0.1629
	0.5	0.1565
	1.0	0.1472
Glycerine	0.125	0.1670
	0.250	0.1647
	0.5	0.1613
	1.0	0.1532
Mannitol	0.125	0.1705
	0.250	0.1737
	0.5	0.1778
Glucose	0.125	0.1702
	0.250	0.1728
	0.5	0.1752
	1.0	0.1778
Sucrose	0.125	0.1693
	0.250	0.1689
	0.5	0.1661
	1.0	0.1557
Urea	0.125	0.1686
	0.250	0.1673
	0.5	0.1643
	1.0	0.1605

Solubility in organic compds + Aq  
at 25°—Continued

Organic compd	Normality of the solution	Mol L sol in 1 l	O <sub>2</sub> l
Thio-urea	0.125	0.16	7
	0.250	0.16	3
	0.5	0.16	3
	1.0	0.15	3
Dimethyl-pyrone	0.125	0.15	2
	0.250	0.14	2
	0.5	0.12	4
	1.0	0.09	2
Ammonia	0.125	0.16	3
	0.250	0.16	3
	0.5	0.15	7
	1.0	0.14	3
Diethylamine	0.125	0.15	9
	0.250	0.14	1
	0.5	0.12	3
	1.0	0.09	7
Pyridine	0.125	0.15	2
	0.250	0.15	3
	0.5	0.15	7
	1.0	0.10	1
Piperidine	0.125	0.15	4
	0.250	0.14	3
	0.5	0.1	0
	1.0	0.10	9
Urethane	0.125	0.16	4
	0.250	0.15	5
	0.5	0.1	7
	1.0	0.1	3
Acetamide	0.250	0.16	4
	0.5	0.15	0
	1.0	0.1	8
Acetonitrile	0.125	0.16	8
	0.250	0.1	6
	0.5	0.1	9
	1.0	0.1	8
Mercuric cyanide	0.125	0.16	7
	0.250	0.1	4

(Rothmund, Z phys Ch 1909, **69** 51)

Insol in methyl acetate (Naumann, B 1909, **42** 3790), ethyl acetate (Naumann, B 1904, **37** 3601)

Insol in acetone (Naumann, B 1914, **37** 4329, Eidmann, C C 1899, II 1014)

Lithium hydrogen carbonate, LiHCO<sub>3</sub>

100 pts H<sub>2</sub>O dissolve 5.501 pts at 13°  
(Bewad, B 17 406 R)

**Magnesium carbonate, basic**,  $\text{Mg}_3\text{C}_2\text{O}_7 + 3\text{H}_2\text{O} = 3\text{MgO}, 2\text{CO}_2 + 3\text{H}_2\text{O}$  or  $2\text{MgCO}_3, \text{MgO}, \text{H}_2\text{O} + 2\text{H}_2\text{O}$  (Fritzsche, Pogg 37 310)

*Magnesia alba*,  $3\text{MgCO}_3, \text{Mg}(\text{OH})_2 + 4\text{H}_2\text{O}, 4\text{MgCO}_3, \text{Mg}(\text{OH})_2 + 5\text{H}_2\text{O}$ , or  $5\text{MgCO}_3, 2\text{Mg}(\text{OH})_2 + 7\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$  Sol in 10,000 pts hot or cold  $\text{H}_2\text{O}$  (Bineau)

Sol in 2500 pts cold, and 9000 pts hot  $\text{H}_2\text{O}$  (Fyfe)

Sol in  $\text{H}_2\text{O}$  containing  $\text{CO}_2$

Very easily sol in acids

Easily sol in dil  $\text{HCl} + \text{Aq}$

Easily sol in  $\text{NH}_4$  sulphate, nitrate, or succinate +  $\text{Aq}$ , also in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Wittstein) Sol in cold  $\text{Na}_2\text{CO}_3, \text{K}_2\text{CO}_3, \text{K}_2\text{SO}_4, \text{KCl}$ , or  $\text{KNO}_3 + \text{Aq}$  (Longchamp), also in  $\text{NH}_4\text{Cl} + \text{Aq}$ , separating out on heating (Vogel, J pr 7 455) Slowly sol in conc  $\text{BaCl}_2, \text{CaCl}_2$ , or  $\text{ZnSO}_4 + \text{Aq}$  (Karsten)

Sol in  $\text{MgSO}_4 + \text{Aq}$  (Dulong)

Sol in ferric salts +  $\text{Aq}$  with evolution of  $\text{CO}_2$  and pptn of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (Fuchs)

Sol in boiling  $\text{Co}, \text{Ni}, \text{Zn}, \text{Mn}$ , or  $\text{Cu}$  nitrates or chlorides +  $\text{Aq}$

Mm *Hydromagnesite*,  $4\text{MgO}, 3\text{CO}_2 + 4\text{H}_2\text{O}$

+  $10\text{H}_2\text{O}$  Sol in considerable amount in  $\text{H}_2\text{CO}_3 + \text{Aq}$  as  $\text{MgH}_2(\text{CO}_3)_2 + \text{Aq}$  (Engel, C R 100 911)

**Magnesium carbonate,  $\text{MgCO}_3$**

*A, hydrous* Insol in  $\text{H}_2\text{O}$  1 l  $\text{H}_2\text{O}$  dissolves 106 mg  $\text{MgCO}_3$  (Chevalet, Z anal 8 91) Sol in 5071 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Kremers)  $\text{MgCO}_3$  combines with  $\text{H}_2\text{O}$  to form  $\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$ , and +  $5\text{H}_2\text{O}$ , which are less sol in  $\text{H}_2\text{O}$  than anhydrous salt (Engel, C R 101 814)

Very hygroscopic About 20 g are sol in 1 l  $\text{H}_2\text{O}$  (Engel, C R 1899, 129 598)

0 7156 g are sol in 1 l  $\text{H}_2\text{O}$  at  $15^\circ$

0 627 g are sol in 1 l  $\text{H}_2\text{O}$  at  $15^\circ$  with vapour pressure of  $\text{CO}_2$  equal to zero

6 977 grams are sol in 1 l  $\text{H}_2\text{O}$  at  $15^\circ$  with vapour pressure  $\text{CO}_2$  equal to 1 atm (Treadwell and Reuter, Z anorg 1898, 17 202)

94 4 mg are sol in 1 l of  $\text{CO}_2$ -free water (Gothe, Ch Z 1915, 39 306)

Solubility in  $\text{H}_2\text{O}$  in equilibrium with  $\text{Mg}(\text{HCO}_3)_2$  and  $\text{CO}_2$

System  $\text{MgCO}_3, \text{Mg}(\text{HCO}_3)_2$  and  $\text{CO}_2$  at  $30^\circ \text{C}$

Total Mg (grams per liter)	Mg as $\text{MgCO}_3$ (grams per liter)	Mg as $\text{Mg}(\text{HCO}_3)_2$ (grams per liter)
0 02410	0 01205	0 01205
0 13135	0 06820	0 06314
0 16087	0 08676	0 07411

Solubility in  $\text{H}_2\text{O}$  in equilibrium with  $\text{Mg}(\text{HCO}_3)_2$  and  $\text{CO}_2$ —*Continued*

System  $\text{MgCO}_3, \text{Mg}(\text{HCO}_3)_2$  and  $\text{CO}_2$  at  $30^\circ \text{C}$

Total Mg (gram atoms per liter)	Mg as $\text{MgCO}_3$ Per cent	Mg as $\text{Mg}(\text{HCO}_3)_2$ Per cent
0 00100	50 00	50 00
0 00545	51 92	48 08
0 00667	53 93	46 07

Total salts in solution Grams per liter	$\text{MgCO}_3$		$\text{Mg}(\text{HCO}_3)_2$	
	Grams per liter	Per cent	Grams per liter	Per cent
0 1144	0 0418	36 5	0 0726	63 5
0 6174	0 2368	38 2	0 3806	61 7
0 7479	0 3012	40 3	0 4467	59 7

In a solution near the saturation point and in equilibrium with atmospheric air upwards of 50 per cent of the magnesium is in the form of the normal carbonate When the solution is brought in contact with the solid phase, the proportion of the base combined as normal carbonate falls to about 34 per cent, or lower (Cameron and Briggs, J phys Chem 1901, 5 552-3)

For solubility in  $\text{H}_2\text{CO}_3 + \text{Aq}$ , see *Magnesium hydrogen carbonate*

Scarcely acted upon by  $\text{HCl} + \text{Aq}$  (Senarmont)

The solubility of  $\text{MgCO}_3$  in  $\text{NaCl} + \text{Aq}$  when in contact with ordinary air increases with increasing concentration of  $\text{NaCl}$  up to a maximum, and then decreases (Cameron and Seidell, J phys Chem 1903, 7 579)

Solubility of  $\text{MgCO}_3$  in salts +  $\text{Aq}$  in equilibrium with an atmosphere free from  $\text{CO}_2$

$\text{NaCl} + \text{Aq}, t = 23^\circ$

Weight of liter of solution	Grams $\text{NaCl}$ per liter	Grams $\text{MgCO}_3$ per liter	Reacting weights $\text{NaCl}$ per liter	Reacting weights $\text{MgCO}_3$ per liter
996 92	0 0	0 176	0 000	0 00210
1016 82	28 0	0 418	0 482	0 00500
1041 09	59 5	0 527	1 025	0 00630
1070 50	106 3	0 585	1 831	0 00699
1094 53	147 4	0 544	2 539	0 00650
1142 48	231 1	0 460	3 981	0 00550
1170 14	272 9	0 393	4 701	0 00470
1199 28	331 4	0 293	5 709	0 00350

(Cameron and Seidell, J phys Chem 1903, 7 585)

Solubility of  $\text{MgCO}_3$  in salts + Aq—*Continued* $\text{Na}_2\text{SO}_4 + \text{Aq}$ ,  $t = 24^\circ$ 

Weight of liter of solution	Grams $\text{Na}_2\text{SO}_4$ per liter	Grams $\text{MgCO}_3$ per liter	Reacting wts $\text{Na}_2\text{SO}_4$ per liter	Reacting wts $\text{MgCO}_3$ per liter
997 52	0 00	0 216	0 000	0 00258
1021 24	25 12	0 586	0 178	0 00700
1047 60	54 76	0 828	0 388	0 00990
1080 95	95 68	1 020	0 678	0 01219
1133 85	160 80	1 230	1 140	0 01470
1157 34	191 90	1 280	1 360	0 01530
1206 03	254 60	1 338	1 804	0 01600
1223 91	278 50	1 338	1 973	0 01600
1241 99	305 10	1 388	2 162	0 01660

 $t = 35.5^\circ$ 

Weight of liter of solution	Grams $\text{Na}_2\text{SO}_4$ per liter	Grams $\text{MgCO}_3$ per liter	Reacting weights $\text{Na}_2\text{SO}_4$ per liter	Reacting weights $\text{MgCO}_3$ per liter
995 15	0 32	0 131	0 000	0 00156
1032 89	41 84	0 577	0 296	0 00689
1067 23	81 84	0 753	0 579	0 00900
1094 77	116 56	0 904	0 826	0 01080
1120 38	148 56	0 962	1 052	0 01149
1151 70	186 70	1 047	1 323	0 01251
1179 82	224 00	1 088	1 587	0 01300
1196 32	249 20	1 100	1 751	0 01314
1236 52	197 20	1 130	2 120	0 01350

(Cameron and Seidell)

 $\text{Na}_2\text{CO}_3 + \text{Aq}$ ,  $t = 25^\circ$ 

Weight of liter of solution	Grams $\text{Na}_2\text{CO}_3$ per liter	Grams $\text{MgCO}_3$ per liter	Reacting weights $\text{Na}_2\text{CO}_3$ per liter	Reacting weights $\text{MgCO}_3$ per liter
996 84	0 00	0 223	0 000	0 00266
1019 89	23 12	0 288	0 220	0 00344
1047 72	50 75	0 510	0 482	0 00620
1082 47	86 42	0 879	0 820	0 01027
1118 91	127 30	1 314	1 209	0 01570
1147 66	160 80	1 636	1 526	0 01955
1166 05	181 90	1 972	1 727	0 02357
1189 38	213 20	2 317	2 024	0 02770

(Cameron and Seidell)

## Solubility in salts + Aq

g salt added per litre	mg $\text{MgCO}_3$ dissolved per litre
0 0	94 4
0 585 g $\text{NaCl}$	128 3
1 17 g "	134 4
2 93 g "	120 95
0 85 g $\text{NaNO}_3$	122 85
1 70 g "	138 80
4 25 g "	137 20

Solubility in salts + Aq—*Continued*

g salt added per litre	mg $\text{MgCO}_3$ dissolved per litre
0 805 g $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$	145 05
1 61 g "	162 05
4 03 g "	150 75
0 53 g $\text{Na}_2\text{CO}_3$	98 6
1 06 g "	53 5
2 65 g "	15 7
0 51 g $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$	47 0
1 02 g "	39 5
2 55 g "	35 3

The solubility of  $\text{MgCO}_3$  in  $\text{CO}_2$ -free water is increased by the addition of  $\text{NaCl}$ ,  $\text{NaNO}_3$ , or  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  but decreased by the addition of  $\text{Na}_2\text{CO}_3$  or  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$

(Gothe, Ch Z 1915, 39 306)

Insol in liquid  $\text{NH}_3$  (Franklin, Arr Ch J 1898, 20 828)

Insol in acetone (Naumann, B 304, 37 4329)

Insol in acetone and in methylal (Naumann, C C 1899, II 1014)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3601)

Min *Magnesite* Very sl attacked by warm conc  $\text{HCl} + \text{Aq}$  100 pts  $\text{H}_2\text{O}$  dissolve 0 0027 pt, calculated as  $\text{MgO}$  (Lubavinsky, J Russ Soc 24 3 1911)

Solution in  $\text{H}_2\text{O}$  contains 0 018 g  $\text{MgCO}_3$  and 0 065 g  $\text{CO}_2$  per l at  $20^\circ$  (Wells, J Am Chem Soc 1915, 37 1705)

Solution in  $\text{H}_2\text{O}$  containing 27 2 g  $\text{CaCl}_2$  per l contains 0 028 g  $\text{Mg}$  and 0 086 g  $\text{CO}_2$  per l at  $20^\circ$  (Wells, J Am Chem Soc 1915, 37 1705)

+  $\text{H}_2\text{O}$   
+  $2\text{H}_2\text{O}$  Decomp by suspension in  $\text{H}_2\text{O}$  into basic salt (Engel, C R 100 911)

+  $3\text{H}_2\text{O}$  Small quantities of this salt are wholly dissolved by much  $\text{H}_2\text{O}$  (Biney, J Chem Soc 1891, 121 122)

The solution contains in 100 pts at—

$0^\circ$  6 5° 8° 16°  
0 15 0 153 0 155 0 179 pts  $\text{MgCO}_3 + \text{H}_2\text{O}$  (Nørgaard, 1850)

Decomp by boiling  $\text{H}_2\text{O}$  into a basic salt and  $\text{CO}_2$  100 pts  $\text{H}_2\text{O}$  dissolve 0 1518 pt at  $19^\circ$  (Fritzsch, Pogg 37 304)

Sol in 48 pts  $\text{H}_2\text{O}$ , and decomp by large amt (Fourcroy)

100 pts  $\text{H}_2\text{O}$  dissolve 0 1518 pt at  $1^\circ$ , or sol in 658 pts  $\text{H}_2\text{O}$  at  $19^\circ$  (Beckurts, J B 1881 212)

100 pts  $\text{H}_2\text{O}$  dissolve 0 0812 pt, calculated as  $\text{MgO}$  (Lubavinsky, J Russ Soc 24 3 1911)

Solution in  $\text{H}_2\text{O}$  contains 0 36 g  $\text{Mg}$  and 1 01 g  $\text{CO}_2$  per l at  $20^\circ$  (Wells, J Am Chem Soc 1915, 37 1707)

Solubility in  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  has been determined at  $20^\circ$ ,  $25^\circ$ ,  $30^\circ$ ,  $34^\circ$  and

at  $\text{CO}_2$  pressures corresponding with 0.5 to 30.3%  $\text{CO}_2$  in the gas phase (Leather and Sen, Chem Soc 1915, 108 (2) 13)

Easily sol in acids even when dil

Not decomp by 1 pt  $\text{H}_2\text{SO}_4 + 6$  pts alcohol, or by alcoholic solutions of glacial acetic, racemic, or tartaric acids, but is slowly decomp by alcoholic solution of citric acid, or  $\text{HNO}_3 + \text{abs}$  alcohol (Butin, 1827)

100 pts  $\text{NaCl} + \text{Aq}$  (2.525%) dissolve 0.1250 ppt, calculated as  $\text{MgO}$  (Lubavin)

1%  $\text{Na}_2\text{CO}_3 + \text{Aq}$ , when mixed with 1%  $\text{MgSO}_4 + \text{Aq}$ , cause no ppt, but 1.5–2% solutions ppt this salt (Brandes, 1825)

More sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  than  $\text{CaCO}_3$  Sol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ , but less easily than in  $\text{NH}_4\text{Cl} + \text{Aq}$

### Solubility in $\text{KHCO}_3 + \text{Aq}$ at $t^\circ$

Values are given in mol/litre

$t^\circ$	K	Mg	Solid phase
15°	0 0	0 0095	$\text{MgCO}_3 + 3\text{H}_2\text{O}$
	0 0992	0 0131	
	0 1943	0 0167	
	0 3992	0 0211	
	0 2681	0 0192	
			labile
	0 5243	0 0097	$\text{MgCO}_3 + 3\text{H}_2\text{O} + \text{MgCO}_3$ $\text{KHCO}_3 + 4\text{H}_2\text{O}$ $\text{MgCO}_3 \cdot \text{KHCO}_3 + 4\text{H}_2\text{O}$
	0 6792	0 0074	
	0 9810	0 0028	
25°	0 0	0 0087	$\text{MgCO}_3 + 3\text{H}_2\text{O}$
	0 0985	0 0115	
	0 2210	0 0149	
	0 3188	0 0175	
	0 3434	0 0181	
	0 4216	0 0205	labile
	0 4985	0 0207	
	0 3906	0 0196	
	0 5893	0 0128	$\text{MgCO}_3 + 3\text{H}_2\text{O} + \text{MgCO}_3$ $\text{KHCO}_3 + 4\text{H}_2\text{O}$ $\text{MgCO}_3 \cdot \text{KHCO}_3 + 4\text{H}_2\text{O}$
	0 6406	0 0117	
	0 788	0 0089	
	1 125	0 0061	
35°	0 0	0 0071	$\text{MgCO}_3 + 3\text{H}_2\text{O}$
	0 1092	0 0098	
	0 2001	0 0132(?)	
	0 2811	0 0142	
	0 3704	0 016	
	0 4847	0 0177	labile
	0 5867	0 0195	
	0 5088	0 0154	
	0 6231	0 0153	$\text{MgCO}_3 + 3\text{H}_2\text{O} + \text{MgCO}_3$ $\text{KHCO}_3 + 4\text{H}_2\text{O}$ $\text{MgCO}_3 \cdot \text{KHCO}_3 + 4\text{H}_2\text{O}$
	0 8435	0 0119	

The experiments were performed in such a way as to prevent, as far as possible, loss of  $\text{CO}$  from the solutions

(Auerbach, Z Elektrochem 1904, 10 164)

11  $\text{H}_2\text{O}$ , containing 6%  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  and

a little  $\text{NaCl}$ , dissolves 5 g  $\text{MgCO}_3$  (Hunt, Sil Am J (2) 42 49)

More sol in cold alkali borates +  $\text{Aq}$  than in hot (Wittstein)

Sol in  $\text{Na citrate} + \text{Aq}$

+  $4\text{H}_2\text{O}$  Efflorescent

+  $5\text{H}_2\text{O}$  Two modifications

$\alpha$  Plates Sol in 600 pts  $\text{H}_2\text{O}$  at  $0-7^\circ$ , solution gradually separates out  $\text{MgCO}_3 + 2\text{H}_2\text{O}$   $\text{H}_2\text{CO}_3 + \text{Aq}$  sat at 3–4 atmos pressure dissolves 9% at  $0-4^\circ$   $\text{MgSO}_4 + \text{Aq}$  dissolves 4% moist salt at 3–4°, and it is easily sol in  $\text{Na}_2\text{CO}_3$ , or  $\text{NaHCO}_3 + \text{Aq}$  (Norgaard)

$\beta$  Prisms More efflorescent than  $\alpha$  Sol in 600 pts  $\text{H}_2\text{O}$  but not in  $\text{MgSO}_4$ , or  $\text{Na}_2\text{CO}_3 + \text{Aq}$  Both forms are decomp by boiling  $\text{H}_2\text{O}$  (Norgaard)

### Magnesium hydrogen carbonate,

$\text{MgH}_2(\text{CO}_3)_2(?)$

Known only in solution

1 l  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat at 1 atmos pressure dissolves 23.5 g  $\text{MgCO}_3$  (Bineau)

1 l carbonic acid water dissolves 0.115 g magnesite at  $18^\circ$  and 0.75 m pressure (Cossa, B 2 697)

1 pt  $\text{MgCO}_3$  dissolves in  $\text{H}_2\text{O}$  saturated with  $\text{CO}_2$  at  $5^\circ$  and a pressure of—

1 2 3 4 5 6 atmospheres  
in 161 144 134 100 7 110 76 pts  $\text{H}_2\text{O}$

(Merkel, Techn J B 1867 213)

$\text{H}_2\text{CO}_3 + \text{Aq}$  sat at 3–4 atmos pressure and  $0-4^\circ$  dissolved 9%  $\text{MgCO}_3 + 5\text{H}_2\text{O}$  (Norgaard)

$\text{MgCO}_3 + 3\text{H}_2\text{O}$  is sol in 72.4 pts  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat at  $20^\circ$  and ord pressure, 30.5 pts  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat at 2 atmos pressure, 26.0 pts  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat at 3 atmos pressure, 21.1 pts  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat at 4 atmos pressure, 17.09 pts  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat at 5 atmos pressure (Beckurts, J B 1881 212)

1  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  at p pressure and  $t^\circ$  dissolves g  $\text{MgCO}_3$

p atmos	t	$\text{MgCO}_3$	p mm	$t^\circ$	$\text{MgCO}_3$
1 0	19 5	27 79	751	13 4	28 45
2 1	19 5	33 11	760	19 5	25 79
3 2	19 7	37 3	762	29 3	21 95
4 7	19 0	43 5	764	46	15 7
5 6	19 2	46 2	764	62	10 4
6 2	19 2	48 51	765	70	8 1
7 5	19 5	51 2	765	82	4 9
9 0	18 7	56 5	765	91	2 4
			765	100	0 0

(Engel and Ville, C R 93 34)

The low figures of other observers are due to their using basic carbonates By very careful experiments it was found that 1 l  $\text{H}_2\text{O}$



sat with  $\text{CO}_2$  at 1 atmos pressure and  $t^\circ$  dissolved the following amts of  $\text{MgCO}_3$

$t^\circ$	$\text{MgCO}_3$	$t^\circ$	$\text{MgCO}_3$	$t^\circ$	$\text{MgCO}_3$
3 5	35 6	18	22 1	40	22 1
12	26 5	30	15 8	50	9 5

(Engel, C R 100 444)

1 9540 g are sol 1 l  $\text{H}_2\text{O}$  at  $15^\circ$  (Treadwell and Reuter, Z anorg 1898, 17 202)

$\text{MgH}_2(\text{CO}_3)_2$  is not stable except in the presence of free  $\text{CO}_2$

At  $15^\circ$  and 760 mm, a solution having the partial pressure of  $\text{CO}_2=0$ , contains 1 9540 g  $\text{MgH}_2(\text{CO}_3)_2$  and 0 7156 g  $\text{MgCO}_3$  per liter (Treadwell and Reuter, Z anorg 1898, 17 204)

Solubility of  $\text{MgH}_2(\text{CO}_3)_2$  in  $\text{H}_2\text{O}$  containing carbonic acid, at  $15^\circ$

% carbonic acid in the gas at $0^\circ$ and 760 mm	partial pressure mm Hg	mg free $\text{CO}_2$	mg $\text{MgH}_2(\text{CO}_3)_2$ in 100 cc of the solution	mg $\text{MgCO}_3$ in 100 cc of the solution	mg Mg
18 86	143 3	119 0	1210 5		201 6
5 47	41 6	86 6	1210 5		201 6
4 45	33 8	223 5	1210 5		201 6
1 54	11 7		1076 6	77 3	201 6
1 35	10 3		762 9	76 5	149 2
1 07	8 2		595 2	80 7	122 4
0 62	4 7		366 3	70 1	86 5
0 60	4 6		341 7	75 8	78 8
0 33	2 5		263 2	74 8	65 5
0 21	1 6		222 9	77 1	59 4
0 14	1 1		216 9	71 0	56 6
0 03	0 3		203 6	71 1	54 5
			203 3	68 5	53 6
			196 0	70 2	52 9
			203 6	62 5	52 0
			195 4	61 6	51 1
			195 4	64 1	51 8

(Treadwell and Reuter, Z anorg 1898, 17 200)

No bicarbonate of magnesium is formed under pressures of  $\text{CO}_2$  up to five atmospheres at  $0^\circ$  (Cameron, J phys Chem 1908, 12 570)

A critical analysis and recalculation of results of Engel and others is given by Johnston (J Am Chem Soc 1915, 37 2001)

Solubility in  $\text{NaCl}+\text{Aq}$  at  $23^\circ\text{C}$  in equilibrium with an atmosphere of  $\text{CO}_2$

g NaCl per liter	g $\text{Mg}(\text{HCO}_3)_2$ per liter
7 0	30 64
56 5	30 18
119 7	27 88
163 9	24 96
224 8	20 78
306 6	10 75

(Cameron and Seidell, J phys Chem 1903, 7 582)

Solubility in  $\text{Na}_2\text{SO}_4+\text{Aq}$  at  $23^\circ\text{C}$  in equilibrium with an atmosphere of  $\text{CO}_2$

Strength of $\text{Na}_2\text{SO}_4+\text{Aq}$	g $\text{Mg}(\text{HCO}_3)_2$ in 100 m
0 0	1 463
12%	1 916
saturated	1 612

(Cameron and Seidell)

**Magnesium potassium carbonate,**  
 $\text{MgK}_2(\text{CO}_3)_2+4\text{H}_2\text{O}$

Quickly decomp by cold  $\text{H}_2\text{O}$  (De lle, A ch (3) 33 87)

Ppt Decomp by  $\text{H}_2\text{O}$  (Reynolds, C m Soc 1898, 73, 264)

$\text{MgKH}(\text{CO}_3)_2+4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  but decomp thereby into an insol basic Mg carbonate, and  $\text{MgH}_2(\text{CO}_3)_2$  and  $\text{KHCO}_3$ , which dissolve (Berzelius)

**Magnesium rubidium hydrogen carbonate,**  
 $\text{MgRbH}(\text{CO}_3)_2+4\text{H}_2\text{O}$

Decomp in the air (Erdmann, A 97, 294 75)

**Magnesium sodium carbonate,  $\text{MgCO}_3$**   
 $\text{Na}_2\text{CO}_3$

Quickly decomp with  $\text{H}_2\text{O}$  (Dewill, A ch (3) 33 89)

+15 $\text{H}_2\text{O}$  (Norgaard)

**Magnesium sodium carbonate/sodium chloride,  $\text{MgCO}_3$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{NaCl}$**

Decomp by  $\text{H}_2\text{O}$  (de Schulten, C R 1896, 122 1427)

**Manganous carbonate,  $\text{MnCO}_3$**

Permanent Practically insol in  $\text{H}_2\text{O}$  sol in  $\text{H}_2\text{CO}_3+\text{Aq}$  and in acids generally

1 l  $\text{H}_2\text{O}$  dissolves 0 065 g at  $25^\circ$  (A no and Valla, Att Accad I inc 1911 20, II 6)

Insol in liquid  $\text{NH}_3$  (Franklin, Am J 1898, 20 828)

Insol in ethyl acetate (Naumann B 1910, 43 314)

Min Rhodochrosite

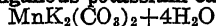
+ $\frac{1}{2}$ , or 1 $\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  So in acids Sol in  $\text{H}_2\text{CO}_3+\text{Aq}$  1 pt  $\text{MnCO}_3$  requires 2000 pts  $\text{H}_2\text{CO}_3+\text{Aq}$  for solution

(Lassaigne) Sol in 7680 pts  $H_2O$ , and 3840 pts  $H_2O$  containing  $CO_2$  (Jahn) When freshly precipitated is sol in  $NH_4$  salts + Aq (Wittstein) Not more sol in  $H_2O$  containing  $Na_2CO_3$  or  $K_2CO_3$  than in pure  $H_2O$  (Ebelmen) Insol in  $NH_4Cl$ , or  $NH_4NO_3$  + Aq (Brett)

Sol in ferric salts + Aq, with evolution of  $CO_2$  and pptn of  $Fe_2C_6H_5$  (Fuchs)

Not pptd in presence of Na citrate (Spiller)

#### Manganous potassium carbonate,



Ppt Decomp by  $H_2O$  alone

Sl sol in  $Mn(C_2H_3O_2)_2$  + Aq or  $K_2CO_3$  + Aq (Reynolds, Chem Soc 1898, 73 264)

#### Manganous carbonate hydroxylamine,



Ppt Sol in acids (Goldschmidt and Syngros, Z anorg 5 138)

#### Mercurous carbonate, $Hg_2CO_3$

Ppt Decomp by hot  $H_2O$  Sol in hot or warm  $NH_4Cl$  + Aq, but less easily than mercuric carbonate, less sol in  $NH_4NO_3$  + Aq (Brett, 1837)

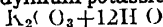
Sl sol in  $K_2CO_3$  + Aq, partially sol with decomp in  $NH_4OH$  + Aq (Wittstein)

#### Mercuric carbonate, basic, $4HgO, CO$

Can be washed with cold  $H_2O$  without decomp (Millon, A ch (3) 19 368)

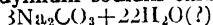
$3HgO, CO_2$  Insol in cold  $H_2O$  Sol in  $CO_2$  + Aq, sl sol in  $K_2CO_3$  + Aq Easily sol in  $NH_4Cl$  + Aq (Berzelius)

#### Neodymium potassium carbonate, $Nd_2(CO_3)_3,$



Ppt Sol in 30%  $K_2CO_3$  + Aq (Meyer, Z anorg 1904, 41 105)

#### Neodymium sodium carbonate, $2Nd_2(CO_3)_3,$



Ppt Easily decomp

Sl sol in conc  $Na_2CO_3$  + Aq (Meyer, Z anorg 1904, 41 106)

#### Nickel carbonate, basic, $3NiO, CO_2 + 5H_2O$

Min Zarautic Easily sol in  $HCl$  + Aq

Pptd nickel carbonate is a basic salt of varying composition Insol in  $H_2O$  or  $H_2CO_3$  + Aq Sol in acids Sol in  $(NH_4)_2CO_3$  + Aq,

very sl sol in  $Na_2CO_3$  + Aq, sol in warm  $NH_4Cl$  + Aq, and  $KCN$  + Aq (Rose)

Not pptd in presence of Na citrate (Spiller)

#### Nickel carbonate, $NiCO_3$

1 l  $H_2O$  dissolves 0.0925 g at 25% (Agno and Valla, Att Accad Linc 1911, 20, II 706)

Not attacked by cold conc  $HCl$ , or  $HNO_3$  + Aq (Senarmont, A ch (3) 30 138)

+  $6H_2O$  Sol in acids (Deville, A ch (3) 35 446)

See also Carbonate, nickel, basic

#### Nickel potassium carbonate, $NiCO_3, K_2CO_3 + 4H_2O$

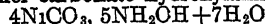
Ppt (Deville, A ch (3) 33 96)

$NiCO_3, KHCO_3 + 4H_2O$  Decomp by  $H_2O$ , but may be washed by  $KHCO_3$  + Aq without decomp (Rose, Pogg 84 566)

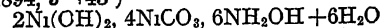
#### Nickel sodium carbonate, $NiCO_3, Na_2CO_3 + 10H_2O$

Ppt (Deville)

#### Nickel carbonate hydroxylamine, $2Ni(OH)_2,$



Ppt (Goldschmidt and Syngros, Z anorg 1894, 5 143)



Ppt (Goldschmidt and Syngros)

#### Palladium carbonate, $PdCO_3, 9PdO + 10H_2O$

Insol in  $H_2O$ , partly sol in  $NH_4OH$  + Aq, sl sol in  $Na_2CO_3$  + Aq, sol in acids (Kane, 1842)

#### Potassium carbonate, $K_2CO_3$

Deliquescent Verv sol in  $H_2O$  with evolution of heat

Sol in 1.05 pts  $H_2O$  at 3 0.962 pt at 6 0.900 pt at 12.6 0.747 pt at 26 and 0.490 pt at 70 (Osann)

Sol in 0.92 pt  $H_2O$  (M R and P)

Sol in 0.922 pt  $H_2O$  at 15 (Gerlach)

Sol in 1 pt  $H_2O$  (Ahl)

100 pts  $H_2O$  at 15 dissolves 100 pts  $K_2CO_3$  (Ure's Dict)

Solubility in 100 pts  $H_2O$  at  $t^\circ$

$t^\circ$	100 pts $K_2CO_3$	t	100 pts $K_2CO_3$	t	100 pts $K_2CO_3$
0	83 12	40	106 20	80	134 25
10	88 72	50	112 90	90	143 18
20	94 06	60	119 24	100	153 66
30	100 09	70	127 16	135	205 11

(Poggiale, A ch (3) 8 468)

Solubility in 100 pts  $H_2O$  at  $t^\circ$ 

$t^\circ$	Pts K CO <sub>3</sub>	$t^\circ$	Pts K CO <sub>3</sub>	$t^\circ$	Pts K CO <sub>3</sub>
0	89.4	46	119	91	148
1	94	47	120	92	149
2	97	48	120	93	150
3	100	49	121	94	151
4	102	50	121	95	151
5	104	51	122	96	152
6	105	52	122	97	153
7	106	53	123	98	154
8	107	54	124	99	155
9	108	55	124	100	156
10	109	56	125	101	157
11	109	57	125	102	158
12	109	58	126	103	159
13	110	59	127	104	160
14	110	60	127	105	161
15	110	61	128	106	162
16	111	62	128	107	163
17	111	63	129	108	164
18	111	64	130	109	166
19	111	65	130	110	167
20	112	66	131	111	168
21	112	67	132	112	169
22	112	68	132	113	171
23	112	69	133	114	172
24	112	70	133	115	173
25	113	71	134	116	175
26	113	72	135	117	176
27	113	73	135	118	178
28	113	74	136	119	179
29	114	75	137	120	181
30	114	76	137	121	182
31	114	77	138	122	184
32	114	78	139	123	185
33	115	79	139	124	187
34	115	80	140	125	188
35	115	81	141	126	190
36	115	82	141	127	191
37	116	83	142	128	193
38	116	84	143	129	195
39	116	85	144	130	196
40	117	86	144	131	198
41	117	87	145	132	200
42	117	88	146	133	201
43	118	89	147	134	203
44	118	90	147	135	205
45	119				

(Mulder, Scheik Verhandel 1864 97)

112 g are sol in 100 g  $H_2O$  at  $20^\circ$  (Frankforter, J Am Chem Soc 1914, 36 1106)Sp gr of K CO<sub>3</sub> + Aq at 15

% K CO <sub>3</sub>	Sp gr	% K CO <sub>3</sub>	Sp gr
0.489	1.0048	11.748	1.1282
0.979	1.0098	12.727	1.1400
1.958	1.0108	13.706	1.1520
2.934	1.0299	14.685	1.1642
3.916	1.0401	15.664	1.1766
4.895	1.0505	16.643	1.1892
5.874	1.0611	17.622	1.2020
6.853	1.0719	18.601	1.2150
7.832	1.0829	19.580	1.2282
8.811	1.0940	20.559	1.2417
9.790	1.1052	21.538	1.2554
10.769	1.1166	22.517	1.2694

Sp gr of K<sub>2</sub>CO<sub>3</sub> + Aq at  $15^\circ$ —Continued

% K CO <sub>3</sub>	Sp gr	% K CO <sub>3</sub>	Sp
23.496	1.2836	33.286	1.410
24.475	1.2980	34.265	1.430
25.454	1.3078	35.244	1.447
26.432	1.3177	36.223	1.467
27.412	1.3277	37.202	1.484
28.391	1.3378	38.181	1.494
29.360	1.3480	39.160	1.496
30.349	1.3585	40.139	1.490
31.328	1.3692	40.504	1.412
32.807	1.3803		

(Tünnerman)

Sp gr and boiling point of K<sub>2</sub>CO<sub>3</sub> + Aq

% K <sub>2</sub> CO <sub>3</sub>	Sp gr	B pt	% K <sub>2</sub> CO <sub>3</sub>	Sp gr	B
4.7	1.06	100.56°	43.3	1.46	109.4°
9.0	1.11	100.56	45.8	1.50	111.1
13.2	1.15	101.11	48.1	1.54	112.5
16.8	1.19	101.11	52.1	1.58	114.4
20.5	1.22	101.66	56.0	1.63	116.1
24.0	1.25	102.22	60.4	1.70	117.5
27.3	1.28	102.78	65.5	1.80	119.4
30.5	1.31	103.33	71.8	1.95	122.7
33.6	1.34	104.44	79.2	2.15	125.5
36.2	1.38	105.56	84.4	2.40	129.1
39.0	1.41	107.22	100.0	2.60	137.5
41.7	1.44	108.33			

(Dalton)

Sp gr of K<sub>2</sub>CO<sub>3</sub> + Aq at  $17.5^\circ$ 

% K CO <sub>3</sub>	Sp gr	% K CO <sub>3</sub>	Sp gr	% K CO <sub>3</sub>	Sp
1	1.009	19	1.182	36	1.33
2	1.018	20	1.192	37	1.33
3	1.027	21	1.203	38	1.33
4	1.036	22	1.213	39	1.40
5	1.045	23	1.224	40	1.40
6	1.054	24	1.235	41	1.40
7	1.064	25	1.245	42	1.40
8	1.073	26	1.256	43	1.40
9	1.082	27	1.267	44	1.40
10	1.092	28	1.278	45	1.40
11	1.102	29	1.289	46	1.45
12	1.112	30	1.300	47	1.50
13	1.122	31	1.312	48	1.51
14	1.132	32	1.323	49	0.5
15	1.141	33	1.334	50	1.54
16	1.151	34	1.345	51	1.55
17	1.161	35	1.357	52	1.56
18	1.172				

(Hager, Comm 1883)

The sp. gr. increases or diminishes between  $8^\circ$  and  $20^\circ$  by a decrease or increase of temperature of  $1^\circ$  by the following amounts—

% K CO <sub>3</sub>	Corr
40-50	0.0007
30-40	0.0005
20-30	0.0003
10-20	0.0002

(Hager)

Sp gr of  $K_2CO_3 + Aq$  at  $15^\circ$ 

% $K_2CO_3$	Sp gr	% $K_2CO_3$	Sp gr
1	1 00914	28	1 27893
2	1 01829	29	1 28999
3	1 02743	30	1 30105
4	1 03658	31	1 31261
5	1 04572	32	1 32417
6	1 05513	33	1 33573
7	1 06354	34	1 34729
8	1 07396	35	1 35885
9	1 08337	36	1 37082
10	1 09278	37	1 38279
11	1 10258	38	1 39476
12	1 11238	39	1 40673
13	1 12219	40	1 41870
14	1 13199	41	1 43104
15	1 14179	42	1 44388
16	1 15200	43	1 44573
17	1 16222	44	1 46807
18	1 17243	45	1 48041
19	1 18265	46	1 49314
20	1 19286	47	1 50588
21	1 20344	48	1 51861
22	1 21402	49	1 53135
23	1 22459	50	1 54408
24	1 23517	51	1 55728
25	1 24575	52	1 57048
26	1 25681	52 024	1 57079
27	1 26787		

(Gerlach, Z anal 8 279)

Sp gr of  $K_2CO_3 + Aq$  at  $15^\circ$ 

K CO	Sp gr	K CO	Sp gr
5	1 0419	30	1 3002
10	1 0919	40	1 4170
20	1 1920	50	1 5428

(Kohlrausch, W Ann 1879 1)

 $K_2CO_3 + Aq$  containing 10%  $K_2CO_3$  boils at  $100.5^\circ$  $K_2CO_3 + Aq$  containing 20%  $K_2CO_3$  boils at  $102.2^\circ$  $K_2CO_3 + Aq$  containing 30%  $K_2CO_3$  boils at  $104.1^\circ$  $K_2CO_3 + Aq$  containing 40%  $K_2CO_3$  boils at  $108.6^\circ$  $K_2CO_3 + Aq$  containing 50%  $K_2CO_3$  boils at  $115.2^\circ$ 

(Gerlach)

Sat  $K_2CO_3 + Aq$  containing 158 pts  $K_2CO_3$  to 100 pts  $H_2O$  forms a crust at  $126^\circ$ , highest temp observed 149 (Gerlach, Z anal 26 427)B-pt of  $K_2CO_3 + Aq$  containing pts  $K_2CO_3$  to 100 pts  $H_2O$  G=according to Gerlach (Z anal 26 459), L=according to Legrand (A ch (2) 59 438)

B pt	G	L
101°	11 5	13
102	22 5	22 5
103	32	31
104	40	38 8
105	47 5	46 1
106	54 5	53 1
107	61	59 6
108	67	65 9
109	73	71 9
110	78 5	77 6
111	83 5	83 0
112	88 5	88 2
113	93 5	93 2
114	98 5	98 0
115	103 5	102 8
116	108 5	107 5
117	113 5	112 3
118	117 5	117 1
119	122 5	122 0
120	127 5	127 0
121	132 5	132 0
122	137 5	137 0
123	142 5	142 0
124	147 5	147 1
125	152 5	152 2
126	158	157 3
127	163 5	162 5
128	169 5	167 7
129	175 5	172 9
130	181 5	178 1
131	187 5	183 4
132	193 5	188 8
133	199 5	194 2
133 3	202 5	
134		199 6
135		205 0

When  $K_2CO_3 + Aq$  is sat with  $NH_3$ , two layers form. When  $K_2CO_3$  is added to  $NH_4OH + Aq$ , it dissolves with formation of two layers and evolution of  $NH_3$ . The same takes place also when sat  $K_2CO_3 + Aq$  and  $NH_4OH + Aq$  are brought together (Girard, Bull Soc (2) 43 552)Solubility of  $K_2CO_3 + KHCO_3$  in  $H_2O$  at  $0^\circ$ 

K per 100 cc solution		Sp gr
$K_2CO_3$	$KHCO_3$	
0 0	21 2	1 133
11 8	15 3	1 182
16 7	12 6	1 200
23 5	10 3	1 241
34 0	7 6	1 298
43 0	5 9	1 350
51 6	4 9	1 398
60 5	3 8	1 448
81 4	0 0	1 542

(Engel A ch 1888, (6) 13 348)

Equilibrium between  $K_2CO_3$  and  $KHCO_3$  in  $H_2O$  and in contact with the air System  $K_2CO_3$ ,  $KHCO_3$ , and  $CO_2$  at  $25^\circ C$

Grams atoms K per liter	Amount of solution used for titration cc	Amount K combined as $K_2CO_3$ Per cent	Amount K combined as $KHCO_3$ Per cent
0 393	5 5	77 5	22 5
0 553	2 5	83 9	16 1
1 025	2 2	86 8	13 2
1 865	2 2	91 4	8 6
2 820	2 2	89 0	11 0
3 710	2 2	88 6	11 4
4 310	1 1	89 6	10 4
5 695	1 1	88 7	11 3

(Cameron and Briggs, J phys Chem 1901, 5 546)

Solubility of  $K_2CO_3 + Na_2CO_3$  in  $H_2O$  at  $25^\circ$

g per 100 g solution		g per 100 g H O		Solid phase
$K_2CO_3$	$Na_2CO_3$	$K_2CO_3$	$Na_2CO_3$	
52 82	0	112	0	$K_2CO_3 \cdot 2H_2O$
52 0	1 0	110 7	2 2	
50 7	2 6	108 7	7 7	
49 0	4 6	107 5	10 0	
46 5	4 3	94 6	8 8	$K_2CO_3 \cdot 2H_2O + Na_2CO_3 \cdot 12H_2O$
46 2	5 2	94 8	10 6	
41 0	6 3	77 6	11 8	
37 7	7 0	68 3	12 6	
31 0	10 5	53 0	17 9	$Na_2CO_3 \cdot K_2CO_3 \cdot 12H_2O$
29 8	11 3	50 7	19 1	
27 2	14 1	41 4	23 2	
22 4	16 6	36 8	27 3	
19 8	18 7	32 1	30 3	$Na_2CO_3 \cdot K_2CO_3 \cdot 12H_2O + Na_2CO_3 \cdot 10H_2O$
19 1	19 7	31 2	32 1	
15 1	23 2	24 7	37 6	
14 5	22 8	23 1	36 4	
10 8	22 7	16 2	31 0	$Na_2CO_3 \cdot K_2CO_3$
10 7	22 4	16 0	33 3	
4 7	21 9	6 1	29 8	
0	22 71	0	29 37	

(Osaka, J Ind Chem Soc 1911, 32 870)

Solubility of  $K_2CO_3 + Na_2CO_3$  in  $H_2O$  at  $24^\circ$

In 1000 ccm H O		Solid phase
$Na_2CO_3$	$K_2CO_3$	
28 35		$Na_2CO_3$
354 2	150 03	"
369 7	226 6	"
363 0	243 5	$Na_2CO_3, K_2CO_3 \cdot 6H_2O$
330 8	282 7	"
273 8	344 9	"
187 2	483 9	"
130 0	921 5	"
137 9	982 6	"
112 3	1074 0	$Na_2CO_3, K_2CO_3 \cdot 6H_2O + Na_2CO_3$
95 2	1085 1	"
25 5	1108 6	$K_2CO_3$
	1125 7	"

(Kremann and Zitek, M 1909, 30 3 7)

Solubility of  $K_2CO_3 + Na_2CO_3$  in  $H_2O$  at  $10^\circ$

In 1000 ccm H O		Solid phase
$Na_2CO_3$	$K_2CO_3$	
119 8		$Na_2CO_3$
176 4	354 1	"
108	500 1	"
61 19	0052 9	$Na_2CO_3, K_2CO_3$
	1084 0	$K_2CO_3$

(Kremann and Zitek, M 1909, 30 3 1)

Solubility of  $K_2CO_3 + KNO_3$  in  $H_2O$  at  $52^\circ$

1 l of the solution contains	
Mol $K_2CO_3$	Mol $KNO_3$
0 00	3 217
0 59	2 62
1 35	1 97
2 10	1 46
2 70	1 14
3 58	0 79

(Louden, C R 1900, 131 259)

Solubility of  $K_2CO_3 + KNO_3$  in  $H_2O$  at  $10^\circ$

In 1000 ccm H O		Solid phase
$KNO_3$	$K_2CO_3$	
208 9		$KNO_3$
26 62	1076 0	$KNO_3, K_2CO_3$
	1084 0	$K_2CO_3$

(Kremann and Zitek, M 1909, 30 3 5)

Solubility of  $K_2CO_3 + KNO_3$  in  $H_2O$  at 24°

In 1000 com $H_2O$		Solid phase
$KNO_3$	$K_2CO_3$	
376 85		$KNO_3$
285 00	130 3	"
161 67	348 4	"
141 80	371 9	"
73 04	688 1	"
38 78	878 3	"
31 11	1112 2	$KNO_3, K_2CO_3$

(Kremann and Zitek, M 1909, 30 316)

Solubility of  $K_2CO_3 + KCl$  in  $H_2O$  at 30°

$\% K_2CO_3$	$\% KCl$	Solid phase
53 27	0	$K_2CO_3, 1\frac{1}{2}H_2O$
52 22	1 03	$K_2CO_3, 1\frac{1}{2}H_2O + KCl$
51 66	1 07	$KCl$
* 1 64	26 22	$KCl$
0	28 01	"

\* Author gives intermediary data  
(de Waal, Dissert 1910)Solubility of  $K_2CO_3 + KOH$  in  $H_2O$  at 30°

$\% KOH$	$\% K_2CO_3$	Solid phase
55 75	0	$KOH, 2H_2O$
55 14	2 05	$KOH, 2H_2O + K_2CO_3, 1\frac{1}{2}H_2O$
53 77	2 50	$K_2CO_3, 1\frac{1}{2}H_2O$
* 0	53 27	$K_2CO_3, 1\frac{1}{2}H_2O$

\* Author gives intermediary data  
(de Waal, Dissert 1910)Insol in liquid  $NH_3$  (Franklin, Am Ch J 1898, 20, 828)

Sol in 9 pts alcohol of 17° B Insol in absolute alcohol

Not decomp by 1 pt  $H_2SO_4 + 6$  pts absolute alcohol Not decomp by 1 pt  $HNO_3 + 6$  pts absolute alcohol Not decomp by an alcoholic solution of  $HCl$ , oxalic, racemic, tartaric, or glacial acetic acids, but is decomp by alcoholic solution of citric acidSolubility in methyl alcohol Composition of liquids in equilibrium with solid  $K_2CO_3$  at t°

t	Upper layer			Lower layer		
	$\% K_2CO_3$	$\% CH_3OH$	$\% H_2O$	$\% K_2CO_3$	$\% CH_3OH$	$\% H_2O$
-30	21 7	42 2	36 1			
-20	13 8	52 1	34 1			
20	12 4			44 2	8 2	47 6
0	7 6	66 3	26 1	46 3	6 7	47
0	7 4			46 6	6 6	46 8
+17	6 2	60 6	24 2	48 3	5 7	46
35	5 0	72 0	22 1		4 3	44 7

(de Bruyn, Z phys Ch 1900, 32 63 and ff)

Solubility in ethyl alcohol Composition of liquids in equilibrium with solid  $K_2CO_3$  at t°

t	Upper layer			Lower layer		
	$\% K_2CO_3$	$\% C_2H_5OH$	$\% H_2O$	$\% K_2CO_3$	$\% C_2H_5OH$	$\% H_2O$
-18	0 03	90 3	9 7	51 2	0 2	48 6
0	0 04	91 2	8 1	51 3	0 2	48 5
+17	0 06	91 5	8 4	52 1	0 2	47 7
35	0 07	90 9	9	53 4	0 2	46 4
50	0 09	91 8	8 1	55 3	0 2	44 5
75	0 12	91 4	8 5	57 9	2 0	40 9

(de Bruyn)

## Solubility in ethyl alcohol + Aq at 25°

When  $K_2CO_3$  is dissolved in ethyl alcohol + Aq two layers are formed, the compositions of which are as follows

Upper layer			Lower layer		
$\% alcohol$	$\% H_2O$	$\% K_2CO_3$	$\% alcohol$	$\% H_2O$	$\% K_2CO_3$
81 25	18 61	0 14	0 82	55 42	43 76
71 67	27 91	0 42	1 79	61 61	36 60
56 98	41 55	1 47	4 02	65 73	30 25
53 92	44 13	2 05	4 88	66 87	28 25
50 91	47 94	2 55	5 54	67 06	27 41
4					
3					
28					

(Cuno, W Ann 1909, (4) 28 664)

Solubility of  $K_2CO_3$  in alcohol + Aq at 30°

$\% K_2CO_3$	$\% Alcohol$	$\% H_2O$	Solid phase
53 27	0	46 73	$K_2CO_3, 1\frac{1}{2}H_2O$
53 09	0 1	46 81	"
		*	"
			"
0 13	90 49	9 38	$K_2CO_3, 1\frac{1}{2}H_2O$
			"
			"
0 04	99 92	0 04	$K_2CO_3 + K_2CO_3, 1\frac{1}{2}H_2O$

\* Solution separates into two layers  
(de Waal, Dissert Leiden, 1910)A full discussion of the solubility of  $K_2CO_3$  in methyl, ethyl, propyl, isopropyl, and allyl alcohols is given by Frankforter and Frary (J phys Ch 1913, 17 402), and Frankforter and Temple (J Am Chem Soc 1915, 37 2697)

$K_2CO_3$  will "salt out" acetone from aqueous solution. The table shows the composition of the solutions at the points at which inhomogeneous solutions of  $K_2CO_3$ , acetone and  $H_2O$  just become homogeneous at 20° 100 g of the solution contain

$K_2CO_3$	$H_2O$	acetone	$K_2CO_3$	$H_2O$	acetone
18 84	73 22	7 94	2 43	55 36	42 21
13 32	71 38	15 30	22 29	72 81	4 90
11 83	70 34	17 83	17 86	73 12	9 02
10 13	69 03	20 84	15 81	72 53	11 66
8 24	67 31	24 45	14 39	71 89	13 72
7 22	65 99	26 79	10 29	69 46	20 25
6 04	64 39	29 57	1 91	54 05	44 04
28 87	69 08	2 05	1 76	52 86	45 38
23 94	71 98	4 08	1 60	51 60	46 80
21 52	72 75	5 33	1 29	49 57	49 14
19 60	73 10	7 70	1 08	47 86	51 06
6 46	65 34	28 20	0 94	46 73	52 33
5 91	64 65	29 44	0 75	44 72	54 53
5 60	63 93	30 47	0 66	43 31	56 03
5 04	62 80	32 16	0 60	42 49	56 91
4 50	61 48	34 02	0 54	41 73	57 73
3 80	59 79	36 41	0 50	40 69	58 81
3 18	57 95	38 87	0 46	40 48	60 06
2 73	56 50	40 77			

(Frankforter and Cohen, J Am Chem Soc 1914, **36** 1121)

Insol in benzonitrile (Naumann, B 1914, **47** 1370)

Insol in methyl acetate (Naumann, B 1909, **42** 3790), ethyl acetate (Naumann, B 1910, **34** 314)

Sol in phenol  
Sol in 13.5 pts glycerine of 1.225 sp gr (Vogel, N Rept 16 557)

100 g sat  $K_2CO_3$  + sugar + Aq contains 22.44 g  $K_2CO_3$  and 56 g sugar at 31.25° (Kohler, Z Ver Zuckeind 1897, **47** 447)

+  $H_2O$   
+  $1\frac{1}{2}H_2O$  Very deliquescent (Pohl)  
Deliquescent only in very moist air (Stedeler)

Sol in  $H_2O$  with evolution of heat (Pohl)  
Sol at 17.6° with absorption of heat, at 32° with evolution of heat, and at 25° with neither absorption nor evolution of heat (Berthelot, C R **78** 1722)

Sat solution of  $K_2CO_3 + 1\frac{1}{2}H_2O$  in  $H_2O$  contains 53.27 g anhydrous  $K_2CO_3$  in 100 g solution at 30° (de Wail, Dissert 1910)

+  $2H_2O$  Salt usually given as containing  $1\frac{1}{2}H_2O$  contains  $2H_2O$  (Gerlach, Z anal **26** 460)

Sat solution of  $K_2CO_3 + 2H_2O$  contains 112 g anhydrous  $K_2CO_3$  in 100 g  $H_2O$  at 25° (Osaki, J Tok Ch Soc 1911, **32** 870)

+  $4H_2O$  Not deliquescent in closed vessels (Gerlach, l c)

Potassium hydrogen carbonate,  $KHCO_3$

Not deliquescent

Sol in 3.5 pts  $H_2O$  at 15° (Redwood) Sol in 4 pts  $H_2O$  at moderate temperatures (Bergmann in 0.8333 pt boiling  $H_2O$  (Pelletier) in 4 pts col 1.2 pts boiling  $H_2O$  (M R and P s Pharm) 4 pts  $H_2O$  at 18.75° (Abl) 100 pts  $H_2O$  at dissolve 30 pts and at 100 83 pts (Urc s Diet 100 pts  $H_2O$  at 10-11.2° dissolve 26.1 pts K and the sp gr of solution is 1.1536 (Anthon 161 216)

100 pts  $H_2O$  dissolve at—

0°	10°	20°	30°
19 61	23 23	26 91	30 57 pts $KHCO_3$
40°	50°	60°	70°
34 15	37 92	41 35	45 24 pts $KHCO_3$

(Poggiale, A ch (3) 8 468)

100 pts  $H_2O$  dissolve pts  $KHCO_3$  at

t°	Pts $KHCO_3$	t°	Pts K <sub>2</sub>	O <sub>3</sub>
0	22 4	40	45	
20	33 2	60	46	

(Dibbitts, J pr (2) 10 417)

Sp gr of  $KHCO_3$  + Aq at 15° contains 5%  $KHCO_3$  = 1.0328, containing 10% K<sub>2</sub>CO<sub>3</sub> = 1.0674 (Kohlrausch, Z anal **28** 472)

Sol in 1200 pts boiling alcohol (Berthelot) Insol in alcohol (Dumas)

100 pts  $H_2O$  dissolve 19.3 pts  $KHCO_3$  and 8.3 pts  $NaHCO_3$  if the sat solution of is sat with former, and 26.1 pts  $KHCO_3$  and 6.0 pts  $NaHCO_3$  if the sat solution of the former is sat with the latter, all at 10° (Mulder, J B **1866** 67)

Insol in sat  $K_2CO_3$  + Aq (Engel, C R **102** 365)

Solubility of  $KHCO_3 + KNO_3$  in  $H_2O$  in atmosphere of  $CO_2$

1 litre of the solution contains			
at 11°		at 20°	
Mol $KHCO_3$	Mol $KNO_3$	Mol $KHCO_3$	Mol $KNO_3$
0 60	2 33	0 60	3
0 39	2 17	0 59	2
0 76	2 03	1 53	2
1 16	1 92	1 91	2
1 55	1 81		

This case is complicated by the fact that  $KNO_3$  is more sol in  $H_2O$  sat with  $CO_2$  than in pure  $H_2O$

(Louden, C R 1900, **131** 261)

Insol in benzonitrile (Naumann, B **47** 1370)

Insol in methyl acetate (Naumann, B 1909, **42** 3790) ethyl acetate (Naumann, B 1910, **43** 314)

Potassium praseodymium carbonate,  $K_2O_3$ ,  $Pr(CO_3)_3 + 12H_2O$

Ppt Sol in 0%  $K_2CO_3$  + Aq (Mey, Z inorg 1904, **41** 104)

**Potassium samarium carbonate**,  $K_2CO_3$ ,  $Sm_2(CO_3)_3 + 12H_2O$   
(Cleve)

**Potassium silver carbonate**,  $KAgCO_3$   
Decomp by  $H_2O$  (de Schulten, C R 105 811)

Ppt Decomp by  $H_2O$  (Reynolds, Chem Soc 1898, 73 265)

**Potassium sodium carbonate**,  $KNaCO_3 + 6H_2O$

Slightly efflorescent Sol in 0.75 pt  $H_2O$  at  $12.5^\circ$ , in 0.54 pt  $H_2O$  at  $15^\circ$

Sat solution at  $15^\circ$  has sp gr = 1.366 (Stolba, J pr 94 406)

Decomp by recrystallizing from  $H_2O$ , but crystallizes undecomposed from sat  $K_2CO_3 + Aq$

Sol in  $H_2O$  (Osaka, C A 1911 2601)

See  $K_2CO_3 + Na_2CO_3$  under  $Na_2CO_3 + 3H_2O$  (Kremann and Zitek, M 1909

30 317) Does not exist (Osaka)

$K_2CO_3, 2Na_2CO_3 + 18H_2O$  Sl efflorescent Very sol in  $H_2O$  (Marignac)

**Potassium stannous carbonate**,  $K_2CO_3, 2SnCO_3 + 2H_2O$

Decomp by  $H_2O$  (Deville)

**Potassium uranyl carbonate**,  $2K_2CO_3, (UO_2)_2CO_3$

Sol without decomp in 13.5 pts  $H_2O$  at  $15^\circ$ , and in somewhat less warm  $H_2O$  Sol in boiling  $H_2O$  with decomp

More sol in  $K_2CO_3$ , or  $KHCO_3 + Aq$  than in  $H_2O$  (Rose)

Insol in alcohol (Ebelmen, A ch (3) 5 189)

**Potassium zinc carbonate**,  $4K_2O, 6ZnO, 11CO_2 + 8H_2O$

Can be washed with cold  $H_2O$  without decomp (Deville, A ch (3) 33 99)

**Praseodymium carbonate**,  $Pr_2(CO_3)_3 + 8H_2O$

Sol in  $H_2O$  (von Schule, Z anorg 1898, 18 362)

**Praseodymium sodium carbonate**,  $2Pr_2(CO_3)_3, 3Na_2CO_3 + 22H_2O(?)$

Ppt Easily decomp (Meyer, Z anorg 1904, 41 105)

**Radium carbonate**

Less sol in  $H_2O$  than corresponding Ba comp (Curie, Dissert 1903)

**Rubidium carbonate**,  $Rb_2CO_3$

Very deliquescent, and sol in  $H_2O$  100 pts absolute alcohol dissolve 0.74 pt  $Rb_2CO_3$  (Bunsen)

**Rubidium hydrogen carbonate**,  $RbHCO_3$

Not deliquescent Easily sol in  $H_2O$  (Bunsen)

**Samarium carbonate**,  $Sm(CO_3)_3 + 3H_2O$

Insol in  $H_2O$  (Cleve, Bull Soc (2) 43 168)

**Samarium sodium carbonate**,  $Sm(CO_3)_3, Na_2CO_3 + 16H_2O$

Ppt (Cleve)

**Scandium carbonate**,  $Sc(CO_3)_3 + 12H_2O$

(Crookes, Roy Soc Proc 1908, 80, A 518)

**Scandium sodium carbonate**,  $Sc_2(CO_3)_3, 4Na_2CO_3 + 6H_2O$

Difficultly sol in  $H_2O$

Sol in cold, less sol in hot alkali carbonates + Aq (R Meyer, Z anorg 1910, 67 410)

**Silver carbonate**,  $Ag_2CO_3$

Somewhat sol in  $H_2O$  Sol in 31,978 pts  $H_2O$  at  $15^\circ$  (Kremers, Pogg 85 243) 1 g  $Ag_2CO_3$  dissolves in 2 l boiling  $H_2O$  (Joulin, A ch (4) 30 260)

Solubility in  $H_2O$  at  $25^\circ = 1.16 \times 10^{-4}$  mol/l (Spencer and Le Pla, Z anorg 1910, 65 14)

1 l  $H_2O$  at  $25^\circ$  dissolves  $1.2 \times 10^{-4}$  gram atoms of silver (Abegg and Cox, Z phys Ch 1903, 46 11)

Insol in  $H_2CO_3 + Aq$  (Bergman) Sol in 961 pts  $H_2CO_3 + Aq$  (Lassaigne) 1 l sat  $H_2CO_3 + Aq$  dissolves 0.846 g  $Ag_2CO_3$  at  $15^\circ$  (Johnson, C N 54 75)

Sol in  $(NH_4)_2CO_3 + Aq$  or  $NH_4OH + Aq$ , sl sol in  $K_2CO_3 + Aq$  (Wittstein) Easily sol in  $Na_2S_2O_3 + Aq$  (Herschel, 1819) Sol in hot  $NH_4Cl + Aq$ , and sl sol in  $NH_4NO_3 + Aq$  (Brett, 1837) Not pptd in presence of Na citrate (Spiller) Decomp by  $HCl + Aq$ , and chlorides + Aq

Somewhat sol in conc  $NaNO_3 + Aq$  (de Coninck, Belg Acad Bull 1909, 333)

Insol in liquid  $NH_3$  (Franklin, Am Ch J 1898, 20 829)

Insol in alcohol

Insol in methyl acetate (Naumann B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Insol in acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

**Silver carbonate ammonia**

Easily sol in  $H_2O$  Sol in  $NH_4OH + Aq$  from which it is precipitated by absolute alcohol (Berzelius)

$Ag_2CO_3, 4NH_3$  Ppt Insol in alcohol (Keen, C N 31 231)

**Sodium carbonate**,  $Na_2CO_3$

*Anhydrous* Sol in  $H_2O$  with evolution of heat

Sol in 967 pts  $H_2O$  at  $15^\circ$  (Thomson, 1831)  $H_2O$  at  $14.6^\circ$  dissolve 7.74 pts  $Na_2CO_3$  or 20.64 pt  $Na_2CO_3, 10H_2O$  is sol in rather less than 1 pt boiling  $H_2O$  (Thomson, 1831)

Sol in 2 pts  $H_2O$  (Berzeman) Sol in 2 pts  $H_2O$  at  $18.7^\circ$  (Abel)



Solubility in 100 pts H <sub>2</sub> O at t°						Possesses four different degrees of solubility, according to different states of mole constitution and degrees of hydration (L A ch (3) 44 330 )	Little more sol at 34-38° than at 104° maximum of solubility is probably at (Lowel)	out 5°
t°	Pts Na <sub>2</sub> CO <sub>3</sub>	Pts Na <sub>2</sub> CO <sub>3</sub> +10H <sub>2</sub> O	t°	Pts Na <sub>2</sub> CO <sub>3</sub>	Pts Na <sub>2</sub> CO <sub>3</sub> +10H <sub>2</sub> O			
0	7 08	21 52	25	35 90	171 33			
10	16 66	61 98	30	35 90	241 57			
20	30 83	123 12	104 6	48 50	420 68			

(Poggiale A ch (3) 8 468 )

Solubility of Na<sub>2</sub>CO<sub>3</sub>, Na<sub>2</sub>CO<sub>3</sub>+10H<sub>2</sub>O, Na<sub>2</sub>CO<sub>3</sub>+7H<sub>2</sub>O (a), and Na<sub>2</sub>CO<sub>3</sub>+7H<sub>2</sub>O (b) in 20

t°	Sat solution of Na <sub>2</sub> CO <sub>3</sub> +10H <sub>2</sub> O contains—		Sat solution of Na <sub>2</sub> CO <sub>3</sub> +7H <sub>2</sub> O (b) contains—			Sat solution of Na <sub>2</sub> CO <sub>3</sub> +7H <sub>2</sub> O (a) contains—			+ m H <sub>2</sub> O
	Pts	Pts Na <sub>2</sub> CO <sub>3</sub> +10H <sub>2</sub> O in 100 pts H <sub>2</sub> O	Pts Na <sub>2</sub> CO <sub>3</sub> in 100 pts H <sub>2</sub> O	Pts Na <sub>2</sub> CO <sub>3</sub> +7H <sub>2</sub> O (b) in 100 pts H <sub>2</sub> O	Pts Na <sub>2</sub> CO <sub>3</sub> +10H <sub>2</sub> O in 100 pts H <sub>2</sub> O	Pts Na <sub>2</sub> CO <sub>3</sub> in 100 pts H <sub>2</sub> O	Pts Na <sub>2</sub> CO <sub>3</sub> +7H <sub>2</sub> O (a) in 100 pts H <sub>2</sub> O	Pts Na <sub>2</sub> CO <sub>3</sub> +10H <sub>2</sub> O in 100 pts H <sub>2</sub> O	
0	6 97	21 33	20 39	58 93	84 28	31 93	112 94	188 7	
10	12 06	40 94	26 33	83 94	128 57	37 85	150 77	286 3	
15	16 20	63 20	29 58	100 00	160 51	41 55	179 90	381 9	
20	21 71	92 82	38 55	122 25	210 58	45 79	220 20	556 1	
25	28 50	149 13	38 07	152 36	290 91				
30	37 24	273 64	43 45	196 93	447 93				
38	51 67	1142 17							
104	45 47	539 63							

(Lowel, A ch (3) 33 382 )

100 pts H<sub>2</sub>O at 14° dissolve 60 4 pts Na<sub>2</sub>CO<sub>3</sub>+10H<sub>2</sub>O, at 36°, 833 pts, at 104°, 445 pts Solubility increases to 36°, then diminishes (Payen, A ch (3) 43 233 )

There are apparently two maxima of solubility, the one occurring at 15°, or even lower, as warm solutions cool, the other at 34-38°, when cold solutions are warmed (Payen, A ch (3) 44 330 )

Solubility in 100 pts H<sub>2</sub>O at t°

t°	Pts Na <sub>2</sub> CO <sub>3</sub>	t	Pts Na <sub>2</sub> CO <sub>3</sub>	t	Pts Na <sub>2</sub> CO <sub>3</sub>
0	7 1	22	23 8	43	46 2
1	7 5	23	25 1	44	46 2
2	7 8	24	26 5	45	46 2
3	8 4	25	28 0	46	46 2
4	8 9	26	29 7	47	46 2
5	9 5	27	31 6	48	46 2
6	10 0	28	33 6	49	46 2
7	10 6	29	35 8	50	46 2
8	11 2	30	38 1	51	46 2
9	11 9	31	41 1	52	46 2
10	12 6	32	46 2	53	46 2
11	13 3	32 5	59 0	54	46 2
12	14 0	33	46 2	55	46 2
13	14 8	34	46 2	56	46 2
14	15 6	35	46 2	57	46 2
15	16 5	36	46 2	58	46 2
16	17 4	37	46 2	59	46 2
17	18 3	38	46 2	60	46 2
18	19 3	39	46 2	61	46 2
19	20 3	40	46 2	62	46 2
20	21 4	41	46 2	63	46 2
21	22 6	42	46 2	64	46 2

Solubility in 100 pts H<sub>2</sub>O at t°—Continued

t	Pts Na <sub>2</sub> CO <sub>3</sub>	t°	Pts Na <sub>2</sub> CO <sub>3</sub>	t°	N <sub>2</sub> O <sub>3</sub>
65	46 2	79	46 2	93	4 6
66	46 2	80	46 1	94	4 6
67	46 2	81	46 1	95	4 6
68	46 2	82	46 1	96	4 6
69	46 2	83	46 0	97	4 5
70	46 2	84	46 0	98	4 5
71	46 2	85	45 9	99	4 5
72	46 2	86	45 9	100	4 4
73	46 2	87	45 8	101	4 4
74	46 2	88	45 8	102	4 3
75	46 2	89	45 8	103	4 3
76	46 2	90	45 7	104	4 2
77	46 2	91	45 7	105	4 1
78	46 2	92	45 7		

(Mulder, Schenk Verhandl 1864 120 )

Unable to form supersaturated solution  
Supersat Na<sub>2</sub>CO<sub>3</sub>+Aq (2 pts Na<sub>2</sub>CO<sub>3</sub>+10H<sub>2</sub>O 1 pt H<sub>2</sub>O) may be kept in a closed with cotton wool (Schroder) ask

When supersat Na<sub>2</sub>CO<sub>3</sub>+Aq is exposed to low temperatures, the 10H<sub>2</sub>O salt crystallizes out, but under other circumstances two other salts are formed, each containing 7H<sub>2</sub>O one is four times as sol at 10° as the 10H<sub>2</sub>O salt, and the other twice as sol See above (Lowel, A ch (3) 33 337 )

See also Na<sub>2</sub>CO<sub>3</sub>+H<sub>2</sub>O, 7H<sub>2</sub>O, and 10 H<sub>2</sub>O

Sp gr of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $15^\circ$ 

% $\text{Na}_2\text{CO}_3$	Sp gr	% $\text{Na}_2\text{CO}_3$	Sp gr
0 372	1 0040	7 812	1 0892
0 744	1 0081	8 184	1 0937
1 116	1 0121	8 556	1 0982
1 488	1 0163	8 928	1 1028
1 850	1 0204	9 300	1 1074
2 232	1 0245	9 672	1 1120
2 504	1 0286	10 044	1 1167
2 976	1 0327	10 416	1 1214
3 348	1 0368	10 788	1 1261
3 720	1 0410	11 160	1 1308
4 090	1 0452	11 532	1 1356
4 464	1 0494	11 904	1 1404
4 836	1 0537	12 276	1 1452
5 208	1 0576	12 648	1 1500
5 580	1 0625	13 020	1 1549
5 972	1 0669	13 392	1 1598
6 324	1 0713	13 764	1 1648
6 396	1 0757	14 136	1 1698
6 768	1 0802	14 508	1 1748
7 440	1 0847	14 880	1 1816

(Tinnerman)

Sp gr of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $15^\circ$ 

%	Sp gr if % is $\text{Na}_2\text{CO}_3$	Sp gr if % is $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$
1	1 0105	1 004
2	1 0210	1 008
3	1 0315	1 012
4	1 0420	1 016
5	1 0525	1 020
6	1 0631	1 023
7	1 0737	1 027
8	1 0843	1 031
9	1 0950	1 035
10	1 1057	1 039
11	1 1165	1 043
12	1 1274	1 047
13	1 1384	1 050
14	1 1495	1 054
15		1 058
16		1 062
17		1 066
18		1 070
19		1 074
20		1 078
21		1 082
22		1 086
23		1 090
24		1 094
25		1 099
26		1 103
27		1 106
28		1 110
29		1 114
30		1 119
31		1 123
32		1 126
33		1 130
34		1 135
35		1 139
36		1 143
37		1 147
38		1 150

(Gerlach, Z anal 8 279)

Sp gr of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $17.5^\circ$ 

% $\text{Na}_2\text{CO}_3$	% $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	Sp gr	% $\text{Na}_2\text{CO}_3$	% $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	Sp gr
1	2 70	1 010	9	24 30	1 095
2	5 40	1 020	10	27 00	1 105
3	8 10	1 031	11	29 70	1 116
4	10 18	1 041	12	32 40	1 127
5	13 50	1 052	13	35 10	1 137
6	16 20	1 063	14	37 80	1 148
7	18 90	1 073	15	40 50	1 157
8	21 60	1 084			

(Hager)

Sp gr of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  increases or diminishes by a change of temperature of  $1^\circ$  by the following amounts—

Corr	% $\text{Na}_2\text{CO}_3$
0 0004	13-15
0 00033	8-12
0 00026	3-7

(Hager, Comm 1883)

Sp gr of conc  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $30^\circ$ 

Sp gr	% $\text{Na}_2\text{CO}_3$	% $\text{Na}_2\text{CO}_3$ in 1 l	Sp gr	% $\text{Na}_2\text{CO}_3$	% $\text{Na}_2\text{CO}_3$ in 1 l
1 310	28 13	368 5	1 220	20 47	249 7
1 300	27 30	354 9	1 210	19 61	237 3
1 290	26 46	341 3	1 200	18 76	225 1
1 280	25 62	327 9	1 190	17 90	214 0
1 270	24 78	314 7	1 180	17 04	201 1
1 260	23 93	301 5	1 170	16 18	189 3
1 250	23 08	288 5	1 160	15 32	177 7
1 240	22 21	275 4	1 150	14 47	166 4
1 230	21 33	262 3	1 140	13 62	155 3

(Lunge, Chem Ind 1882 320)

Sp gr of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $23^\circ$ 

% $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	% $\text{Na}_2\text{CO}_3$	Sp gr	% $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	% $\text{Na}_2\text{CO}_3$	Sp gr
1	0 370	1 0038	16	5 929	1 0628
2	0 741	1 0076	17	6 299	1 0668
3	1 112	1 0114	18	6 670	1 0708
4	1 482	1 0153	19	7 041	1 0748
5	1 853	1 0192	20	7 412	1 0789
6	2 223	1 0231	21	7 782	1 0836
7	2 594	1 0271	22	8 153	1 0871
8	2 965	1 0309	23	8 523	1 0912
9	3 335	1 0348	24	8 894	1 0953
10	3 706	1 0388	25	9 264	1 0994
11	4 076	1 0428	26	9 635	1 1035
12	4 447	1 0468	27	10 005	1 1076
13	4 817	1 0508	28	10 376	1 1117
14	5 188	1 0548	29	10 746	1 1158
15	5 558	1 0588	30	11 118	1 1200

Sp gr of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $23^\circ$ —Continued

$\frac{\% \text{Na}_2\text{CO}_3}{+10\text{H}_2\text{O}}$	$\frac{\% \text{Na}_2\text{CO}_3}{+10\text{H}_2\text{O}}$	Sp gr	$\frac{\% \text{Na}_2\text{CO}_3}{+10\text{H}_2\text{O}}$	$\frac{\% \text{Na}_2\text{CO}_3}{+10\text{H}_2\text{O}}$	Sp gr
31	11 488	1 1242	41	15 195	1 1662
32	11 859	1 1284	42	15 556	1 1704
33	12 230	1 1326	43	15 936	1 1746
34	12 600	1 1368	44	16 307	1 1788
35	12 971	1 1410	45	16 677	1 1830
36	13 341	1 1452	46	17 048	1 1873
37	13 712	1 1494	47	17 418	1 1916
38	14 082	1 1536	48	17 789	1 1959
39	14 530	1 1578	49	18 159	1 2002
40	14 824	1 1620	50	18 530	1 2045

(Schuff, A 113 186)

Sp gr of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $23^\circ$   $a$  = number of grms  $\times \frac{1}{2}$  mol wt, dissolved in 1000 grms  $\text{H}_2\text{O}$ ,  $b$  = sp gr if  $a = \text{Na}_2\text{CO}_3$ ,  $10\text{H}_2\text{O}$  ( $\frac{1}{2}$  mol wt = 143),  $c$  = sp gr if  $a = \text{Na}_2\text{CO}_3$  ( $\frac{1}{2}$  mol wt = 53)

$a$	$b$	$c$	$a$	$b$	$c$
1	1 048	1 052	5	1 163	1 226
2	1 086	1 100	6	1 182	
3	1 117	1 145	7	1 198	
4	1 142	1 187			

(Favre and Valson, C R 79 968)

Sp gr of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $18^\circ$ 

$\frac{\% \text{Na}_2\text{CO}_3}{+10\text{H}_2\text{O}}$	Sp gr	$\frac{\% \text{Na}_2\text{CO}_3}{+10\text{H}_2\text{O}}$	Sp gr
5	1 0511	15	1 1590
10	1 1044		

(Kohlrausch, W Ann 1879 1)

Sp gr of  $\text{Na}_2\text{CO}_3 + \text{Aq}$ 

$\frac{\text{g equivalents}}{\text{Na}_2\text{CO}_3 \text{ per l}}$	$t$	Sp gr $t/t$
0 002524	16 004	1 0001418
0 005041	16 026	1 0002844
0 01006	16 049	1 000568
0 02501	16 028	1 001413
0 04954	16 050	1 002789
0 10188	16 030	1 005699
0 24646	16 041	1 013598
0 002628	16 051	1 0001473
0 003948	16 088	1 0002216
0 009182	16 081	1 0005181
0 01830	16 089	1 001033
0 10842	16 042	1 006048
0 21570	16 055	1 011910
0 4297	15 14	1 02346
2 5015	16 05	1 12533

(Kohlrausch, W Ann 1894, 53 26)

Sp gr of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $t^\circ$   $\text{H}_2\text{O}$  at  $t^\circ$  = 1

$t^\circ$	$\% \text{Na}_2\text{CO}_3$	Sp gr
60°	28 74	1 297
	25 20	1 254
	22 25	1 219
	18 23	1 174
	14 06	1 127
80°	28 59	1 280
	18 26	1 160

(Wegscheider, M 1905, 26 690)

Sp gr of dil  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at 20 004°  
 Conc = g equiv  $\text{Na}_2\text{CO}_3$  per l at 20 04°  
 and 730 mm

Sp gr compared with  $\text{H}_2\text{O}$  at 20 004 - 1

Conc	Sp gr
0 0000	1 000,000,0
0 0001	1 000,005,6
0 0002	1 000,011,2
0 0004	1 000,022,5
0 0005	1 000,028,1
0 0010	1 000,056,3
0 0020	1 000,112,7
0 0040	1 000,225,8
0 0050	1 000,282,4
0 0100	1 000,564,8

(Lamb and Lee, J Am Chem Soc 1913 15 1685)

$\text{Na}_2\text{CO}_3 + \text{Aq}$  containing 5%  $\text{Na}_2\text{CO}_3$  l at 100 5°, 10%  $\text{Na}_2\text{CO}_3$  at 101 1°, 1%  $\text{Na}_2\text{CO}_3$  at 101 8° (Gerlach)

Sat solution boils at 104 4° (Griffiths, 1825), 106° (Kremers), 104° (Payen)

Sat solution forms a crust at 104 1°, and contains 42 2 pts  $\text{Na}_2\text{CO}_3$  to 100 pts  $\text{H}_2\text{O}$ , highest temperature observed, 105° (Gerlach, Z anal 26 427)

B-pt of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  containing pts  $\text{Na}_2\text{CO}_3$  to 100 pts  $\text{H}_2\text{O}$  G = according to Gerlach (Z anal 26 458), L = according to Legrand (A ch (2) 59 426)

B pt	G	L	B pt	G	L
100 5°	5 2	7 5	103 5°	36 2	4 0
101 0	10 4	14 4	104 0	41 2	4 7
101 5	15 6	20 8	104 5	46 2	4 9
102 0	20 8	26 7	104 6 3		4 5
102 5	26 0	32 0	105 0	51 2	
103 0	31 1	36 8			

Less sol in dil  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Fresenius)

See also under Ammonia

Solubility of  $\text{Na}_2\text{CO}_3 + \text{NH}_4\text{Cl}$  See un r

Ammonium Chloride

Solubility of  $\text{Na}_2\text{CO}_3 + \text{K}_2\text{CO}_3$  See un r

Carbonate, potassium

The reciprocal solubility of sodium carbonate and sodium hydrogen carbonate in  $H_2O$  has been determined (de Paepe, C A 1911, 2603, and 1912, 2723)

Solubility of  $Na_2CO_3 + NaHCO_3$  in  $H_2O$  at  $25^\circ$

g per 100 g $H_2O$		Solid phase
$NaHCO_3$	$Na_2CO_3$	
0	28.3	$Na_2CO_3 \cdot 10H_2O$
2.1	27.3	"
4.2	26.5	$Na_2CO_3 \cdot 10H_2O + NaHCO_3$
5.7	19.2	$NaHCO_3$
7.3	12.4	"
9.0	6.2	"
10.1	1.0	"

(de Paepe, Bull Soc Chim Belg 1911, 25 174)

Solubility of  $Na_2CO_3 + NaHCO_3$  in  $H_2O$  at  $25^\circ$

g per l		Solid phase
$NaHCO_3$	$Na_2CO_3$	
98.7	0.0	$NaHCO_3$
50.8	216.6	$NaHCO_3 + Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$
27.6	276.3	$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O + Na_2CO_3 \cdot 10H_2O$
0.0	276.4	$Na_2CO_3 \cdot 10H_2O$

(McCoy and Test, J Am Chem Soc 1911, 33 474)

Equilibrium between  $Na_2CO_3$ ,  $NaHCO_3$  and  $CO_2$ . See under Carbonate, sodium hydrogen

Solubility of  $NaNO_3$  in  $Na_2CO_3 + Aq$  at  $10^\circ$

In 1000 ccm $H_2O$		Solid phase
$NaNO_3$	$Na_2CO_3$	
805.0		$NaNO_3$
704.8	87.5	$NaNO_3, Na_2CO_3$
	119.8	$Na_2CO_3$

(Kremann, M 1909, 30 325)

Solubility of  $NaNO_3$  in  $Na_2CO_3 + Aq$  at  $24.2^\circ$

In 1000 ccm $H_2O$		Solid phase
$NaNO_3$	$Na_2CO_3$	
913.58		$NaNO_3$
844.50	59.61	"
627.75	217.85	$NaNO_3 + Na_2CO_3 \cdot 7H_2O$
544.3	246.30	$Na_2CO_3 \cdot 7H_2O$
459.6	263.30	$Na_2CO_3 \cdot 10H_2O$
	28.55	$Na_2CO_3 \cdot 10H_2O$

(Kremann)

Solubility of  $Na_2CO_3 + NaBr$  in  $H_2O$  at  $30^\circ$

$Na_2CO_3$	$NaBr$	Solid phase
27.98	0	$Na_2CO_3 \cdot 10H_2O$
27.54	2.41	
26.72	4.06	
26.23	6.26	$Na_2CO_3 \cdot 10H_2O + Na_2CO_3 \cdot 7H_2O$
23.40	11.00	$Na_2CO_3 \cdot 7H_2O$
22.68	12.22	
19.86	16.88	
19.57	16.95	$Na_2CO_3 \cdot 7H_2O + Na_2CO_3 \cdot H_2O$
18.11	19.32	$Na_2CO_3 \cdot H_2O$
8.45	33.39	
6.90	36.13	
3.04	44.75	
2.99	45.31	$NaBr \cdot 2H_2O + Na_2CO_3 \cdot H_2O$
2.60	45.68	$NaBr \cdot 2H_2O$
0	49.40	

(Cocheret, Dissert 1911)

Solubility in  $NaCl + Aq$  100 pts  $H_2O$  dissolve pts  $NaCl$  and pts  $Na_2CO_3 \cdot 10H_2O$ , when that salt is in excess at  $15^\circ$

Pts $NaCl$	Pts $Na_2CO_3 \cdot 10H_2O$	Pts $NaCl$	Pts $Na_2CO_3 \cdot 10H_2O$
0.00	61.42	23.70	39.06
4.03	53.86	27.93	39.73
8.02	48.00	31.65	41.44
12.02	43.78	35.46	43.77
16.05	40.96	sat	
19.82	39.46	37.27	45.32

Solubility of anhydrous  $Na_2CO_3$  in 100 pts  $NaCl + Aq$  containing %  $NaCl$  at  $15^\circ$

% $NaCl$	Pts $Na_2CO_3$	% $NaCl$	Pts $Na_2CO_3$
0	16.408	12	10.488
1	15.717	13	10.244
2	15.060	14	10.041
3	14.438	15	9.880
4	13.851	16	9.762
5	13.299	17	9.686
6	12.783	18	9.655
7	12.305	19	9.667
8	11.864	20	9.725
9	11.461	21	9.828
10	11.097	22	9.997
11	10.773		

(Reich, W A B 99, 2b 433)

Solubility of  $Na_2CO_3 + NaCl$  in  $H_2O$  at  $30^\circ$

$Na_2CO_3$	% $NaCl$	Solid phase
27.98	0	$Na_2CO_3 \cdot 10H_2O$
27.48	0.9	
27.12	3.33	
26.82	4.15	$Na_2CO_3 \cdot 10H_2O + Na_2CO_3 \cdot 7H_2O$
25.59	5.17	$Na_2CO_3 \cdot 7H_2O$
24.26	5.93	

Solubility of  $\text{Na}_2\text{CO}_3 + \text{NaCl}$  in  $\text{H}_2\text{O}$  at  $30^\circ$ —*Continued*

% $\text{Na}_2\text{CO}_3$	% $\text{NaCl}$	Solid phase
22 75	10 24	$\text{Na CO } 7\text{H}_2\text{O} + \text{Na CO}_3 \text{H O}$ $\text{Na}_2\text{CO}_3 \text{H}_2\text{O}$ $\text{NaCl} + \text{Na}_2\text{CO}_3 \text{H}_2\text{O}$ $\text{NaCl}$
20 72	11 49	
18 00	14 12	
14 81	16 26	
9 71	18 76	
5 05	21 94	
0	26 47	

(Cocheret, Dissert 1911)

Solubility of  $\text{Na}_2\text{CO}_3 + \text{NaI}$  in  $\text{H}_2\text{O}$  at  $30^\circ$ 

% $\text{Na}_2\text{CO}_3$	% $\text{NaI}$	Solid phase
27 4	0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
26 5	2 4	
25 5	4 7	
25 2	5 2	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} + \text{Na CO}_3 \cdot 7\text{H}_2\text{O}$ $\text{Na CO}_3 \cdot 7\text{H}_2\text{O}$
24 4	8 6	
24 3	9 5	
23 0	11 2	$\text{Na CO}_3 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \text{H O}$ $\text{Na CO}_3 \text{H}_2\text{O}$
20 8	14 0	
20 0	15 7	
18 7	18 4	$\text{Na CO}_3 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \text{H O}$ $\text{Na CO}_3 \text{H}_2\text{O}$
15 3	25 4	
13 1	29 1	
10 4	33 3	$\text{NaI} \cdot 2\text{H}_2\text{O} + \text{Na CO}_3 \text{H O}$ $\text{NaI} \cdot 2\text{H}_2\text{O}$
6 4	40 4	
4 2	46 0	
3 1	49 5	
2 7	51 0	
1 5	54 6	
0 9	57 6	
0 6	61 2	
0 3	65 6	
0 0	65 5	

(Cocheret, Dissert 1911)

Insol in liquid  $\text{CO}_2$  (Buchner, Z phys Ch 1906, 54 674)Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1893, 20 829)

Insol in alcohol (Fresenius)

Sl sol in absolute alcohol, apparently insol in an alcoholic solution of soap (Duffy, Chem Soc 5 305)

Solubility of  $\text{Na}_2\text{CO}_3$  in ethyl alcohol at  $20^\circ$ 

Alcohol wt percent	g $\text{Na}_2\text{CO}_3$ per 100 g solution
44	1 7
46	1 13
48	0 9
50	0 84
54	0 80

(Linebarger, A Ch J 1892, 14 380)

Solubility of  $\text{Na}_2\text{CO}_3$  in alcohol +  $\text{H}_2\text{O}$  at  $30^\circ$ 

% $\text{Na}_2\text{CO}_3$	% alcohol	Solid phase
27 4	0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
26 61	2 64	
{ 26 14*	{ 3 41 }	
1 38	44 81	$\text{Na CO}_3 \cdot 10\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$ $\text{Na CO}_3 \cdot 7\text{H}_2\text{O}$
0 62	52 99	
0 61	53 26	
0 53	55 70	
0 51	56 56	
0 47	62 61	
0 40	63 20	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \text{H}_2\text{O}$ $\text{Na CO}_3 \text{H}_2\text{O}$
0 15	72 80	
0 11	73 06	
0 07	78 19	$\text{Na CO}_3 \text{H}_2\text{O} + \text{Na}_2\text{CO}_3$ $\text{Na CO}_3$
0 07	82 26	
0 06	86 76	
0 06	90 95	
0 04	93 09	
0 03	95 06	
	95 65	
	98 46	

\* Conjugated liquid phases  
(Cocheret, Dissert 1911)See also under  $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$ , +  $7\text{H}_2\text{O}$  at 1 +  $10\text{H}_2\text{O}$ Not decomp by 1 pt  $\text{H}_2\text{SO}_4$  + 6 pts absolute alcoholNot decomp by alcoholic solutions of racemic tartaric, or glacial acetic acids, slowly decomp by  $\text{HNO}_3$  + absolute alcoholSolubility of  $\text{Na}_2\text{CO}_3 + \text{NaBr}$ ,  $\text{NaCl}$  and  $\text{NaI}$  in alcohol. Numerical data given by Cocheret (Dissert 1911), reported in *Annuaire international des Constantes*, et for 1911Solubility of  $\text{Na}_2\text{CO}_3$  in propyl alcohol at  $20^\circ$ 

Alcohol wt percent	g $\text{Na}_2\text{CO}_3$ per 100 g solution
28	1 4
38	2 7
44	1 7
46	1 5
48	1 3
50	1 2
54	0 9
62	0 4

(Linebarger, A Ch J 1892, 14 380)

A full discussion of the solubility of  $\text{NaCl}$  in propyl and allyl alcohol is given by Franforter and Temple (J Am Ch Soc 1915, 3 2697)Insol in  $\text{CS}_2$  (Arctowski, Z inorg 189, 6 257)

Insol in benzonitrile (Naumann, B 191, 47 1370)

Insol in methyl acetate (Naumann, 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3602)

Solubility in mixtures of pyridine and  $H_2O$  from  $-65^\circ$  to  $+200^\circ$ . Solubility curves are given (Limbosch, Chem Soc 1909, **96** (2), 472)

Insol in acetone and in methylal (Eidmann, C C **1899**, II 1014)

100 g glycerine (sp gr = 1.262) dissolve 98.3 g  $Na_2CO_3$  at  $15-16^\circ$  (Ossendowski, Pharm J 1907, **79** 575)

100 g sat solution in glycol contain 3.28-3.4 g  $Na_2CO_3$  (de Coninck, Bull Soc Belg 1907, **21** 141)

100 g sat  $Na_2CO_3$  + sugar + Aq contain 6.89 g  $Na_2CO_3$  + 64.73 g sugar at  $31.25^\circ$  (Kohler, Z Ver Zuckerind 1897, **47** 447)

+  $H_2O$ . Takes up  $H_2O$  from the air. Less sol in  $H_2O$  at  $104^\circ$  than at  $38^\circ$ , at  $15-20^\circ$ , 100 pts  $H_2O$  dissolve 52.4 pts of this salt, calculated as  $Na_2CO_3$ . Insol in alcohol (Lowell)

#### Solubility in 100 pts $H_2O$ at $t^\circ$

Corrected $t^\circ$ (Hydrogen scale)	Pts anhydrous salt
29.86	50.53
29.89	50.75
31.80	50.31
35.17	49.63
35.37	49.67
35.66	49.37
35.86	49.44
36.45	49.36
36.90	49.29
37.91	49.11
38.92	49.09
40.94	48.51
40.93	48.52
43.94	47.98

(Wells and McAdam, J Am Chem Soc 1907, **29** 726)

#### Solubility in alcohol + Aq

Composition of the alcohol and water layers in contact with the solid phase  $Na_2CO_3 + H_2O$

$t^\circ$	Alcohol layer			Water layer		
	$c_i$ alcohol	$c_i$ alt	% water	% alcohol	% salt	% water
68	55.8	0.9	43.3	2.3	28.8	68.9
49	61.0	0.4	38.6	1.2	31.5	67.3
40	61.0	0.4	38.6	1.2	31.9	66.9
36	62.0	0.3	37.7	1.1	32.1	66.8
35	62.9	0.3	36.8	1.0	32.4	66.6

(Ketner, Z phys Ch 1902, **39** 651)

+ 3H<sub>2</sub>O (Schuckendantz, A **155** 359)

+ 5H<sub>2</sub>O (Persoz, Pogg **32** 303)

Not efflorescent Sol in  $H_2O$

+ 6H<sub>2</sub>O (Mitscherlich, Pogg **8** 441)

+ 7H<sub>2</sub>O Efflorescent Two salts, 7H<sub>2</sub>O

(b) (= + 8H<sub>2</sub>O of Thomson), and 7H<sub>2</sub>O

(a) See also under  $Na_2CO_3$

#### Solubility in 100 pts $H_2O$ at $t^\circ$

Corrected $t^\circ$ (Hydrogen scale)	Pts anhydrous salt
30.35	43.50
31.82	45.16
32.86	46.28
34.37	48.22
34.76	48.98
35.15	49.23
35.17	49.34
35.62	50.08

(Wells and McAdam, J Am Chem Soc 1907, **29** 726)

Composition of the solutions which can be in equilibrium with  $Na_2CO_3 + 7H_2O$  at different temperatures

$t^\circ$	% $Na_2CO_3$
32.1	31.8
32.5	32.1
33.3	32.7
33.9	33.0
34.5	33.9

(Ketner, Z phys Ch 1902, **39** 646)

Composition of the alcohol and water layers in contact with the solid phase,  $Na_2CO_3 + 7H_2O$ , at different temperatures

$t^\circ$	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% al cobol	% salt	% water
33.2	58.1	0.5	42.4	1.4	31.0	67.6
32.3	56.1	0.6	43.3	1.5	30.2	68.3
31.9	54.8	0.7	44.5	1.7	29.8	68.5
31.45	53.5	0.7	45.8		29.3	
31.2	52.4	0.8	46.8		29.3	

(Ketner)

Composition of the two liquid layers which at different temperatures can be in metastable equilibrium with  $Na_2CO_3 + 7H_2O$

$t$	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% al cobol	% salt	% water
28.9	46.9	1.3	51.8	2.3	26.3	71.4
26.6	39.1	1.3	59.6	3.3	25.4	71.3
23.0	24.5	6.7	68.8	7.0	20.2	72.8

(Ketner)

+ 10H<sub>2</sub>O Efflorescent Sol in 105 pts  $H_2O$  at  $23^\circ$ , and sat solution has sp gr 1.1995 (Schiff, A **109** 326)

Melts in crystal  $H_2O$  at  $34^\circ$  (Tilden, Chem Soc **45** 409)

See above under  $Na_2CO_3$  for further data

Solubility in 100 pts H <sub>2</sub> O at t°	
Corrected t° (Hydrogen scale)	Pts anhydrous salt
27 84	34 20
29 33	37 40
29 85	38 89
30 35	40 12
31 45	43 25
31 66	43 95
31 72	44 21
32 06	45 64

(Wells and McAdam, J Am Chem Soc 1907, 29 726 )

Sat solution at 25° contains 29 37 g anhyd Na<sub>2</sub>CO<sub>3</sub> in 100 g H<sub>2</sub>O (Osaka, J Tok Ch Soc 1911, 32 870 )

Sat solution at 25° contains 28 3 g anhyd Na<sub>2</sub>CO<sub>3</sub> in 100 g H<sub>2</sub>O (de Paepe, Bull Soc Chim Belg 1911, 25 174 )

Sat solution at 30° contains 27 4-27 98 g anhyd Na<sub>2</sub>CO<sub>3</sub> in 100 g of the solution (Cocheret, Dissert 1911 )

Sat solution at 25° contains 27 64 g anhyd Na<sub>2</sub>CO<sub>3</sub> in 100 cc of the solution (McCoy and Test, J Am Chem Soc 1911, 33 474 )

#### Solubility in alcohol

Composition of the alcohol and water layers in contact with the solid phase, Na<sub>2</sub>CO<sub>3</sub>+10H<sub>2</sub>O, at different temperatures

t	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
30 6	47 8	1 2	51 0	2 3	27 8	69 9
29 7	40 0	2 1	57 9	2 9	25 5	71 6
29 0	32 7	3 8	63 5	4 3	22 7	73 0
28 2	23 5	7 3	69 2	7 9	18 6	73 5

(Ketner, Z phys Ch 1902, 39 651 )

#### Solubility in alcohol+Aq

Liquids which can be in equilibrium with Na<sub>2</sub>CO<sub>3</sub>+10H<sub>2</sub>O at 21°

% alcohol	% salt	% water
0	18 5	81 5
6 2	12 7	81 1
15 3	6 9	77 8
26 1	3 2	70 7
39 2	1 2	59 6
58 2	0 2	41 6
67 1	0 1	32 8
73 3	0 06	26 64

(Ketner )

Composition of the alcohol liquids which be in equilibrium with Na<sub>2</sub>CO<sub>3</sub>+1 and Na<sub>2</sub>CO<sub>3</sub>+7H<sub>2</sub>O at different temperatures

t°	% alcohol	% salt	% water
29°	62 3	0 3	37
26°	67 8	0 1	32
21°	73 3	0 06	26

(Ketner )

See also under Na<sub>2</sub>CO<sub>3</sub>+15H<sub>2</sub>O (Jacquelin, A 80 241 )

#### Sodium hydrogen carbonate, NaHCO<sub>3</sub>

100 pts cold H<sub>2</sub>O dissolve 7 7 pts NaHCO<sub>3</sub> (Schw J 6 52 )

100 pts H<sub>2</sub>O at 11 25° dissolve 8 27 pts NaHCO<sub>3</sub> to form solution of 1 0613 sp gr (Anthon Dingl 161 )

100 pts H<sub>2</sub>O dissolve at—

0°	10°	20°	30°
8 95	10 04	11 15	12 24
40°	50°	60°	70°
13 35	14 45	15 57	16 69

pts NaHCO<sub>3</sub> (Poggiale, A ch (3) 8 468 )

100 pts H<sub>2</sub>O dissolve pts NaHCO<sub>3</sub> at °

t°	Pts NaHCO <sub>3</sub>	t°	Pts NaHCO <sub>3</sub>	t°	Pts NaHCO <sub>3</sub>
0	6 90	21	9 75	42	13 15
1	7 00	22	9 90	43	13 20
2	7 10	23	10 05	44	13 25
3	7 20	24	10 20	45	13 30
4	7 35	25	10 35	46	13 35
5	7 45	26	10 50	47	13 40
6	7 60	27	10 65	48	14 0
7	7 70	28	10 80	49	14 0
8	7 85	29	10 95	50	14 5
9	8 00	30	11 10	51	14 5
10	8 15	31	11 25	52	14 5
11	8 25	32	11 40	53	15 0
12	8 40	33	11 55	54	15 0
13	8 55	34	11 70	55	15 0
14	8 70	35	11 90	56	15 0
15	8 85	36	12 05	57	15 0
16	9 00	37	12 20	58	16 0
17	9 15	38	12 35	59	16 0
18	9 30	39	12 50	60	16 0
19	9 40	40	12 70		
20	9 60	41	12 90		

(Dibbits, J pt (2) 10 417 )

Experiments with solutions of sodium hydrogen carbonate show that they gradually decompose after a time (Freudwell Z and 1898, 17 204 )

The source of error of many solubility determinations of this substance is due to loss of CO<sub>2</sub>. Solutions exposed to the air lose CO<sub>2</sub> (McCoy, Am Ch J 1903, 29 435 )

1 l sat solution at 25° contains 98 4 g NaHCO<sub>3</sub> (McCoy and Test, J Am Chem Soc 1911, 33 474 )

$\text{NaHCO}_3 + \text{Aq}$  sat at  $16^\circ$  has sp gr = 1.06904 (Stolba)  
 Nearly insol in sat  $\text{NaCl}$ , or  $\text{Na}_2\text{SO}_4 + \text{Aq}$  (Balmain, B 5 121)

Equilibrium between  $\text{Na}_2\text{CO}_3$  and  $\text{NaHCO}_3$  in  $\text{H}_2\text{O}$  and in contact with the air  
 System  $\text{Na}_2\text{CO}_3$ ,  $\text{NaHCO}_3$ , and  $\text{CO}_2$   
 Temperature,  $25^\circ\text{C}$

Gram atoms Na per liter	Amount solution used for titration cc	Amount Na combined as $\text{Na}_2\text{CO}_3$ Per cent	Amount Na combined as $\text{NaHCO}_3$ Per cent
0.0044	50	8.7	91.3
0.0143	50		
	20	20.0	80.0
0.0562	20		
	10	37.3	62.7
0.2248	10		
	10	59.3	40.7
0.8847	10		
	2	64.0	36.0
	2		
	3		

Temperature,  $37^\circ\text{C}$ 

Gram atoms Na per liter	Amount solution used for titration cc	Amount Na combined as $\text{Na}_2\text{CO}_3$ Per cent	Amount Na combined as $\text{NaHCO}_3$ Per cent
0.0019	50	10.5	89.5
	50		
0.0071	20	21.1	78.9
	20		
0.0276	10	41.3	58.7
	10		
0.030	10	64.5	35.5
	10		
0.421	2	81.9	18.1
	2		
0.815	2	86.5	13.5
	2		
1.795	2+	83.4	16.6
	2		

Temperature,  $50^\circ\text{C}$ 

Gram atoms Na per liter	Amount solution used for titration cc	Amount Na combined as $\text{Na}_2\text{CO}_3$ Per cent	Amount Na combined as $\text{NaHCO}_3$ Per cent
0.0017	50	22.2	77.8
	2		
0.0071	20	32.9	67.1
	20		
0.0266	10	50.7	49.3
	20		
0.1011	10	70.0	30.0
	10		
0.4066	10	81.0	19.0
	2		
0.8068	2	86.8	13.2
	2		
1.7186	2.1	87.1	12.9
	2		

Temperature,  $75^\circ\text{C}$ 

Gram atoms Na per liter	Amount solution used for titration cc	Amount Na combined as $\text{Na}_2\text{CO}_3$ Per cent	Amount Na combined as $\text{NaHCO}_3$ Per cent
0.003	50	25.7	74.3
	25		
0.019	25		
	20	34.8	65.2
	20		
0.036	10	55.7	44.3
	10		
0.270	5	79.5	20.5
	5		
0.702	1	85.0	15.0
	1		
6.56	1	84.8	15.2
	1		

System  $\text{Na}_2\text{CO}_3$  and  $\text{NaHCO}_3$  at  $25^\circ\text{C}$ 

Total salts dissolved grams	$\text{Na}_2\text{CO}_3$		$\text{NaHCO}_3$	
	Weight Grams	Per cent	Weight Grams	Per cent
0.3555	0.0203	5.71	0.3352	94.29
1.1053	0.1505	13.62	0.9548	86.38
4.0443	1.1041	27.30	2.9402	72.70
14.6558	7.0212	47.91	7.6346	52.09
56.3982	29.8223	52.88	26.5759	47.12

(Cameron and Briggs, J phys Chem 1901, 5 540)

100 g alcohol of 0.941 sp gr dissolve 1.2 g  $\text{NaHCO}_3$  at  $15.5^\circ$

100 g glycerol dissolve 8 g  $\text{NaHCO}_3$  at  $15.5^\circ$  (Ossendowski, Pharm J 1907, 79 575)

Insol in acetone (Naumann, B 1904, 37 4329)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Insol in acetone and in methylal (Eidmann, C C 1899, II 1014)

Sodium dihydrogen tricarbonates,  
 $\text{Na}_4\text{H}_2(\text{CO}_3)_3 + 3\text{H}_2\text{O}$ 

More sol than  $\text{NaHCO}_3$ , less sol than  $\text{Na}_2\text{CO}_3$  in  $\text{H}_2\text{O}$  (Rose, Pogg 34 160)

100 pts  $\text{H}_2\text{O}$  dissolve, calculated as  $2\text{Na}_2\text{O}$ ,  $3\text{CO}_2$ —

at $0^\circ$	12.63 pts	at $60^\circ$	29.68 pts
" $10^\circ$	15.50 "	" $70^\circ$	32.55 "
" $20^\circ$	18.30 "	" $80^\circ$	35.8 "
" $30^\circ$	21.15 "	" $90^\circ$	38.63 "
" $40^\circ$	23.95 "	" $100^\circ$	41.59 "
" $50^\circ$	26.78 "		

(Poggiale, A ch (3) 8 468)

Min Froma, Urao Ste  $\text{Na}_3\text{H}(\text{CO}_3)_2 + 2\text{H}_2\text{O}$



**Trisodium hydrogen carbonate**,  $\text{Na}_3\text{H}(\text{CO}_3)_2 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$

True formula of "Trona" and "Urao" (Zepharovich, Zeit Kryst **13** 135, de Mondesir, C R **104** 1505)

**Sodium thorium carbonate**,  $3\text{Na}_2\text{CO}_3, \text{Th}(\text{CO}_3)_2 + 12\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Cleve)

**Sodium uranyl carbonate**,  $2\text{Na}_2\text{CO}_3, (\text{UO}_2)\text{CO}_3$

Slowly sol in  $\text{H}_2\text{O}$  Solution sat at  $15^\circ$  has sp gr = 1.161 (Anthon, Dingl **156** 207)

**Sodium yttrium carbonate**,  $\text{Na}_2\text{CO}_3, \text{Y}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$

Ppt Not decomp by cold  $\text{H}_2\text{O}$  (Cleve)

**Sodium zinc carbonate**,  $3\text{Na}_2\text{O}, 8\text{ZnO}, 11\text{CO}_2 + 8\text{H}_2\text{O} = 3\text{Na}_2\text{CO}_3, 8\text{ZnCO}_3 + 8\text{H}_2\text{O}$

Sl decomp by pure  $\text{H}_2\text{O}$  (Wohler)

Less easily decomp by  $\text{H}_2\text{O}$  than most double carbonates (Deville, A ch (3) **33** 101)

$\text{Na}_2\text{O}, 3\text{ZnO}, 4\text{CO}_2 + 3\text{H}_2\text{O}$  (Kraut, Z anorg **1897**, **13** 13)

**Sodium carbonate sulphite**,  $\text{Na}_2\text{CO}_3, 2\text{Na}_2\text{SO}_3 + 21\text{H}_2\text{O}$

Sol in hot  $\text{H}_2\text{O}$ , sl sol in cold  $\text{H}_2\text{O}$  (Johnson, J Soc Chem Ind **1895**, **14** 271)

**Strontium carbonate**,  $\text{SrCO}_3$

Sol in 18,045 pts  $\text{H}_2\text{O}$  at ordinary temp (Fresenius)

Sol in 12,522 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Kremers, Pogg **85** 247)

Sol in 33,000 pts  $\text{H}_2\text{O}$  (Bineau, C R **41** 511)

Less sol in  $\text{H}_2\text{O}$  than  $\text{SrSO}_4$  (Dulong)

Sol in 1536 pts boiling  $\text{H}_2\text{O}$  (Hcpe, Edinb Trans **4** 5)

Calculated from electrical conductivity of  $\text{SrCO}_3 + \text{Aq}$ ,  $\text{SrCO}_3$  is sol in 121,760 pts  $\text{H}_2\text{O}$  at  $8^\circ$  and 91,468 pts at  $24.3^\circ$  (Holleman, Z phys Ch **12** 130)

1 l  $\text{H}_2\text{O}$  dissolves 11 mg  $\text{SrCO}_3$  at  $18^\circ$  (Kohlrausch and Rose, Z phys Ch **12** 241)  
"Solubility product" =  $15.67 \times 10^{-10}$  mol litic (McCoy and Smith, J Am Chem Soc **1911**, **33** 473)

Sol in 833 pts  $\text{H}_2\text{CO}_3 + \text{Aq}$  at  $10^\circ$  (Gmelin)

Sol in 56,545 pts  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3$

Quite sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ , but reprecipitated on addition of  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Fresenius)

Partially decomp by boiling with aqueous solutions of  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{CaSO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{MgSO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $(\text{NH}_4)_2\text{HPO}_4$ ,  $\text{K}_2\text{SO}_3$ ,  $\text{Na}_2\text{SO}_3$ ,  $(\text{NH}_4)_2\text{SO}_3$ ,  $\text{Na}_2\text{B}_4\text{O}_7$ ,

$\text{Na}_2\text{AsO}_3$ ,  $\text{K}_2\text{AsO}_3$ ,  $\text{K}_2\text{C}_2\text{O}_4$ ,  $\text{Na}_2\text{C}_2\text{O}_4$ ,  $\text{NaF}$  and  $\text{K}_2\text{CrO}_4$  Decomp is complete with the  $\text{NH}_4$  salts (Dulong, A ch **82** 286)

Sl decomp by  $\text{Na}_2\text{SO}_4$ , or  $\text{K}_2\text{SO}_4 + \text{Aq}$  (Persoz)

Easily sol in  $\text{NH}_4$  chloride, nitrate, or succinate +  $\text{Aq}$ , but less so than  $\text{BaCO}_3$  (Fresenius) Sol in ferric salts +  $\text{Aq}$ , with pptn of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  Sol in Na citrate +  $\text{Aq}$  (Spiller) Not decomp by a mixture of 1 pt  $\text{H}_2\text{SO}_4$  and 6 pts absolute alcohol, or by alcoholic solutions of tartaric, racemic, citric or glacial acetic acids, immediately decomp by  $\text{HNO}_3$  + absolute alcohol, or  $\text{H}_2\text{C}_2\text{O}_4$  + abs alcohol

Solubility of  $\text{SrCO}_3$  in  $\text{NH}_4\text{Cl} + \text{Aq}$

% $\text{NH}_4\text{Cl}$	% $\text{SrCO}_3$
5 35	0 179
10	0 259
20	0 358

(Cantoni and Goguelia, Bull Soc **1905**, (**33** 13)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Cl J **1898**, **20** 829)

Insol in methyl acetate (Naumann, J **1909**, **42** 3790), ethyl acetate (Naumann, B **1904**, **37** 3602)

Insol in acetone (Naumann, B **1904**, **3** 4329)

Insol in acetone and in methylal (Ermann, C C **1899**, II 1014)

Min *Strontianite*

**Strontium hydrogen carbonate**

$\text{SrCO}_3$  is sol in 850 pts of sat solution of  $\text{CO}_2$  in  $\text{H}_2\text{O}$

**Strontium uranyl carbonate**,  $\text{SrO}, 2\text{UO}_3, 2\text{CO}_2 + 16\text{H}_2\text{O}$

As  $\text{Ba}$  comp (Blunkoff, Dissert **1900**)

**Terbium carbonate**

Ppt Insol in excess  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Potratz, C N **1905**, **92** 3)

**Thallos carbonate**,  $\text{HlCO}_3$

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{HlCO}_3$  (C = according to Crookes, I = according to Lam) at—

$15.5^\circ$	$18^\circ$	$62^\circ$	$100^\circ$	$100^\circ \text{S}$
4.2	5.23	12.85	27.2	22.4 pts $\text{H}_2\text{CO}_3$
C	I	L	(	I

Insol in absolute alcohol (I), and ether (C)

Insol in acetone and pyridine (Naumann, B **1904**, **37** 4329)

Insol in methyl acetate (Naumann, B **1909**, **42** 3790)

**Thallos carbonate, acid**,  $\text{HlO}, 2\text{CO}_2$

Rather easily sol in cold  $\text{H}_2\text{O}$  (Carstensen)

**THCO<sub>3</sub>** (Giorgis, Gazz ch it 1894, 24 474-479)

**Thalious carbonate platinocyanide**,  $Tl_2CO_3 \cdot Tl_2Pt(CN)_4$

Sl sol in hot, insol in cold H<sub>2</sub>O (Friswell, Chem Soc (2) 9 461)

**Thorium carbonate, basic**,  $2ThO_3 \cdot CO_2 + 3H_2O$

Insol in CO<sub>2</sub>+Aq, but sol in excess of alkali carbonates+Aq, if conc

**Tin (stannous) carbonate**,  $2SnCO_3 \cdot CO_2$

Easily decomp on air, insol in H<sub>2</sub>O or H<sub>2</sub>CO<sub>3</sub>+Aq (Deville, A ch (3) 35 448)

**Uranyl carbonate, basic**,  $5(UO_2)(OH)_2 \cdot 3(UO_2)CO_3 + 6H_2O$

Ppt (Seubert and Elten, Z anorg 1893, 4 80)

**Ytterbium carbonate, basic**,  $Yb(OH)CO_3 + H_2O$

Ppt (Cleve, Z anorg 1902, 32 146)

**Ytterbium carbonate**,  $Yb_2(CO_3)_3 + 4H_2O$

Ppt (Cleve, Z anorg 1902, 32 146)

**Yttrium carbonate**,  $Y_2(CO_3)_3 + 3H_2O$

Insol in H<sub>2</sub>O, very sl sol in H<sub>2</sub>CO<sub>3</sub>+Aq Sol in SO<sub>2</sub>+Aq and all mineral acids Sol in NH<sub>4</sub> salts, and alkali carbonates+Aq to some extent More sol in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq than in K<sub>2</sub>CO<sub>3</sub>+Aq (Berlin) More sol in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq than cerium, but 5 or 6 times less sol than glucinum carbonate (Vauquelin) Sol in large excess of KHCO<sub>3</sub>+Aq (Rose) Slowly sol in NH<sub>4</sub> salts+Aq (Berzelius)

**Zinc carbonates, basic**,  $8ZnO \cdot CO_2 + 2H_2O$ ,  $5ZnO \cdot 2CO_2 + 3$ , or  $7H_2O$ ,  $3ZnO \cdot CO_2 + H_2O$ ,  $11ZnO \cdot 4CO_2 + 14H_2O$ ,  $14ZnO \cdot 5CO_2 + 9H_2O$ ,  $2ZnO \cdot CO_2 + H_2O$ ,  $8ZnO \cdot 3CO_2 + 5H_2O$ , etc

All ppts formed from Zn salts and carbonates+Aq Sol in 2000-3000 pts cold H<sub>2</sub>O, separates out on heating and does not redissolve on cooling (Schindler) Sol in 20,895 pts H<sub>2</sub>O at 15° (Kremers, Pogg 85 248) Sol in 44,600 pts H<sub>2</sub>O at ord temp (Fresenius)

Sol in 1428 pts sat H<sub>2</sub>CO<sub>3</sub>+Aq (Las saigne) Sol in 189 pts H<sub>2</sub>CO<sub>3</sub>+Aq sat at 4-6 atmos (Wagner, Z anal 6 107) Easily sol in KOH, NaOH, NH<sub>4</sub>OH, (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq, and in acids Somewhat sol in alkali bicarbonates and NH<sub>4</sub> salts+Aq (Fresenius) Sol in hot (Fuchs), also cold (Brett, 1837) NH<sub>4</sub>Cl+Aq, less sol in NH<sub>4</sub>NO<sub>3</sub>+Aq (Brett)

Sol in all NH<sub>4</sub> salts+Aq excepting (NH<sub>4</sub>)<sub>2</sub>S +Aq (Terrel, Bull Soc (2) 9 441)

Insol in Na CO<sub>3</sub>, or K CO<sub>3</sub>+Aq Sol in ferric salts+Aq with pptn of Fe<sub>2</sub>O<sub>3</sub>·H<sub>2</sub>O (Fuchs, 1831)

The carbonates described by Boussingault, Wackenroder, Rose, and probably all salts between ZnO, CO<sub>2</sub> and 5ZnO, 2CO<sub>2</sub>, are mixtures (Kraut, Z anorg 1897, 13 1-15)

$3ZnO \cdot CO_2 + 2H_2O$  Min *Zinc bloom*, *Hydrozincite*

$ZnCO_3 \cdot 3ZnO \cdot H_2O$  Min *4uricalcule*

**Zinc carbonate**,  $ZnCO_3$

1 l H<sub>2</sub>O at 15° dissolves 0.01 g, 1 l H<sub>2</sub>O dissolves  $1.64 \times 10^{-4}$  mols, or 0.206 g ZnCO<sub>3</sub> at 25° (Ageno and Valla, Att acc Linc 1911, 20, II 706)

1 l 5.85% NaCl+Aq dissolves 0.0586 g, 1 l 7.45% KCl+Aq dissolves 0.0477 g ZnCO<sub>3</sub> (Essen, Gm -K 4, 1 680)

Sol in acids, KOH+Aq, and NH<sub>4</sub> salts+Aq

Sol in H<sub>2</sub>CO<sub>3</sub>+Aq

Solubility in various salts+Aq

Solvent	g ZnCO <sub>3</sub> sol in 1 l of the solvent
10% NaNO <sub>3</sub> +Aq	0.058981
sat NaNO <sub>3</sub> +Aq	0.149000
5% NaCl+Aq	0.021730
10% NaCl+Aq	0.046564
sat NaCl+Aq	0.130380
10% Na <sub>2</sub> SO <sub>4</sub> +Aq	0.009313
sat Na SO <sub>4</sub> +Aq	0.015521

(Ehlert, Z Elektrochem 1912, 18 728)

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 830)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Min *Calamine*, *Smithsonite*

*Calamine* is sol in NH<sub>4</sub>OH+Aq only in the presence of NH<sub>4</sub> salts (Brandhorst, Zeit angew Ch 1904, 17 513)

+ $\frac{1}{2}$ H<sub>2</sub>O (Mikusch, Z anorg 1908, 56 366)

+H O (Belar, Zeit kryst 1890, 17 126)

**Zinc carbonate ammonia**,  $ZnCO_3 \cdot NH_3$

Slowly decomp by H O, but not on the air or by boiling with alcohol (Favre, A ch (3) 10 474)

**Zinc carbonate hydroxylamine**,  $ZnCO_3 \cdot 2NH_2O$

Insol in H O Decomp by acids (Goldschmidt and Syngros, Z anorg 5 129)

**Zirconium carbonate**,  $3ZrO \cdot CO + 6H_2O$

Decomp by hot H O, all CO being given off (Hermann)

Sol in alkali carbonates+Aq

**Percarbonic acid***See* Percarbonic acid**Carbonic anhydride, CO<sub>2</sub>***See* Carbon dioxide**Carbonophosphoric acid****Potassium carbonophosphate, (K<sub>2</sub>HPO<sub>4</sub>)<sub>2</sub>, 2CO<sub>2</sub>, 2KHCO<sub>3</sub>**

Known only in solution (Barillé, C R 1903, 137 566)

**Carbonyl bromide, COBr<sub>2</sub>**Decomp by H<sub>2</sub>O (Besson, C R 1895, 120 192)**Carbonyl platinumous bromide, CO, PtBr<sub>2</sub>**Sol in H<sub>2</sub>O with almost instant decomp  
Sol in absolute alcohol (Pullinger, Chem Soc 59 603)Quite easily sol in hot C<sub>6</sub>H<sub>6</sub>, insol in ligroine, and can be crystallized from CCl<sub>4</sub>  
Very easily sol in HBr+Aq (Mylus and Forster, B 24 2432)**Carbonyl bromochloride, COClBr**

Decomp by H O (Besson)

**Carbonyl chloride, COCl<sub>2</sub>***Phosgene* Cold H<sub>2</sub>O dissolves 1-2 vols COCl<sub>2</sub> gas with slow decomposition Alcohol decomp immediately Immediately absorbed by KOH, or NH<sub>4</sub>OH+Aq Very sol in glacial HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, benzene, and most liquid hydrocarbons (Berthelot, Bull Soc (2) 13 14)Sol in SCl<sub>2</sub>1 vol AsCl<sub>3</sub> absorbs 10 vols COCl<sub>2</sub>**Dicarbonyl cuprous chloride, Cu<sub>2</sub>Cl<sub>2</sub>, 2CO+4H<sub>2</sub>O**

Decomp by air (Jones, Am Ch J 1899, 22 305)

**Carbonyl platinumous chloride, 2COCl, PtCl**Sl deliquescent Easily sol in H<sub>2</sub>O without decomp, sl sol in alcohol Almost insol in CCl<sub>4</sub> (Pullinger, Chem Soc 59 600)**Monocarbonyl platinumous chloride, CO, PtCl**Decomp by H<sub>2</sub>O and alcohol, sol in hot CCl<sub>4</sub> (Schutzenberger, A ch (4) 15 100)

Sol in conc HCl+Aq (Mylus and Forster)

**Dicarbonyl platinumous chloride, 2CO, PtCl<sub>2</sub>**Decomp by H<sub>2</sub>O and alcohol Sol in CCl<sub>4</sub> (Schutzenberger)Decomp by conc HCl+Aq into CO and CO, PtCl<sub>2</sub> (Mylus and Forster)**Sesquicarbonyl platinumous chloride, 3CO, 2PtCl<sub>2</sub>**Decomp by H<sub>2</sub>O or alcohol Much more sol in CCl<sub>4</sub> than 2CO, PtCl.**Carbonyl platinumous iodide, CO, PtI<sub>2</sub>**Not hygroscopic Insol in, but slowly decomp by, H<sub>2</sub>O Easily sol in benzene ether, also in alcohol, which decomp on warming, sol in HI+Aq (Mylus and Forster)**Carbonyl platinumous sulphide, CO, PtS**

Easily decomp Insol in ordinary solvents (Mylus and Forster)

**Carbonyl sulphide, COS**H<sub>2</sub>O absorbs 1 vol COSAbsorption of COS by H<sub>2</sub>O at t°

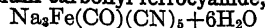
t°	Coefficient of absorption
0	1 333
10	0 835
20	0 561
30	0 403

(Winkler, Z phys Ch 1906, 55 351)

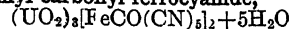
1 ccm H<sub>2</sub>O at 13.5° and 756 mm pr dissolves 0.8 ccm COS (Hempel, Z angew ch 1901, 14 867)1 ccm of a hydrochloric acid solution of Cu<sub>2</sub>Cl<sub>2</sub> absorbs about 0.2 ccm COS (Hempel)**Carbonyl ferrocyanhydric acid**H<sub>3</sub>Fe(CO)(CN)<sub>5</sub>Very sol in H<sub>2</sub>O, decomp on heating (Muller, A ch (6) 17 94)**Cobalt carbonyl ferrocyanide**Sl sol in H<sub>2</sub>O, very sol in dil HNO<sub>3</sub>+ (M)**Cupric carbonyl ferrocyanide,**Cu<sub>2</sub>[Fe(CO)(CN)<sub>5</sub>]Insol in H<sub>2</sub>O H<sub>2</sub>SO<sub>4</sub> or dil HNO<sub>3</sub>+ (M)**Iron (ferric) carbonyl ferrocyanide,**Fe<sub>3</sub>[Fe(CO)(CN)<sub>5</sub>]Insol in H<sub>2</sub>O Sol in HCl O<sub>4</sub>+Aq Insol in acetic, lactic, succinic, tartaric, and citric acids+Aq but easily sol in the neutral salts of those acids Insol in KCl, or KNO<sub>3</sub>+Aq but sensibly sol in NaHPO<sub>4</sub>+Aq Insol even on warming in very dil H<sub>2</sub>SO<sub>4</sub> or H<sub>2</sub>P<sub>4</sub>+Aq (Muller)**Potassium carbonyl ferrocyanide,**K<sub>3</sub>Fe(CO)(CN)<sub>5</sub>+3½H<sub>2</sub>O100 pts H<sub>2</sub>O dissolve 148 pts at 0° (Muller, C R 104 992)

**Silver carbonyl ferrocyanide,**

Insol in  $\text{H}_2\text{O}$ , sl sol in dil  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3$ +Aq, scarcely attacked by conc  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$ +Aq (Muller)

**Sodium carbonyl ferrocyanide,**

Sol in  $\text{H}_2\text{O}$  (Muller)

**Uranyl carbonyl ferrocyanide,**

Sl sol in  $\text{H}_2\text{O}$ , but more easily if  $\text{H}_2\text{O}$  is acidified with  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$

**Cericotungstic acid****Ammonium cericotungstate,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{Ce}_2\text{O}_3$ ,  $16\text{WO}_3$ + $2\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , but decomp by boiling therewith (Smith, J Am Chem Soc 1904, 26 1481)

**Cerium, Ce**

Decomp pure  $\text{H}_2\text{O}$  very slowly at ordinary temp Not attacked by cold conc  $\text{H}_2\text{SO}_4$  or red fuming  $\text{HNO}_3$  Sol in dil  $\text{H}_2\text{SO}_4$ +Aq,  $\text{HNO}_3$ +Aq, and conc or dil  $\text{HCl}$ +Aq (Hillebrand and Norton, Pogg 155 633)

**Cerous bromide,  $\text{CeBr}_3$** 

*Anhydrous* As the chloride (Robinson, Proc Roy Soc 37 150)

Sol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4328)

Sol in methyl acetate (Naumann, B 1909, 42 379C)

+ $x\text{H}_2\text{O}$  Very deliquescent (John)

**Cerium gold bromide,  $\text{CeBr}_3$ ,  $\text{AuBr}_3$ + $8\text{H}_2\text{O}$** 

*See Bromaurate, cerium*

**Cerium carbide,  $\text{CeC}_2$** 

Decomp by fused alkali nitrates, chlorates, hydroxides and carbonates, and by conc  $\text{H}_2\text{SO}_4$  on heating Insol in conc  $\text{HNO}_3$ , decomp by  $\text{H}_2\text{O}$  and dil acids (Moissan, C R 1896, 122 359)

$\text{CeC}_3$  Not attacked by hot conc acids (Delafontaine, J B 1865 176)

**Cerous chloride,  $\text{CeCl}_3$** 

*Anhydrous* Deliquescent Sol in  $\text{H}_2\text{O}$  with hissing and evolution of heat, sol in alcohol

Sol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4328)

Difficultly sol in methyl acetate (Naumann, B 1909, 42 3790)

+ $7\text{H}_2\text{O}$  Insol in  $\text{NH}_4\text{OH}$ +Aq (Dennis, Z anorg 1894, 7 260)

+ $7\frac{1}{2}\text{H}_2\text{O}$  Deliquescent (Berzelius)

Decomp by boiling with  $\text{H}_2\text{O}$  Sol in 1 pt  $\text{H}_2\text{O}$  at ord temp and 3-4 pts alcohol (Dumas)

**Ceric chloride**

Known only in solution, which decomposes by slight heat (Berzelius)

**Cerous mercuric chloride**

Not deliquescent (v Bonsdorff)

$\text{CeCl}_3$ ,  $4\text{HgCl}_2$ + $10\text{H}_2\text{O}$  Permanent, easily sol in  $\text{H}_2\text{O}$  (John, Bull Sec (2) 21 533)

**Cerium stannic chloride**

*See Chlorostannate, cerium*

**Cerous chloride zinc iodide**

Sol in  $\text{H}_2\text{O}$  and alcohol (Holzmann, J pr 84 76)

**Cerous fluoride,  $\text{CeF}_3$** 

Insol ppt

+ $\frac{1}{2}\text{H}_2\text{O}$

**Ceric fluoride,  $\text{CeF}_4$** 

Insoluble precipitate (Berzelius)

+ $\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Brauner, B 14 1944)

**Ceric cobaltous fluoride,  $2\text{CeF}_4$ ,  $\text{CoF}_2$ + $7\text{H}_2\text{O}$** 

Ppt Easily decomp by  $\text{H}_2\text{O}$  (Rumbach, A 1909, 368 107)

**Ceric cupric fluoride,  $2\text{CeF}_4$ ,  $\text{CuF}_2$ + $7\text{H}_2\text{O}$** 

Ppt Decomp by  $\text{H}_2\text{O}$  (Rumbach, l c)

**Ceric nickel fluoride,  $2\text{CeF}_4$ ,  $\text{NiF}_2$ + $7\text{H}_2\text{O}$** 

Ppt Decomp by  $\text{H}_2\text{O}$  (Rumbach, l c)

**Ceric potassium fluoride,  $2\text{CeF}_4$ ,  $3\text{KF}$ + $2\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Brauner, B 14 1944, 15 109)

Could not be obtained pure (Rumbach, l c)

**Ceric zinc fluoride,  $2\text{CeF}_4$ ,  $\text{ZnF}_2$ + $7\text{H}_2\text{O}$** 

Ppt Decomp by  $\text{H}_2\text{O}$  (Rumbach, l c)

**Ceroceric fluoride  $2\text{CeF}_3$ ,  $\text{CeF}_4$** 

*Min Fluocerite*

**Cerium hydride,  $\text{CeH}_2$** 

Decomp by acids (Winkler, B 24 873)

$\text{CeH}_3$  Decomp in moist air, decomp by hot or cold  $\text{H}_2\text{O}$ , sol in acids with evolution of  $\text{H}_2$  Decomp by alkalis (Muthmann, A 1902, 325 266)

**Cerous hydroxide,  $\text{Ce}_2\text{O}_3$ ,  $x\text{H}_2\text{O}$** 

Easily sol in acids Insol in excess of alkali hydroxides+Aq Sol in  $(\text{NH}_4)_2\text{CO}_3$ +Aq

100 ccm of a solution in glycerine+Aq containing about 60% by vol of glycerine contain 7.9 g  $\text{Ce}_2\text{O}_3$  (Muller, Z anorg 1905, 43 322)

Exists in two modifications one insol in

cold HCl + Aq, the other sol in cold HCl + Aq (Brauner, C N 1895, 71 283)

### Ceric hydroxide, $2\text{CeO}_2, 3\text{H}_2\text{O}$

Sol in  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ , also in HCl + Aq, forming cerous chloride and free chlorine. Insol in hydrofluoric, acetic, or formic acids + Aq. Somewhat sol in dil  $\text{HNO}_3$ , or HCl + Aq (Ordway, Am J Sci (2) 26 205). Insol in  $\text{NH}_4\text{OH}$ , KOH, and NaOH + Aq. Sol in alkali carbonates + Aq (Dumas).

Sl sol in  $(\text{NH}_4)_2\text{CO}_3$  + Aq (Ordway). 100 cem of a solution in glycerine + Aq containing about 60% by vol of glycerine contain 0.08 g  $\text{CeO}_2$  (Muller, Z anorg 1905, 43 232).

### Cerous iodide, $\text{CeI}_3$

Sol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4323).

+  $9\text{H}_2\text{O}$ . Very deliquescent and sol in  $\text{H}_2\text{O}$  (Lange, J pr 82 134).

Sol in alcohol.

### Cerium nitride, $\text{CeN}$

Decomp by  $\text{H}_2\text{O}$  and alkali. Sol in mineral acids with formation of cerous and ammonium salts (Muthmann, A 1902, 325 272).

### Cerous oxide, $\text{Ce}_2\text{O}_3$

When ignited, insol in HCl + Aq, when long digested with  $\text{H}_2\text{SO}_4$ , is sol in HCl + Aq with addition of alcohol.

### Ceric oxide, $\text{CeO}_2$

When ignited, is only dissolved in traces, even on heating, by HCl or  $\text{HNO}_3$  + Aq. Sol in conc  $\text{H}_2\text{SO}_4$  when warmed. Sol in the cold in a solution of KI in HCl + Aq (Bunsen), in a mixture of HCl and  $\text{FeCl}_2$  + Aq, or any reducing substance.

### Cerium peroxide, $\text{Ce}_4\text{O}_9$

Insol in boiling conc acids. Sol in  $\text{H}_2\text{SO}_4$  by long digestion (Popp, A 131 361).

Probably does not exist (Rammelsberg, Pogg 108 40).

$\text{Ce}_2\text{O}_5$  (Hermann, J pr 30 184).

Probably does not exist (Rammelsberg).

$\text{CeO}_2 + x\text{H}_2\text{O}$ . Sol in HCl + Aq (Popp, A 131 361), (Lecoq de Boisbaudran, C R 100 605).

$\text{CeO}_2 + \text{H}_2\text{O}_2$ , according to Cleve (Bull Soc (2) 43 57).

### Cerium oxycarbide, $\text{CeC}_2, 2\text{CeO}_2$

Stable in the air. Slowly attacked by cold  $\text{H}_2\text{O}$ . With hot  $\text{H}_2\text{O}$  and with acids, it gives unsat hydrocarbons (Sterba, C R 1902, 134 1053).

### Cerium oxychloride, $\text{CeOCl}$

Slightly attacked by hot conc HCl + Aq. Slowly sol in conc  $\text{HNO}_3$  + Aq (Wohler).

Easily sol in dil acids (Didier, C R 1 1882).

### Cerium oxychloride tungsten trioxide, $\text{CeO}_2, \text{WO}_3$

(Didier, C R 102 823).

### Cerium selenide

Insol in  $\text{H}_2\text{O}$ , difficultly sol in acids (Berzelius).

### Cerium silicide, $\text{CeSi}_2$

Insol in  $\text{H}_2\text{O}$ , by which it is acted upon only very slowly.

Sol in HCl and HF + Aq with evolution of  $\text{H}_2$ .

Not attacked by alkalis + Aq or  $\text{NH}_4\text{OH}$  + Aq.

Insol in organic solvents (Sterba, C 1902, 135 170).

### Cerium silicide, $\text{Ce}_2\text{Si}_3$

Insol in acids (Ullik, W A B 52, 115).

### Cerium disulphide, $\text{Ce}_2\text{S}_4$

Not decomp by cold  $\text{H}_2\text{O}$ .

Slowly sol in cold dil  $\text{H}_2\text{SO}_4$ , HCl and acetic acid. Rapidly sol in warm dil  $\text{H}_2\text{SO}_4$ , HCl and acetic acid with decomp (Biltz, 1908, 41 3342).

### Cerium sesquisulphide, $\text{Ce}_2\text{S}_3$

Insol in, and not decomp by  $\text{H}_2\text{O}$ , but easily decomp by the weakest acids (M sander), (Didier, C R 100 1161).

### Monochloramine, $\text{NH}_2\text{Cl}$

Easily sol in  $\text{H}_2\text{O}$  (Ruschig, Ch Z 190 31 926).

### Chlorotetraamine comps

See Chlorotetramine comps

### Metachlorantimonic acid, $\text{HSbCl}_6 + 4\text{H}_2\text{O}$

Hydroscopic. Sol in  $\text{H}_2\text{O}$  with decomp. Sol in alcohol, acetone, and acetic acid (Weinland, Z anorg 1905 44 1).

### Metachlorantimonic acid ammonia, $\text{HSbCl}_6, 2\text{NH}_3$

Sol in  $\text{H}_2\text{O}$  and in alcohol (Weinland, Z anorg 1905, 44 59).

### Aluminum metachlorantimonate, $\text{AlSbCl}_6 + 15\text{H}_2\text{O}$

Hydroscopic.

Sol in dil HCl + Aq (Weinland, B 190 36 254).

<b>Ammonium metachlorantimonate</b> , $\text{NH}_4\text{SbCl}_6 + \text{H}_2\text{O}$ Hydroscopic Sol in $\text{H}_2\text{O}$ Solution decomp slowly when cold, rapidly on warming Sol in dil $\text{HCl}$ (Weinland, B 1903, 36 251)	Sol in dil $\text{HCl} + \text{Aq}$ (Weinland, B 1903, 36 250)
<b>Cadmium metachlorantimonate ammonia</b> , $\text{Cd}(\text{SbCl}_6)_2, 7\text{NH}_3$ Ppt (Weinland and Schmid, Z anorg 1905, 44 56)	<b>Rubidium metachlorantimonate</b> , $\text{RbSbCl}_6$ Hydroscopic Sol in dil $\text{HCl} + \text{Aq}$ (Weinland)
<b>Calcium metachlorantimonate</b> , $\text{Ca}(\text{SbCl}_6)_2 + 9\text{H}_2\text{O}$ Hydroscopic Sol in dil $\text{HCl} + \text{Aq}$ (Weinland, B 1903, 36 253)	<b>Silver metachlorantimonate ammonia</b> , $\text{AgSbCl}_6, 2\text{NH}_3$ Decomp by $\text{H}_2\text{O}$ (Weinland and Schmid)
<b>Chromium metachlorantimonate</b> , $\text{Cr}(\text{SbCl}_6)_3 + 13\text{H}_2\text{O}$ Hydroscopic Sol in dil $\text{HCl} + \text{Aq}$ (Weinland)	<b>Zinc metachlorantimonate ammonia</b> , $\text{Zn}(\text{SbCl}_6)_2, 4\text{NH}_3$ (Weinland and Schmid)
<b>Chromium orthochlorantimonate</b> , $\text{CrSbCl}_6 + 10\text{H}_2\text{O}$ Hydroscopic Sol in dil $\text{HCl} + \text{Aq}$ (Weinland)	<b>Chlorarsenious acid</b> <i>See Arsenyl chloride</i>
<b>Cupric metachlorantimonate ammonia</b> , $\text{Cu}(\text{SbCl}_6)_2, 5\text{NH}_3$ (Weinland and Schmid, Z anorg 1905, 44 55)	<b>Chloraureic acid</b> , $\text{HAuCl}_4 + 4\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ , alcohol, and ether Sol in $\text{POCl}_3$ (Walden, Z anorg 1900, 25 212) Difficultly sol in $\text{PCl}_3$ (Walden) Cryst with $3\text{H}_2\text{O}$ as stated by Weber and Schottlander and not with $4\text{H}_2\text{O}$ as stated by Thomsen (Schmudt, C C 1906, II 855)
<b>Glucium metachlorantimonate</b> , $\text{Gl}(\text{SbCl}_6)_2 + 10\text{H}_2\text{O}$ Very hydrescopic Sol in dil $\text{HCl}$ (Weinland, B 1903, 36 252)	<b>Chloraurates</b> All chloraurates are easily sol in $\text{H}_2\text{O}$ and in alcohol (v Bonsdorff, 1829)
<b>Iron (ferric) orthochlorantimonate</b> , $\text{FeSbCl}_6 + 8\text{H}_2\text{O}$ Hydroscopic Can easily be cryst from dil $\text{HCl} + \text{Aq}$ (Weinland)	<b>Ammonium chloraurate</b> , $\text{NH}_4\text{AuCl}_4 + \text{H}_2\text{O}$ Very easily sol in $\text{H}_2\text{O}$ $+ 2\text{H}_2\text{O}$ Very easily sol in $\text{H}_2\text{O}$
<b>Lithium metachlorantimonate</b> , $\text{LiSbCl}_6 + 4\text{H}_2\text{O}$ Very hydroscopic Sol in dil $\text{HCl} + \text{Aq}$ (Weinland, l c)	<b>Barium chloraurate</b> , $\text{Ba}(\text{AuCl}_4)_2 + x\text{H}_2\text{O}$ Deliquescent in moist air Sol in $\text{H}_2\text{O}$ and alcohol (v Bonsdorff, Pogg 17 261)
<b>Magnesium pyrochlorantimonate</b> , $\text{MgSbCl}_6 + 9\text{H}_2\text{O}$ Hydroscopic Sol in dil $\text{HCl} + \text{Aq}$ (Weinland)	<b>Cadmium chloraurate</b> Not deliquescent Sol in $\text{H}_2\text{O}$ and alcohol (v Bonsdorff)
<b>Nickel metachlorantimonate ammonia</b> , $\text{Ni}(\text{SbCl}_6)_2, 6\text{NH}_3$ Sol in $\text{H}_2\text{O}$ (Weinland and Schmid, Z anorg 1905, 44 57)	<b>Cæsium chloraurate</b> , $\text{CsAuCl}_4$ 100 pts aqueous sat solution contain at 10° 20° 30° 40° 50° 0.5 0.8 1.7 3.2 5.4 pts anhydrous salt, 60° 70° 80° 90° 100° 8.2 12.0 16.3 21.7 27.5 pts anhydrous salt (Rosenblatt, B 19 2538) $+ \frac{1}{2}\text{H}_2\text{O}$ (Wells and Wheeler, Am J (3) 44 157)
<b>Potassium metachlorantimonate</b> , $\text{KSbCl}_6 + \text{H}_2\text{O}$ Hydroscopic Sol in $\text{H}_2\text{O}$ Solution decomp slowly when cold rapidly when warmed	<b>Calcium chloraurate</b> , $\text{Ca}(\text{AuCl}_4)_2 + 6\text{H}_2\text{O}$ Deliquescent Sol in $\text{H}_2\text{O}$ and alcohol (v Bonsdorff) <b>Cerium chloraurate</b> , $\text{CeCl}_3, \text{AuCl}_3 + 10\text{H}_2\text{O}$ Extremely deliquescent Easily sol in $\text{H}_2\text{O}$ and absolute alcohol (Holzmann, C C 1863 206) $+ 13\text{H}_2\text{O}$ (John, Bull Soc (2) 21 534)

**Cobalt chloraurate**,  $\text{Co}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  and alcohol (Topsoe)

**Didymium chloraurate**,  $\text{DyCl}_3, \text{AuCl}_3 + 10\text{H}_2\text{O}$

Very deliquescent (Cleve, Bull Soc (2)

43 361)

$2\text{DyCl}_3, 3\text{AuCl}_3 + 20\text{H}_2\text{C}$  (Cleve)

**Gadolinium chloraurate**,  $\text{GdCl}_3, \text{AuCl}_3 + 10\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Benedicks, Z anorg 1900, 22 404)

**Lanthanum chloraurate**,  $\text{LaCl}_3, \text{AuCl}_3 + 5\text{H}_2\text{O}$

Deliquescent in moist air Sol in  $\text{H}_2\text{O}$  (Cleve, B 8 128)

**Lithium chloraurate**,  $\text{LiAuCl}_4$

100 pts aqueous solution contain at

10° 20° 30° 40°  
53 1 57 7 62 5 67 3 pts anhydrous salt,

50° 60° 70° 80°  
72 0 76 4 81 0 85 7 pts anhydrous salt  
(Rosenbladt)

+2 $\text{H}_2\text{O}$  (Antony and Lucchesi, Gazz ch  
it 1890, 20 601)

+4 $\text{H}_2\text{O}$  Not stable

Sol in  $\text{H}_2\text{O}$  and alcohol (Fasbender, C C  
1894, I 409)

**Magnesium chloraurate**,  $\text{Mg}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$

Somewhat deliquescent Sol in  $\text{H}_2\text{O}$  and  
alcohol (Topsoe)

+12 $\text{H}_2\text{O}$

**Manganese chloraurate**,  $\text{Mn}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$

Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol  
(Topsoe)

+12 $\text{H}_2\text{O}$

**Nickel chloraurate**,  $\text{Ni}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$

Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol  
(Topsoe)

**Potassium chloraurate**,  $\text{KAuCl}_4$

Anhydrous Very stable (Lainer, W A  
B 99, 2b 247)

100 pts solution in  $\text{H}_2\text{O}$  contain at

10° 20° 30°  
27 7 38 2 43 7 pts anhydrous salt,

40° 50° 60°  
59 2 70 0 80 2 pts anhydrous salt

(Rosenbladt, B 19 2538)

Sol in  $\text{H}_2\text{O}$  and alcohol, insol in ether  
(Fasbender, C C 1894, I 409)

1 pt is sol in 4 pts 98% alcohol (Fas-  
bender, C C 1894, II 609)

+2 $\text{H}_2\text{O}$  Efflorescent

+½ $\text{H}_2\text{O}$

**Praseodymium chloraurate**,  $\text{PrCl}_3, \text{AuCl}_3 + 10\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , sol in conc HCl (v  
Schule Z anorg 1898, 18 354)

**Rubidium chloraurate**,  $\text{RbAuCl}_4$

100 pts sat  $\text{RbAuCl}_4 + \text{Aq}$  contain at

10° 20° 30° 40° 50°  
4 6 9 0 13 4 17 7 22 2 pts anhydrous sal

60° 70° 80° 90° 100°  
26 6 31 0 35 3 39 7 44 2 pts anhydrous sal  
(Rosenbladt)

1 pt sol in 54 pts 98% alcohol Insol  
ether (Fasbender, C C 1894, II 609)

**Samarium chloraurate**,  $\text{SmCl}_3, \text{AuCl}_3 + 10\text{H}_2\text{O}$

Deliquescent Easily sol in  $\text{H}_2\text{O}$  (Clev  
Bull Soc (2) 43 165)

**Scandium chloraurate**,  $3\text{ScCl}_3, 2\text{AuCl}_3 + 21\text{H}_2\text{O}$

Very deliquescent (Crookes, Phil Tran  
1910, 210 A, 365)

**Silver chloraurate**,  $\text{AgAuCl}_4$

Decomp in the air  
Decomp by  $\text{H}_2\text{O}$ , HCl and  $\text{NH}_3$  (Herr-  
mann, B 1894, 27 597)

**Sodium chloraurate**,  $\text{NaAuCl}_4 + 2\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  and absolute alcohol  
100 pts aqueous solution contain at

10° 20° 30°  
58 2 60 2 64 0 pts anhydrous salt,

40° 50° 60°  
69 4 77 5 90 0 pts anhydrous salt  
(Rosenbladt)

Easily sol in  $\text{NaCl} + \text{Aq}$   
Easily sol in  $\text{H}_2\text{O}$ , alcohol and ether (Fas-  
bender, C C 1894, I 409)

**Strontium chloraurate**

Sol in  $\text{H}_2\text{O}$  (v Bonsdorff)

**Thallium chloraurate**

(Carstensen)

**Ytterbium chloraurate**,  $\text{YbCl}_3, \text{AuCl}_3 + 9\text{H}_2\text{O}$

Ppt (Cleve, Z anorg 1902, 32 138)

**Yttrium chloraurate**,  $\text{YtCl}_3, 2\text{AuCl}_3 + 16\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Cleve)

**Zinc chloraurate**,  $\text{Zn}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Topsoe)  
+12 $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  and alcohol (v  
Bonsdorff)

**Chlorauricyanhydric acid****Barium chlorauricyanide**,  $\text{Ba}[\text{Au}(\text{CN})_2\text{Cl}_2]_2 + 8\text{H}_2\text{O}$ Very sol in  $\text{H}_2\text{O}$  or alcohol (Lindbom, Lund Univ Arsk 12 No 6)**Potassium chlorauricyanide**,  $\text{KAu}(\text{CN})_2\text{Cl}_2 + \text{H}_2\text{O}$ Very sol in  $\text{H}_2\text{O}$  or alcohol**Strontium chlorauricyanide**,  $\text{Sr}[\text{Au}(\text{CN})_2\text{Cl}_2]_2 + 8\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$ **Zinc chlorauricyanide**,  $\text{Zn}[\text{Au}(\text{CN})_2\text{Cl}_2]_2 + 7\text{H}_2\text{O}$ Very sol in  $\text{H}_2\text{O}$ **Chlorhydric acid, HCl***Liquid* Miscible with liquid  $\text{CO}_2$ , and  $\text{H}_2\text{S}$ *Gas* Absorbed by  $\text{H}_2\text{O}$  with production of much heat $\text{H}_2\text{O}$  absorbs 400–500 vols at ord temp and pressure or a little less than 1 pt. by weight (Dalton)1 vol  $\text{H}_2\text{O}$  absorbs 480 vols at  $0^\circ$  sp gr of sat solution is 1.2109 (Davy)1 vol  $\text{H}_2\text{O}$  absorbs 417 822 vols at  $20^\circ$  the vol in creasing to 1 4138 vols 1 vol of  $\text{HCl} + \text{Aq}$  then contains 311 vols  $\text{HCl}$  has sp gr 1.1958 and contains 40.39%  $\text{HCl}$  by weight (Thomson 1831)1 vol  $\text{H}_2\text{O}$  absorbs 464 vols and sat solution has 1.21 sp gr and contains 42.4%  $\text{HCl}$  by weight (Wittstein) $\text{H}_2\text{O}$  sat at  $0^\circ$  contains 480 times its vol of  $\text{HCl}$  and sp gr = 1.2109 sat at ord temp contains 38.3% of its weight in  $\text{HCl}$  and sp gr = 1.192 (Berzelius)1 vol  $\text{H}_2\text{O}$  absorbs 5 vols  $\text{HCl}$  at  $0^\circ$  and 760 mm pressure and the liquid formed has the given sp gr and contains the given per cent  $\text{HCl}$ 

t	V	Sp gr	% HCl
0	25.2	1.2257	45.148
4	494.7	1.2205	44.361
8	480.3	1.218	43.828
12	471.3	1.2148	43.277
16	462.4	1.2074	42.829
18	1.1.2	1.2064	42.344
18.5	1.30.7	1.20.6	42.283
24	1.1.0	1.20.4	41.536

(Ducke, Lohk 119.16)

At 760 mm pressure 1 g  $\text{H}_2\text{O}$  absorbs g  $\text{HCl}$  at  $t^\circ$ 

t	g HCl	t	g HCl	t	g HCl
0	0.825	22	0.710	44	0.618
2	0.814	24	0.700	46	0.611
4	0.804	26	0.691	48	0.603
6	0.793	28	0.682	50	0.596
8	0.783	30	0.673	52	0.589
10	0.772	32	0.665	54	0.582
12	0.762	34	0.657	56	0.575
14	0.752	36	0.649	58	0.568
16	0.742	38	0.641	60	0.561
18	0.731	40	0.633		
20	0.721	42	0.626		

(Roscoe and Dittmar)

Conc  $\text{HCl} + \text{Aq}$  loses  $\text{HCl}$ , and dil  $\text{HCl} + \text{Aq}$  loses  $\text{H}_2\text{O}$  on warming, until an acid of constant composition is formed, containing 20.18%  $\text{HCl}$ , with a sp gr of 1.101 at  $15^\circ$ , which can be distilled unchanged at  $110^\circ$  (Bineau, A ch (3) 7 257)

The above is true if barometer is at 760 mm, but the composition changes with the pressure as follows—

Mm Hg	% HCl	Mm Hg	% HCl	Mm Hg	% HCl
50	23.2	800	20.2	1700	18.8
100	22.9	900	19.9	1800	18.7
200	22.3	1000	19.7	1900	18.6
300	21.8	1100	19.5	2000	18.5
400	21.4	1200	19.4	2100	18.4
500	21.1	1300	19.3	2200	18.3
600	20.7	1400	19.1	2300	18.2
700	20.4	1500	19.0	2400	18.1
760	20.24	1600	18.9	2500	18.0

(Roscoe and Dittmar)

Conc  $\text{HCl} + \text{Aq}$  gradually gives off  $\text{HCl}$  on the air until it has a sp gr 1.128 at  $15^\circ$ , and contains 25.2%  $\text{HCl}$  (Bineau, l c)According to Roscoe and Dittmar, this depends on the temperature. If a current of air is passed through  $\text{HCl} + \text{Aq}$ , acid or water is given off according as the acid is strong or weak, until an acid of constant composition for a given temperature is formed, as follows—

Temp	% HCl	Temp	% HCl	Temp	% HCl
$0^\circ$	25.0	$35^\circ$	23.9	$70^\circ$	22.6
5	24.9	40	23.8	75	22.3
10	24.7	45	23.6	80	22.0
15	24.6	50	23.4	85	21.7
20	24.4	55	23.2	90	21.4
25	24.3	60	23.0	95	21.1
30	24.1	65	22.8	100	20.7

From the above it is seen that the acid which distils unchanged at a given pressure, that is, boils at a certain constant temperature, is identical with the acid which undergoes no change in composition by a current of dry air at the same temperature, and under the ordinary pressure, thus—

Mm Hg	B pt	% HCl	Temp of air current	% HCl
100	61–62°	22.8	62°	22.9
200	76–77	22.1	77	22.2
300	84–85	21.7	85	21.7
380	91	21.3	91	21.4
490	97	20.9	98	21.1
620	103	20.6		

(Roscoe and Dittmar)



Solubility of HCl in H<sub>2</sub>O at 0° under different degrees of pressure P=partial pressure in mm Hg,  $\bar{e}$ , total pressure minus the tension of aqueous vapour at the given temp., G=grammes of HCl dissolved in 1 g H<sub>2</sub>O at the pressure P and 0° temp

P	G	P	G
60	0 613	350	0 751
70	0 628	400	0 763
80	0 640	450	0 772
90	0 649	500	0 782
100	0 657	550	0 791
110	0 664	600	0 800
120	0 670	650	0 808
130	0 676	700	0 817
140	0 681	750	0 824
150	0 686	800	0 831
175	0 697	900	0 844
200	0 707	1000	0 856
225	0 716	1100	0 869
250	0 724	1200	0 882
275	0 732	1300	0 895
300	0 738		

(Roscoe and Dittmar, A 112 334)

1 vol H<sub>2</sub>O dissolves 560 vols HCl at -12°

" " 500 " " 0°

" " 440 " " +20°

(Berthelot, C R 76 779)

1 vol H<sub>2</sub>O absorbs 480 vols HCl at 15° to form a solution containing 42.85% HCl with a sp gr of 1.215 (Hager)

Solubility of HCl at low temperatures, and 760 mm pressure

t	Pts HCl in 1 pt H <sub>2</sub> O	t°	Pts HCl in 1 pt H <sub>2</sub> O
0	0 842	-18	0 957
-5	0 864	-19	0 965
-10	0 898	-20	0 974
-15	0 933	-21	0 983
-17	0 949	-24	1 012

(Rooreboom, R t c 1884, 3 79)

Solubility in H<sub>2</sub>O at t°

t	%HCl
50	61 65
45	61 76
40	62 27
35	62 90
30	63 21
20	64 19
15	64 70
10	65 18
5	65 48
0	65 85
-5	66 44
-10	66 71
-50	67 29
-20	67 65

(Rupert, J Am Chem Soc 1909, 31 860)

Sp gr of HCl+Ag

Sp gr	% HCl	Sp gr	% HCl	Sp gr	% H
1 203	40 66	1 1285	27 21	1 0960	20
1 179	37 00	1 1197	25 53	1 0902	19
1 162	33 95	1 1127	24 03	1 0860	18
1 149	31 35	1 1060	22 70	1 0820	17
1 139	29 13	1 1008	21 51	1 0780	17

(Thomson in his System 2 189)

Sp gr of HCl+Ag

Sp gr	% HCl	Sp gr	% HCl
1 21	12 43	1 10	20 20
1 20	40 60	1 09	18 18
1 19	38 38	1 08	16 16
1 18	36 36	1 07	14 14
1 17	34 34	1 06	12 12
1 16	32 32	1 05	10 10
1 15	30 30	1 04	8 08
1 14	28 28	1 03	6 06
1 13	26 26	1 02	4 04
1 12	24 24	1 01	2 02
1 11	20 30		

(Edm Davy)

Sp gr of HCl+Ag

Sp gr	% HCl	B pt	Sp gr	% HCl	B p
1 199	34 01	49°	1 094	16 08	111°
1 181	31 09	65	1 075	13 16	109
1 166	28 29	76	1 064	11 16	107
1 154	26 57	87	1 047	8 62	105
1 144	24 94	100	1 035	6 92	104
1 136	23 25	103	1 018	5 53	102
1 127	21 06	105	1 009	1 86	101
1 121	20 74	109			

(Kirwan and Dalton)

Sp gr of HCl+Ag at 1

% HCl	Sp gr	% HCl	Sp gr
2 22	1 0103	29 72	1 1304
5 80	1 0189	31 50	1 1388
6 26	1 0310	31 24	1 1730
11 02	1 0557	30 63	1 1811
15 20	1 0751	38 67	1 1938
18 67	1 0912	40 1	1 2021
20 91	1 1048	41 72	1 2074
23 72	1 1196	43 09	1 2121
25 96	1 1308		

(Kirby C R 74 337)

Sp gr of HCl+Ag at 1

Sp gr	HCl	Sp gr	HCl	Sp gr	HCl
1 2000	40 777	1 1620	2 0 1	1 1 01	1 161
1 1982	40 369	1 1 11	3 21	1 118	1 0 8
1 1964	31 961	1 1 78	1 80	1 114	3 0 6
1 1946	39 1	1 1 37	31 398	1 111	2 21
1 1928	31 110	1 1 36	30 000	1 112	2 831
1 1910	38 738	1 1 11	30 82	1 110	1 2
1 1893	38 330	1 1194	30 171	1 108	2 019
1 1875	37 923	1 1173	29 767	1 1061	2 1 611
1 1857	37 516	1 1152	9 50	1 1041	1 03
1 1840	37 108	1 1131	28 9 1	1 1020	0 706
1 1822	36 700	1 1110	8 41	1 1000	20 88
1 1804	36 292	1 1384	28 13	1 0980	1 980
1 1786	35 884	1 1369	27 728	1 0960	1 72
1 1768	35 476	1 1349	27 21	1 0939	1 165
1 1741	35 068	1 1 28	26 013	1 0919	18 757
1 1721	34 660	1 1308	25 5	1 0899	18 349
1 1701	34 252	1 1287	25 098	1 0879	17 941
1 1681	33 845	1 1267	24 690	1 0859	17 534
1 1661	33 437	1 1247	24 282	1 0838	17 126
1 1641	33 029	1 1226	24 874	1 0818	16 718

Sp gr of HCl+Aq at 15°—*C. nrmued*

Sp gr	% HCl	Sp gr	% HCl	Sp gr	% HCl
1 0798	16 310	1 0517	10 602	1 0299	5 301
1 0778	15 902	1 0497	10 194	1 0239	4 893
1 0758	15 494	1 0477	9 768	1 0220	4 486
1 0738	15 087	1 0457	9 379	1 0200	4 078
1 0718	14 679	1 0437	8 971	1 0180	3 670
1 0697	14 271	1 0417	8 563	1 0160	3 262
1 0677	13 863	1 0397	8 155	1 0140	2 854
1 0657	13 456	1 0377	7 747	1 0120	2 447
1 0637	13 049	1 0357	7 340	1 0100	2 039
1 0617	12 641	1 0337	6 932	1 0080	1 631
1 0597	12 233	1 0318	6 524	1 0060	1 224
1 0577	11 825	1 0298	6 116	1 0040	0 816
1 0557	11 418	1 0279	5 709	1 0020	0 408
1 0537	11 010				

(Ure Handwörterbuch)

Sp gr of HCl+Aq U=sp gr at 15 55°  
according to Ure, K=sp gr at 15° ac-  
cording to Kremers

% HCl	U	K	% HCl	U	K
1	1 005	1 005	22	1 109	1 111
2	1 010	1 010	23	1 114	1 116
3	1 015	1 015	24	1 119	1 121
4	1 020	1 020	25	1 124	1 126
5	1 025	1 025	26	1 128	1 131
6	1 030	1 030	27	1 133	1 136
7	1 034	1 034	28	1 138	1 141
8	1 039	1 039	29	1 143	1 146
9	1 044	1 044	30	1 147	1 151
10	1 048	1 048	31	1 153	1 157
11	1 053	1 053	32	1 157	1 163
12	1 059	1 059	33	1 163	1 169
13	1 064	1 065	34	1 169	1 179
14	1 069	1 070	35	1 174	
15	1 074	1 075	36	1 179	
16	1 079	1 080	37	1 183	
17	1 084	1 085	38	1 188	
18	1 089	1 090	39	1 193	
19	1 094	1 095	40	1 197	
20	1 098	1 100	41	1 203	
21	1 104	1 105			

(Calculated by Gerlach, Z anal 8 292)

Sp gr of HCl+Aq at 15° (H O at 0°=1)

HCl	Sp gr	HCl	Sp gr	HCl	Sp gr
0	0 9992	15	1 07539	30	1 15079
1	1 00503	16	1 08042	31	1 15581
2	1 01005	17	1 08545	32	1 16084
3	1 01508	18	1 09047	33	1 16587
4	1 02010	19	1 09550	34	1 17089
5	1 02513	20	1 10052	35	1 17592
6	1 03016	21	1 10555	36	1 18095
7	1 03518	22	1 11058	37	1 18597
8	1 04021	23	1 11560	38	1 191
9	1 04524	24	1 12063	39	1 196
10	1 05026	25	1 12566	40	1 200
11	1 05529	26	1 13068	41	1 204
12	1 06031	27	1 13571	42	1 208
13	1 06534	28	1 14074	43	1 212
14	1 07037	29	1 14516		

(Kolb, recalculated by Gerlach, Z anal 27 316)

Sp gr of HCl+Aq at 15°

% HCl	Sp gr	% HCl	Sp gr	% HCl	Sp gr
5	1 0244	20	1 0982	35	1 1739
10	1 0488	25	1 1234	40	1 1969
15	1 0733	30	1 1488	41	1 2013

(Hager, Adjumenta varia, Leipzig, 1876)

Sp gr of HCl+Aq at 15° (H<sub>2</sub>O at 15°=1)

% HCl	Sp gr	% HCl	Sp gr
44 345	1 21479	34 464	1 17138
43 136	1 21076	25 260	1 12479
41 901	1 20430	19 688	1 09675
41 212	1 20204	14 788	1 07255
39 831	1 19708	6 382	1 03150
37 596	1 18687		

(Pickering, B 26 277)

Most accurate table

Sp gr of HCl+Aq at 15° (H O at 4°=1)

Sp gr	% HCl	Kg HCl in 1 l	Sp gr	% HCl	Kg HCl in 1 l
1 000	0 16	0 016	1 105	20 97	0 232
1 005	1 15	0 012	1 110	21 92	0 243
1 010	2 14	0 022	1 115	22 86	0 255
1 015	3 12	0 032	1 120	23 82	0 267
1 020	4 13	0 042	1 125	24 78	0 278
1 025	5 15	0 053	1 130	25 75	0 291
1 030	6 15	0 064	1 135	26 70	0 303
1 035	7 15	0 074	1 140	27 66	0 315
1 040	8 16	0 085	1 145	28 61	0 322
1 045	9 16	0 096	1 150	29 57	0 340
1 050	10 17	0 107	1 155	30 55	0 353
1 055	11 18	0 118	1 160	31 52	0 366
1 060	12 19	0 129	1 165	32 49	0 379
1 065	13 19	0 141	1 170	33 46	0 392
1 070	14 17	0 152	1 175	34 42	0 404
1 075	15 16	0 163	1 180	35 39	0 418
1 080	16 15	0 174	1 185	36 31	0 430
1 085	17 13	0 186	1 190	37 23	0 443
1 090	18 11	0 197	1 195	38 16	0 456
1 095	19 06	0 209	1 200	39 11	0 469
1 100	20 01	0 220			

(Tunge and Marchlewski, Z angew Ch 1891 133)

Sp gr of HCl+Aq at room temp

% HCl	Sp gr
8 14	1 0370
16 12	1 0843
23 045	1 1138

(Wagner, W Ann 1883, 18 264)

Relation of sp gr of HCl+Aq at  $t^{\circ}$  to sp gr at  $19.5^{\circ}=1.0$ 

t	8.9 % HCl sp gr = 1.0401	16.6 % HCl sp gr = 1.0704	25.5 % HCl sp gr = 1.101	35.8 % HCl sp gr = 1.133	46.6 % HCl sp gr = 1.1608
0	0.99557	0.99379	0.99221	0.99079	0.98982
19.5	1.00000	1.00000	1.00000	1.00000	1.00000
40	1.00707	1.00781	1.00877	1.00990	1.01063
60	1.01588	1.01665	1.01794	1.01969	1.02180
80	1.02639	1.02676	1.02791	1.02986	
100	1.03855	1.03801	1.03867	1.04059	

(Kremers, Pogg 108 115)

## Sp gr of HCl+Aq

G equivalents HCl per liter	$t^{\circ}$	Sp gr $t^{\circ}/t^{\circ}$
0.005036	17.111	1.0000943
0.01006	17.125	1.0001892
0.02008	17.148	1.0003775
0.04990	17.138	1.000935
0.09885	17.133	1.001843
0.19641	17.162	1.003633
0.29247	17.147	1.005382
0.48278	17.140	1.008811
0.4994	17.28	1.00908
4.994	17.35	1.08390

(Kohlrausch, W Ann 1894, 53 28)

Sp gr of a normal solution of HCl+Aq at  $18^{\circ}/4^{\circ}=1.0165$  (Loomis, W Ann 1896, 60 550)

Sp gr of HCl+Aq at  $19.5^{\circ}$ , when p = per cent strength of solution, d = observed density, w = volume conc in grams per cc ( $\frac{pd}{100} = w$ )

p	d	w
36.0	1.1818	0.4255
29.97	1.1511	0.3450
24.35	1.1207	0.2729
18.55	1.0910	0.2024
12.22	1.0587	0.1294
9.148	1.0433	0.0954
6.559	1.0305	0.0676
3.540	1.0159	0.0360
5.345	1.0246	0.0548
1.356	1.0051	0.0136

(Barnes, J Phys Chem 1898, 2 546)

Sp gr of HCl+Aq at  $18^{\circ}/4^{\circ}$ 

% HCl in 100 g of solution	Sp gr
0.12149	0.99928
0.60757	0.99900
0.040609	0.99887
0.030328	0.99881

(Jahn, Z phys Ch 1900, 33 567)

Sp gr of HCl+Aq at  $20^{\circ}$ 

Normality of HCl+Aq	% HCl	Sp gr
8.42	27.10	1.1336
5.784	19.30	1.0936
3.77	12.94	1.0618
2.031	7.17	1.0334
1.588	5.65	1.0261
1.138	4.05	1.0187
0.523	1.90	1.0076

(Forchheimer, Z phys Ch 1900, 34 28)

Sp gr at  $20^{\circ}$  of HCl+Aq containing M g mols HCl per liter

M	0.025	0.05	0.075	0.10
Sp gr	1.00034	1.00101	1.00135	1.00181

M	0.25	0.50	0.75	1.0
Sp gr	1.00425	1.00849	1.01264	1.01744

M	1.5	2.0
Sp gr	1.02542	1.03414

(Jones and Pearce, Am Ch J 1907, 38 730)

HCl is not absorbed by conc.  $\text{H}_2\text{SO}_4$ +Aq but in large amounts by anhydrous  $\text{H}_2\text{SO}_4$  (Aimé)

Absorption of HCl by  $\text{H}_2\text{SO}_4$ +Aq1 cm p =  $17^{\circ}$ 

Sp gr	g per l		g per 100 g	
	HCl	$\text{H}_2\text{SO}_4$	HCl	$\text{H}_2\text{SO}_4$
1.211	517.8		42.7	
1.220	487.3	22.7	39.9	1.86
1.220	478.8	58.0	39.2	4.75
1.235	455.3	99.3	36.9	8.04
1.260	418.0	161.7	33.2	12.8
1.305	371.4	273.2	28.5	20.9
1.355	306.6	417.7	22.6	30.8
1.430	215.3	638.2	15.0	44.6
1.545	96.7	917.6	6.26	59.4
1.580	51.3	1033.5	3.25	65.4
1.660	10.3	1224.0	0.62	73.7
1.735	1.89	1344.9	0.11	77.5
1.815	1.24	1615.3	0.068	89.0

Absorption of HCl by  $H_2SO_4 + Aq$ —Cont  
Temp = 40°

Sp gr	g per l		g per 100 g	
	HCl	$H_2SO_4$	HCl	$H_2SO_4$
1 185	421 4	42 2	35 6	3 56
1 195	416 4	70 0	34 8	5 86
1 210	392 1	107 7	32 4	8 90
1 255	346 3	211 2	27 6	16 8
1 255	325 4	236 3	25 9	18 8
1 340	247 4	383 7	18 5	28 6
1 400	161 6	619 4	11 5	44 2
1 520	50 9	929 3	3 35	61 1
1 575	18 5	1046 0	1 17	66 4
1 650	2 9	1207 6	0 17	73 2
1 725	1 4	1370 5	0 081	79 4
1 755	0 57	1428 4	0 032	81 4
1 770	0 52	1478 4	0 029	83 5

## Temp = 70°

Sp gr	g per l		g per 100 g	
	HCl	$H_2SO_4$	HCl	$H_2SO_4$
1 145	374 1	18 4	32 7	1 61
1 150	357 3	38 9	31 1	3 38
1 160	353 8	55 7	30 5	4 80
1 180	341 3	93 6	28 9	7 93
1 225	277 7	231 9	22 8	18 9
1 230	274 3	246 4	22 3	20 0
1 315	173 7	476 7	13 2	36 2
1 380	96 5	661 8	6 99	48 0
1 510	23 6	946 1	1 56	62 7
1 560	8 4	1055 0	0 54	67 6
1 700	0 86	1371 3	0 05	80 7
1 745	0 62	1448 2	0 035	83 0
1 745	0 57	1455 2	0 032	83 4

(Coppadoro, Gazz ch it 1910, 39 II, 626)

100 pts alcohol of 36° B absorb 68 pts HCl at 12 5° (Boullay)

Alcohol of 0 836 sp gr dissolves 327 vols HCl at 17 5° and 753 mm pressure, and the solution has sp gr = 1 005 (Pierre, A ch (3) 31 135)

Solubility of HCl in methyl alcohol (absolute) at t°

t	% HCl	t	% HCl
10 3	51 6	18	46 9
0	51 3	31 7	43

(de Bruyn, R t c 11 112)

Solubility of HCl in ethyl alcohol (absolute) at t°

t°	% HCl	t	% HCl
0	45 4	19 2	41
6 5	44 2	23 5	40 2
11 5	42 7	32 0	38 1

(de Bruyn, l c)

Solubility of HCl in ether at t° and 760 mm pressure

t°	% HCl	t°	% HCl
-9 2	37 51	15	27 62
-5	37 0	20	24 9
0	35 6	25	22 18
+ 5	33 1	30	19 47
10	30 35		

(Schuncke, Z phys Ch 1894, 14 336)

Sol in glacial  $HC_2H_3O_2$ , ether, hexane, benzene, xylene, etc

Oil of turpentine absorbs 50% HCl (Thénard)

Oil of turpentine absorbs 163 vols HCl at 22° and 724 mm, isoterbenthene absorbs 34% at 24° and 724 mm, metaterbenthene absorbs 17 7% at 24° and 724 mm (Berthelot)

Oil of lavender absorbs 68 7 vols at 24° (Thénard)

Oil of lavender absorbs 210 vols without being saturated, oil of rosemary absorbs 218 vols at 22°, sol in 0 4 vol petroleum (Saussure)

Absorbed by caprylic alcohol (Bous)

Fuming HCl + Aq is sol in glycerine and miscible with conc  $HC_2H_3O_2$

Solubility of HCl in phenol + Aq at 12°

Comp of $H_2O$ layer		Comp of phenol layer	
% HCl	% phenol	% HCl	% phenol
0	7 45	0	72
3 1	6 6	0 09	78
6 6	5 3	0 2	80 3
8 0	5 1	0 36	82 6
10 7	4 8	0 52	84 5

Composition of solution in contact with solid phenol

c, $H_2O$	% HCl	c, phenol
11 22	0	88 78
14 98	0 52	84 5
84 5	10 7	4 8
80 38	15 64	3 98
72 43	24 37	3 2
60 25	36 25	3 5

(Schreinemakers, Z phys Ch 1912, 79 553)

+  $H_2O$  F-pt - 15 35°  
Very sol in  $H_2O$  but only slightly sol in HCl (Rupert, J Am Chem Soc 1909, 31 886)

+  $2H_2O$  M-pt - 17 4°  
+  $3H_2O$  M-pt - 24 8° (Pickering, B 1893 26 280)

The composition of the hydrates formed by HCl at different dilutions is calculated

from determinations of the lowering of the f-pt produced by HCl, and of the conductivity and sp gr of HCl+Aq (Jones, Am Ch J 1905, 34 323)

### Chlorhydric cyanhydric acid, 3HCl, 2HCN

Decomp by H<sub>2</sub>O or alcohol, sol in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> Insol in ether, chloroform, or acetic ether (Clausen, B 16 309)

HCl, HCN Sol in H<sub>2</sub>O, absolute alcohol, HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, and CHCl<sub>3</sub>, with decomp, decomp is especially rapid in H<sub>2</sub>O (Gautier, A ch (4) 17 130)

### Chloric acid, HClO<sub>3</sub>

Known only in aqueous solution, which can be concentrated in vacuo to a sp gr of 1.282 at 14.2°, and then contains 40.10% HClO<sub>3</sub>, corresponding to HClO<sub>3</sub>+7H<sub>2</sub>O, if left longer in vacuo over H<sub>2</sub>SO<sub>4</sub> an acid corresponding to HClO<sub>3</sub>+4½H<sub>2</sub>O is obtained. Aqueous solution of HClO<sub>3</sub> decomp at 40° (Kammereis, Pogg 138 390)

### Chlorates

All chlorates except mercurous chlorate are sol in H<sub>2</sub>O, most of them are deliquescent, many are sol in alcohol

### Aluminum chlorate, Al(ClO<sub>3</sub>)<sub>3</sub>+6H<sub>2</sub>O

Very hygroscopic (Dobroserdow, G C 1904, II 177)  
+9H<sub>2</sub>O Very sol in cold but much less than in hot H<sub>2</sub>O (Dobroserdow)

### Ammonium chlorate, NH<sub>4</sub>ClO<sub>3</sub>

Easily sol in H<sub>2</sub>O less sol in alcohol  
Much less sol in H<sub>2</sub>O at 0° than NaClO<sub>3</sub> (Storer)  
Very sl sol in absolute alcohol (Wichter, J pr 30 321)

### Barium chlorate, Ba(ClO<sub>3</sub>)<sub>2</sub>+2H<sub>2</sub>O

Sol in 4 pts cold, and less hot H<sub>2</sub>O (Chevenix)

100 pts H<sub>2</sub>O dissolve at  
0 20° 40 60 80° 100°  
22.8 37.0 52.1 77.5 98.0 126.1 pts Ba(ClO<sub>3</sub>)<sub>2</sub>

100 grms sat Ba(ClO<sub>3</sub>)<sub>2</sub>+Aq at t contains grms anhydrous Ba(ClO<sub>3</sub>)<sub>2</sub>

t°	Gram Ba(ClO <sub>3</sub> ) <sub>2</sub>	t	Gram Ba(ClO <sub>3</sub> ) <sub>2</sub>
Freezing point -2.749 ± 0.004	15.28	50	36.69
0	16.90	60	40.05
+10	21.23	70	43.04
20	25.26	80	45.90
25	27.53	90	48.70
30	29.43	99.1	51.17
40	33.16	104.6	52.67

\* 104.6° is bpt at 740 mm pressure = 105.0° at 760 mm pressure

(Anschutz, Z phys Ch 1906, 56 238)

### Solubility of Ba(ClO<sub>3</sub>)<sub>2</sub> in H<sub>2</sub>O

t°	g Ba(ClO <sub>3</sub> ) <sub>2</sub> in 100 g H <sub>2</sub> O	Sp gr
0	25.5	1.195
20	39.3	1.274
40	55.9	1.355
60	74.1	1.433
80	92.1	1.508
100	113.2	1.580
105.6*	120	1.600

\* Bpt of sat solution

(Carlson, Dissert 1910)

Only slight traces dissolve in absolute alcohol (Wachter, J pr 30 334)

Sol in acetone (Eidmann, C C 1899, I 1014)

Difficultly sol in acetone (Naumann, B 1904, 37 4328)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethylacetate (Naumann, B 1910, 43 314)

### Bismuth chlorate

Known only in solution, which decomp on evaporation

### Cadmium chlorate, Cd(ClO<sub>3</sub>)<sub>2</sub>+2H<sub>2</sub>O

Very deliquescent, sol in H<sub>2</sub>O and alcohol  
Melts in crystal H<sub>2</sub>O at 80° (Wichter, J pr 30 321)

Solubility in H<sub>2</sub>O

Sat solution contains at

-20°	-15°	0°	+18°
72.18	72.53	74.95	76.36
49°	69°		
80.08	82.95	Cd(ClO <sub>3</sub> ) <sub>2</sub>	

Sp gr of solution containing 76.36 Cd(ClO<sub>3</sub>)<sub>2</sub> at 18° = 2.284 (Meusser, B 1912, 35 1422)

Sol in acetone (Naumann, B 1904, 37 4328)

### Cadmium chlorate ammonia, Cd(ClO<sub>3</sub>)<sub>2</sub>+6NH<sub>3</sub>

Ppt (Liphum, P 1913 48 49)

### Cæsium chlorate, CsClO<sub>3</sub>

100 g H<sub>2</sub>O dissolve at

0°	5°	19.8	30	42.2
24.6	30	62.8	93.3	119
30	77	99		
19.40	11.65	76.33	CsClO <sub>3</sub>	

(Calzolari, Acc Sc med di Ferrara 1911 85 160)

### Calcium chlorate, Ca(ClO<sub>3</sub>)<sub>2</sub>+2H<sub>2</sub>O

Deliquescent, very sol in H<sub>2</sub>O and alcohol (Wichter, J pr 30 323)

Melts in its water of crystallization at over 100°

Sp gr of solution sat at 18°=1 729, containing 64%  $\text{Ca}(\text{ClO}_3)_2$  (Myhus B 1897, 30 1718)

Sol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4328)

### Chromic chlorate

Easily sol in  $\text{H}_2\text{O}$  (Prudhomme, C C 1890, 1 668)

### Cobaltous chlorate, $\text{Co}(\text{ClO}_3)_2 + 2\text{H}_2\text{O}$

(Meusser, B 1902, 35 1418)

+4 $\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

18°	21°	35°	47°	61°
64 19	64 39	67 09	69 66	76 12%

$\text{Co}(\text{ClO}_3)_2$

Sp gr of solution containing 64 19%  $\text{Co}(\text{ClO}_3)_2$  at 18°=1 861 (Meusser, B 1902, 35 1418)

+6 $\text{H}_2\text{O}$  Very deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol Melts in crystal  $\text{H}_2\text{O}$  at 50° (Wachter, J pr 30 321)

Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

-21°	-19°	0°	+10 5°
53 30	53 61	57 45	61 83%

$\text{Co}(\text{ClO}_3)_2$   
(Meusser, B 1902, 35 1418)

### Cupric chlorate, basic, $\text{Cu}(\text{ClO}_3)_2, 3\text{Cu}(\text{OH})_2$

Insol in  $\text{H}_2\text{O}$  Very sol in dil acids Sol in warm conc  $\text{Cu}(\text{ClO}_3)_2 + \text{Aq}$ , the solubility increases with the conc and temp (Bourne, B 1 Soc 1898, (3) 19 950)

### Cupric chlorate, $\text{Cu}(\text{ClO}_3)_2 + 4\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

-31°	-21°	+0 8°	18°	45°
54 59	57 12	58 51	62 17	66 17

59 6°	71°
69 42	76 9%

$\text{Cu}(\text{ClO}_3)_2$

Sp gr of the solution containing 62 17%  $\text{Cu}(\text{ClO}_3)_2$  at 18°=1 695 (Meusser, B 1902, 35 1420)

+6 $\text{H}_2\text{O}$  Very deliquescent Easily sol in  $\text{H}_2\text{O}$  and alcohol Melts in its crystal  $\text{H}_2\text{O}$  at 65° (Wachter, J pr 30 321)

Sp gr of  $\text{Cu}(\text{ClO}_3)_2 + \text{Aq}$  at 15°

% $\text{Cu}(\text{ClO}_3)_2$	2 106	4 778	6 945
Sp gr	1 01620	1 03857	1 05714

% $\text{Cu}(\text{ClO}_3)_2$	10 016	14 387
Sp gr	1 0844	1 12531

(Irube, Gm -K 5 1, 921)

Sol in acetone (Naumann, B 1904, 37 4328)

### Cupric chlorate ammonia, $\text{Cu}(\text{ClO}_3)_2, 4\text{NH}_3$

Ppt Not hygroscopic Insol in alcohol  
 $\text{Cu}(\text{ClO}_3)_2, 6\text{NH}_3$  Not hygroscopic (Ephraim, B 1915, 48 46)

### Erbium chlorate, $\text{Er}(\text{ClO}_3)_3 + 8\text{H}_2\text{O}$

Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol

### Glucinum chlorate

Known only in aqueous solution, which decomposes on evaporation

### Ferrous chlorate

Known only in solution

### Ferric chlorate, $\text{Fe}(\text{ClO}_3)_3$

Sol in  $\text{H}_2\text{O}$

Basic salt Insol in  $\text{H}_2\text{O}$

### Lanthanum chlorate, $\text{La}(\text{ClO}_3)_3$

Deliquescent (Cleve)

### Lead chlorate, $\text{Pb}(\text{ClO}_3)_2 + \text{H}_2\text{O}$

Deliquescent, easily sol in  $\text{H}_2\text{O}$  and alcohol (Wachter, J pr 30 321)

Sp gr of solution sat at 18°=1 947 and contains 60 2%  $\text{Pb}(\text{ClO}_3)_2$  (Myhus, B 1897, 30 1718)

100 g  $\text{H}_2\text{O}$  dissolve 440 g  $\text{Pb}(\text{ClO}_3)_2$  at 18°, sp gr of sat solution=1 63 (Carlson, Dissert 1910)

### Lithium chlorate, $\text{LiClO}_3 + \frac{1}{2}\text{H}_2\text{O}$

Very deliquescent and sol in  $\text{H}_2\text{O}$  Very easily sol in alcohol Melts at 50° in its crystal water (Wachter, J pr 30 321)

$\text{LiClO}_3 + \text{Aq}$  sat at 18° contains 75 8%  $\text{LiClO}_3$  Sp gr=1 815 (Myhus, B 1897, 30 1718)

483 g  $\text{LiClO}_3$  dissolve in 100 g  $\text{H}_2\text{O}$  at 15°, sp gr of solution=1 82 (Carlson, Dissert 1910)

Contains 3 $\text{H}_2\text{O}$ , and is not deliquescent (Lagorio, Zeit f Kryst 15 80)

Salt is anhydrous (Retgers, Z phys Ch 5 449)

### Magnesium chlorate, $\text{Mg}(\text{ClO}_3)_2$

128 1 g  $\text{Mg}(\text{ClO}_3)_2$  dissolve in 100 g  $\text{H}_2\text{O}$  at 19°, sp gr of solution=1 59 (Carlson, Dissert 1910)

Sp gr of solution containing 56 5%  $\text{Mg}(\text{ClO}_3)_2$  at 18°=1 564 (Meusser, l c)

Sp gr of solution sat at 18°=1 594, containing 56 3%  $\text{Mg}(\text{ClO}_3)_2$  (Myhus, B 1897, 30 1718)

Sol in acetone (Naumann, B 1904, 37 4328)

Sol in acetone (Eidmann, C C 1899, II 1014)

+2 $\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

39 5°	61°	68°	93°
65 37	69 46	70 69	73 71%

$\text{Mg}(\text{ClO}_3)_2$   
(Meusser, B 1902, 35 1416)

+4H<sub>2</sub>O Solubility in H<sub>2</sub>O

Sat solution contains at

42° 65 5°  
63 82 69 12% Mg(ClO<sub>3</sub>)<sub>2</sub>  
(Meusser, *l c*)

+6H<sub>2</sub>O Very deliquescent and sol in H<sub>2</sub>O Very easily sol in alcohol Melts at 40° in its crystal water (Wachter, *J pr* 30 325)

Solubility in H<sub>2</sub>O

Sat solution contains at

-18° 0° +18° 29° 35°  
51 64 53 27 56 50 60 23 63 65% Mg(ClO<sub>3</sub>)<sub>2</sub>  
(Meusser)

**Manganous chlorate, Mn(ClO<sub>3</sub>)<sub>2</sub>**

Known only in solution which decomposes on evaporation (Wachter)

**Mercurous chlorate, Hg<sub>2</sub>(ClO<sub>3</sub>)<sub>2</sub>**

*α* Easily sol in alcohol and H<sub>2</sub>O (Wachter, *J pr* 30 321)

*β* Insol in H<sub>2</sub>O, easily sol in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq (Wachter) Decomp by boiling H<sub>2</sub>O

**Mercuric chlorate, 2HgO, Cl<sub>2</sub>O<sub>5</sub> + H<sub>2</sub>O**

Deliquescent Decomp by H<sub>2</sub>O into oxide and an acid salt (Wachter)

Sol in 4 pts cold H<sub>2</sub>O (Chevenix, 1802)

**Nickel chlorate, Ni(ClO<sub>3</sub>)<sub>2</sub> + 4H<sub>2</sub>O**

Solubility in H<sub>2</sub>O

Sat solution contains at

48 5° 55° 65° 75 5°  
67 60 68 78 69 05 79 50% Ni(ClO<sub>3</sub>)<sub>2</sub>  
(Meusser, *B* 1902, 35 1419)

+6H<sub>2</sub>O Deliquescent Easily sol in H<sub>2</sub>O and alcohol Melts in crystal H<sub>2</sub>O at 80° (Wachter, *J pr* 30 321)

Solubility in H<sub>2</sub>O

Sat solution contains at

-18° -8° 0° +18° 40°  
49 55 51 52 52 66 56 74 64 47% Ni(ClO<sub>3</sub>)<sub>2</sub>

Sp gr of solution containing 56 74% Ni(ClO<sub>3</sub>)<sub>2</sub> at 18° = 1 661

Goes over into 4H<sub>2</sub>O salt at 39° (Meusser)  
156 g Ni(ClO<sub>3</sub>)<sub>2</sub> dissolve in 100 g H<sub>2</sub>O at 16°, sp gr of solution = 1 76 (Carlson, *Disser* 1910)

**Nickel chlorate ammonia, Ni(ClO<sub>3</sub>)<sub>2</sub>, 6NH<sub>3</sub>**

Ppt (Ephraim, *B* 1915, 48 47)

**Potassium chlorate, KClO<sub>3</sub>**

Sol in H<sub>2</sub>O with absorption of heat

Sol in about 16 pts cold and in much less hot H<sub>2</sub>O (Chevenix, 1802)

Sol in 30 03 pts H<sub>2</sub>O at 0 17 85 pts at 13 3 and in 1 66 pts at 104 78 (M R and P)

Sol in 16 pts H<sub>2</sub>O at 18 70° (Abl)  
100 pts H<sub>2</sub>O at 15 5° dissolve 6 2 pts at 100° (4 pts (Ure s Dict))

100 pts H<sub>2</sub>O dissolve pts KClO<sub>3</sub> at t°

t°	28	35	40	47	60
Pts KClO <sub>3</sub>	9 5	12 3	14 1	18 3	29 1

(Gerardin)

100 pts H<sub>2</sub>O dissolve pts KClO<sub>3</sub> at t°

t°	Pts KClO <sub>3</sub>	t°	Pts KClO <sub>3</sub>
0	3 33	30 0	12 05
13 32	5 60	49 08	18 96
15 37	6 03	74 89	30 40
24 43	8 44	104 78	60 24

(Gay Lussa *A ch* 11 314)

100 pts H<sub>2</sub>O dissolve pts KClO<sub>3</sub> at t°

t°	Pts KClO <sub>3</sub>	t°	Pts KClO <sub>3</sub>
0	3 3	130	88 5
100	56 5	180	190

(Tilden and Shenstone, *Roy Soc Proc* 31 345)

100 pts H<sub>2</sub>O dissolve pts KClO<sub>3</sub> at t°

t	Pts KClO <sub>3</sub>	t	Pts KClO <sub>3</sub>
120	73 7	160	148
136	98 9	190	183

(Tilden and Shenstone, *Phil Trans* 1884 23)

Coefficient of solubility is 3 2 + 0 109t  
0 0043t<sup>2</sup> between 0° and 35° (Blarez, *C* 1 112 1213)

Sat KClO<sub>3</sub> + Aq contains % KClO<sub>3</sub> at t°

t	% KClO <sub>3</sub>	t	% KClO <sub>3</sub>
-0 5	2 6	92	31 2
-0 3	2 4	106	37 2
+4 5	3 5	130	47 0
4 5	2 9	171	59 8
11	4 7	180	62 1
19	6 1	190	63 1
29	8 9	200	64 2
36	9 9	207	66 0
42	11 4	300	87 0
56	15 1	336	96 7
58	16 6		

(Étard, *A ch* 1894, (7) 2 528)

Solubility in H<sub>2</sub>O

Temp	% KClO <sub>3</sub> in a sat sol	Pts sol in 100 pts H <sub>2</sub> O	Pts H <sub>2</sub> O to 1 pt KClO <sub>3</sub>
0°	3 06	3 14	31 8
5	3 67	3 82	26 2
10	4 27	4 45	22 5
15	5 11	5 35	18 5
20	6 76	7 22	13 6
25	7 56	8 17	12 2
30	8 46	9 26	10 8
35	10 29	11 47	8 7
40	11 75	13 31	7 5
45	13 16	14 97	6 6
50	15 18	17 95	5 6
55	16 85	20 27	4 9
60	18 97	23 42	4 2
65	20 32	25 50	3 9
70	22 55	29 16	3 4
75	24 82	32 99	3 0
80	26 97	36 93	2 6
85	29 25	41 35	2 4
90	31 36	46 11	2 1
95	33 76	51 39	1 9
100	35 83	55 54	1 8

(Pawlewski, B 1899, 32 1041)

1 l KClO<sub>3</sub>+Aq at 25° contains 675 millimols KClO<sub>3</sub> (Calvert, Z phys Ch 1901, 38 541)

100 g H<sub>2</sub>O dissolve at

	0°	20°	40°	60°
Sp gr	1 021	1 045	1 073	1 115

	80°	100°	104°*
Sp gr	1 165	1 219	1 230

\* Bpt of sat solution

(Carlson, Dissert 1910)

100 g H<sub>2</sub>O dissolve at

	8°	19 5°	30°	99°
	4 48	7 15	10 27	57 3 g KClO <sub>3</sub>

(Calzolari, Acc Sc med di Ferrara, 1911, 85 150)

Sat KClO<sub>3</sub>+Aq contains at

	53°	68°	81°	56° (?)
	17 37	23 25	23 53	30 46% KClO <sub>3</sub>

(Ischugaff, Z anorg 1914, 86 161)

Sp gr of KClO<sub>3</sub>+Aq, according to Kremers' experiments (Pogg 96 62), and Gerlach's calculations (Z anal 8 290)

KClO <sub>3</sub>	Sp gr	% KClO <sub>3</sub>	Sp gr
1	1 067	6	1 039
2	1 014	7	1 045
3	1 026	8	1 052
4	1 026	9	1 059
5	1 033	10	1 066

Sp gr of KClO<sub>3</sub>+Aq at 20° containing 1 mol KClO<sub>3</sub> to 100 mols H<sub>2</sub>O=1 04122 (Nicol, Phil Mag (5) 16 122)

Sp gr of KClO<sub>3</sub>+Aq at 15° containing 5% KClO<sub>3</sub>=1 0316 (Kohlrausch, W Ann 1879 1)

B-pt of KClO<sub>3</sub>+Aq containing pts KClO<sub>3</sub> to 100 pts H<sub>2</sub>O

Pts KClO <sub>3</sub>	B pt	Pts KClO <sub>3</sub>	B pt
6 5	100 5°	44 6	103 0°
13 2	101 0	53 4	103 5
20 2	101 5	62 2	104 0
27 8	102 0	69 2	104 4
35 8	102 5		

(Gerlach, Z anal 26 450)

Saturated solution boils at 105° (Kremers)

Saturated solution boils at 104 2°, and contains 61 5 pts KClO<sub>3</sub> to 100 pts H<sub>2</sub>O (Legrand)

Saturated solution boils at 103 3°, and contains 66 6 pts KClO<sub>3</sub> to 100 pts H<sub>2</sub>O (Griffiths)

Saturated solution boils at 104 4° (Gerlach, Z anal 26 427)

Sol in pure HNO<sub>3</sub> without decomp, but decomp at once by HNO<sub>3</sub> containing NO<sub>2</sub> (Millon, A ch (3) 6 92)

Sol in sat NH<sub>4</sub>Cl+Aq without causing pptn

1 mol (=129 pts) KClO<sub>3</sub> dissolves in 2493 vols H<sub>2</sub>O, in 2208 vols H<sub>2</sub>O when 1 mol (=59 pts) NaCl is added, in 2060 vols H<sub>2</sub>O with 2 mols (=118 pts) NaCl, and in 1910 vols H<sub>2</sub>O with 4 mols (=236 pts) NaCl (Gladstone, Chem Soc 15 302)

KClO<sub>3</sub> is sol in about—

29 50 pts H<sub>2</sub>O

35 50 pts NH<sub>4</sub>OH+Aq conc

39 00 pts dil NH<sub>4</sub>OH+Aq (1 vol conc 3 vols H<sub>2</sub>O)

30 50 pts HNO<sub>3</sub>+Aq (1 vol conc HNO<sub>3</sub> 5 vols H<sub>2</sub>O)

33 0 pts HCl+Aq (1 vol conc HCl 4 vols H<sub>2</sub>O)

48 00 pts HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq (1 vol commercial HC H<sub>2</sub>O 1 vol H<sub>2</sub>O)

31 50 pts NH<sub>4</sub>Cl+Aq (1 pt NH<sub>4</sub>Cl 10 pts H<sub>2</sub>O)

18 00 pts NH<sub>4</sub>NO<sub>3</sub>+Aq (1 pt NH<sub>4</sub>NO<sub>3</sub> 10 pts H<sub>2</sub>O)

34 0 (pts) NH<sub>4</sub>C H<sub>3</sub>O<sub>2</sub>+Aq (dil NH<sub>4</sub>OH+Aq+dil HC H<sub>3</sub>O+Aq)

32 50 pts Na<sub>2</sub>C H<sub>3</sub>O+Aq (commercial HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+N<sub>2</sub>CO<sub>2</sub>, diluted with 4 vols H<sub>2</sub>O)

31 50 pts Cu(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>+Aq (See Stolba, Z anal 2 390)

33 50 pts cane-sugar (1 pt cane-sugar 10 pts H<sub>2</sub>O)

36 50 pts grape-sugar (1 pt grape-sugar 10 pts H<sub>2</sub>O) (Pearson, Zeit Chem 1869 662)

Addition of K salts to sat KClO<sub>3</sub>+Aq ppts KClO<sub>3</sub> in such a way, that the sum of the



KClO<sub>3</sub> remaining in solution and the K in the salt added, is a constant, which constant is equal to the solubility of KClO<sub>3</sub>, so that the following formula represents the coefficient of solubility of KClO<sub>3</sub> after addition of a K salt,  $3.2 + 0.109t + 0.0043t^2 - K$  of salt added (Blarez, C R 112 1213)

### Solubility of KClO<sub>3</sub>+TiClO<sub>3</sub>

100 g H<sub>2</sub>O dissolve g salts

t°	g TiClO <sub>3</sub>	g KClO <sub>3</sub>
0	2 8	3 3
15	10	1 5
50	12 67	16 2
100	57 3	48 2

(Rabe, Z anorg 1902, 31 156)

### Solubility of KClO<sub>3</sub> in KNO<sub>3</sub>+Aq

t°	g per l	
	KNO <sub>3</sub>	KClO <sub>3</sub>
19 85	0 00	69 88
	12 65	64 86
	25 29	60 33
	101 19	45 85
	202 38	40 20
23 87	0 00	79 09
	50 59	63 14

(Arrhenius, Z phys Ch 1893, 11 397)

### Solubility in KCl+Aq at 20° C

G KCl in 1 litre	G KClO <sub>3</sub> in 1 litre	Sp gr
0	71 1	1 050
10	58	1 050
20	49	1 050
30	43	1 050
40	39 5	1 054
50	36 5	1 058
60	34	1 064
70	32	1 070
80	30	1 075
90	28	1 081
100	27	1 086
110	25 5	1 091
120	24 5	1 098
130	23 5	1 103
140	22 5	1 108
150	21 5	1 113
160	21 0	1 119
170	20 5	1 124
180	20 0	1 130
190	20 0	1 135
200	20	1 140
210	20	1 145
220	20	1 150
230	20	1 156
240	20	1 161
250	20	1 168

(Winteler, Z Elektrochem 1900, 7 361)

### Solubility in KOH+Aq at 25°

KOH+Aq	Millimols KClO <sub>3</sub> per lit of the solution
$\frac{1}{8}$ -normal	624
$\frac{1}{4}$ -normal	573

(Calvert, Z phys Ch 1901, 38 541)

### Solubility in H<sub>2</sub>O<sub>2</sub> at 25°

Concentration of H <sub>2</sub> O <sub>2</sub> millimols per litre	Millimols KClO <sub>3</sub> per lit of the solution
1260	730
1310	737

(Calvert, l c)

### Solubility in $\frac{1}{4}$ normal KOH+Aq in presence of H<sub>2</sub>O<sub>2</sub> at 25°

Concentration of H <sub>2</sub> O <sub>2</sub> millimols per litre	Millimols KClO <sub>3</sub> per lit of the solution
15	578
276	584
954	616
1073	673

(Calvert, l c)

Moderately sol in liquid NH<sub>3</sub> (Franklin Am Ch J 1898, 20 828)

Neither dissolved nor attacked by liqur NO<sub>2</sub> (Frankland, Chem Soc 1901, 79 1361)

Sol in 120 pts alcohol of 83% at 16 (Wittstein)

Sol in 120 pts alcohol of 77 1% (Poh W A B 6 595)

Insol in absolute alcohol (Gerardin)

Solubility of KClO<sub>3</sub> in dil alcohol D=s<sub>1</sub> gr of alcohol, S=solubility in 100 pt alcohol at t°

D = 0.9904		D = 0.9845		D = 0.9793	
t	S	t°	S	t	S
13	4 9	14	4 7	14	3 2
21	6 3	26	7 1	26	5 4
25	7 5	39	9 3	38	7.9
30	9 1	47	12 8	46	10 8
35	10 2	55	16 1	51	12 2
44	13 6	65	22 3	63	17 5
50	16 2	66	22 5	65	19 0

D = 0.9726		D = 0.9573		D = 0.9390	
t	S	t	S	t	S
13	2 2	13	1 9	14 5	1 1
20	3 3	20	2 7	28	2 2
33	5 8	29	3 6	40	3 4
43	7 2	36	4 3	50	4 3
56	11 4	55	7 9	62	6 6
59	12 9	60	9 7	67	7 6
		63	10 5		

Solubility of  $\text{KClO}_3$  in dil alcohol—*Continued*

D=0.9111		D=0.8967		D=0.8429	
t	S	t°	S	t°	S
13	0.74	12	6.46	25	0.09
25	1.08	31	1.28	34	0.12
32	1.78	43	1.95	56	0.24
52	3.35	58	3.10	64	0.32

(Gerardin, A. ch (4) 5 148)

Solubility of  $\text{KClO}_3$  in alcohol + Aq

wt % alcohol	g $\text{KClO}_3$ per 100 g solution	
	t=30°	t=40°
0	9.23	12.23
5	7.72	10.43
10	6.44	8.84
20	4.51	6.40
30	3.21	4.67
40	2.35	3.41
50	1.64	2.41
60	1.01	1.41
70	0.54	0.78
80	0.24	0.34
90	0.06	0.12

(Taylor, J. phys. Ch. 1897, 1 301)

Insol in benzonitrile (Naumann, B. 1914, 47 1370)

Very sl sol in acetone (Krug and M'Elroy, J. Anal. Ch. 6 184)

Insol in acetone (Naumann, B. 1904, 37 4329; Eidmann, C. C. 1899, II 1014)

Solubility of  $\text{KClO}_3$  in acetone + Aq

wt % acetone	g $\text{KClO}_3$ per 100 g solution	
	t=30	t=40°
0	9.23	12.23
5	8.32	11.10
9.09	7.63	10.28
20	6.09	8.27
30	4.93	6.69
40	3.90	5.36
50	2.90	4.03
60	2.03	2.86
70	1.24	1.68
80	0.57	0.79
90	0.18	0.24

(Taylor, J. phys. Ch. 1897, 1 301)

Insol in methyl acetate (Naumann, B. 1909, 42 3790), ethyl acetate (Naumann, B. 1904, 37 3601)

Solubility in glycol = 0.9% at ord temp (de Coninck, Belg. Acad. Bull. 1905 359)

100 g glycerol (sp. gr. 1.256) dissolve 3.54 g  $\text{KClO}_3$  at 15–16° (Ossendowski, Pharm. J. 1907, 79 575)Potassium silver chlorate,  $\text{KClO}_3$ ,  $\text{AgClO}_3$   
(Pfaundler, W. A. B. 46, 2 266)Rubidium chlorate,  $\text{RbClO}_3$ 100 pts  $\text{H}_2\text{O}$  dissolve 2.8 pts at 47°, 3.9 pts at 13°, 4.9 pts at 18°, 5.1 pts at 19° (Reissig, A. 127 33)100 g  $\text{H}_2\text{O}$  dissolve 3.1  $\text{RbClO}_3$  at 15°, sp. gr. of solution = 1.07 (Carlson, Dissert. 1910)100 g  $\text{H}_2\text{O}$  dissolve at

0°	8°	19.8°	30°
2.138	3.07	5.36	8.00 g $\text{RbClO}_3$

42.2°	50°	76°	99°
12.48	15.98	34.12	62.8 g $\text{RbClO}_3$

(Calzolari, Acc. Sc. med. di Ferrara, 1911, 85 150)

## Scandium chlorate

(Crookes, Roy. Soc. Proc. 1908, 80 A, 518)

Silver chlorate,  $\text{AgClO}_3$ Sol in 10–12 pts cold  $\text{H}_2\text{O}$  (Vauquelin), in 8–10 pts cold, and 2 pts hot  $\text{H}_2\text{O}$  (Chevenix), in 5 pts cold  $\text{H}_2\text{O}$  (Wachter). Sl sol in alcohol (Chevenix), easily sol in alcohol (Wachter)Silver chlorate ammonia,  $\text{AgClO}_3$ ,  $2\text{NH}_3$ Easily sol in  $\text{H}_2\text{O}$  or alcohol (Wachter, 1843)Sodium chlorate,  $\text{NaClO}_3$ 

## Deliquescent

Sol in 3 pts cold and less hot  $\text{H}_2\text{O}$  (Wachter, Chevenix)Sol in 3 pts  $\text{H}_2\text{O}$  at 14.75° (Abl.)100 pts  $\text{H}_2\text{O}$  dissolve 35.5 pts  $\text{NaClO}_3$  (Ure's Dict.)100 pts  $\text{H}_2\text{O}$  dissolve at

0°	20°	40°	60°
81.9	99	123.5	147.1 pts $\text{NaClO}_3$

80°	100°	120°
175.6	232.6	333.3 pts $\text{NaClO}_3$

(Kremers, Pogg. 97 4)

100 pts  $\text{H}_2\text{O}$  dissolve 89.3 pts  $\text{NaClO}_3$  at 12° (Schlosing)100 g  $\text{H}_2\text{O}$  dissolve at

-15°	0°	20°	40°
72	79	101	126 pts $\text{NaClO}_3$
Sp. gr.	1.380	1.389	1.430 1.472

60°	80°	100°	122° +
155	189	230	286 pts $\text{NaClO}_3$
Sp. gr.	1.514	1.559	1.604 1.654

\* Bpt of sat. solution

(Carlson, Dissert. 1910)

100 g  $\text{NaClO}_3$ +Aq contain at  
 4 78° 19 85° 30 05° 35 10° 44 72°  
 45 47 48 91 51 22 52 36 54 50 g  $\text{NaClO}_3$   
 (Le Blanc and Schmandt, Z phys Ch 1911,  
 77 614)

Sp gr of  $\text{NaClO}_3$ +Aq, containing  
 10 15 20 25 30 25%  $\text{NaClO}_3$   
 1 070 1 108 1 147 1 190 1 235 1 282  
 (Gerlach, Z anal 8 290)

Sp gr of  $\text{NaClO}_3$ +Aq at 20° containing 1  
 mol  $\text{NaClO}_3$  in 100 mols  $\text{H}_2\text{O}$ =1 03844  
 (Nicol, Phil Mag (5) 16 122)

$\text{NaClO}_3$ +Aq containing 7 23%  $\text{NaClO}$   
 has sp gr 20°/20°=1 0496 (Le Blanc and  
 Rohland, Z phys Ch 1896, 19 278)

Sat solution boils at 132°, and temp can  
 be raised to 135° by supersaturation (Krem-  
 ers, Pogg 97 4)

Easily sol in liquid HF (Franklin, Z  
 anorg 1905, 46 2)

$\text{NaClO}_3$ +NaCl  
 100 pts  $\text{H}_2\text{O}$  dissolve 50 75 pts  $\text{NaClO}_3$ +  
 24 4 pts NaCl at 12°, 100 pts  $\text{H}_2\text{O}$  dissolve  
 249 6 pts  $\text{NaClO}_3$ +11 5 pts NaCl at 122°,  
 and when cooled to 12° contain 68 6 pts  
 $\text{NaClO}_3$ +11 5 pts NaCl (Schlosing, C R  
 73 1272)

Solubility in  $\text{NaCl}$ +Aq at 20° C

	G $\text{NaClO}_3$ in 1 litre	Sp gr
5	668	1 426
10	661	1 424
15	653	1 423
20	645	1 421
25	638	1 419
30	630	1 418
35	622	1 417
40	615	1 415
45	607	1 414
50	599	1 412
55	590	1 411
60	582	1 409
65	574	1 408
70	566	1 406
75	559	1 405
80	551	1 404
85	544	1 402
90	537	1 401
95	529	1 399
100	522	1 398
105	514	1 396
110	507	1 394
115	499	1 392
120	491	1 391
125	484	1 389
130	476	1 387
135	467	1 385
140	459	1 383
145	451	1 381

Solubility in  $\text{NaCl}$ +Aq at 20° C—*Continue*

G NaCl in 1 litre	G $\text{NaClO}_3$ in 1 litre	Sp gr
150	442	1 379
155	437	1 377
160	423	1 374
165	414	1 372
170	403	1 369
175	393	1 365
180	382	1 362
185	371	1 359
190	360	1 355
195	349	1 350
200	338	1 345
205	326	1 340
210	315	1 335
215	302	1 330
220	287	1 324
225	271	1 319
230	257	1 313
235	243	1 307
240	228	1 301
245	211	1 295
250	197	1 289
255	184	1 283
260	170	1 276
265	150	1 270
270	135	1 263
275	120	1 256
280	105	1 249
285	91	1 241
290	78	1 235
295	67	1 226
300	55	1 217

(Winteler, Z Elektrochem 1900, 7 361)

Very sol in liquid  $\text{NH}_3$  (Franklin, Ann  
 Ch J 1898, 20 829)

Sol in 34 pts alcohol of 83% at 16° and in  
 less hot alcohol (Wittstein)

Somewhat more easily sol in alcohol than  
 NaCl (Berzelius)

Solubility of  $\text{NaClO}_3$  in alcohol  
 (g  $\text{NaClO}_3$  per 1 of solution)

t	Alcohol		
	90 %	70 %	50 %
20	16 1	110 8	311 5
40	22 9	133 5	321 8
60	29 0	155 8	326 8
70		161 3	

(Carlson, Dissert 1910)

Insol in methyl acetate (Naumann, B  
 1909, 42 3790), ethyl acetate (Naumann  
 B 1910, 43 314)

100 g glycerol dissolve 20 g  $\text{NaClO}_3$  at  
 15 5° (Ossendowski, Pharm J 1907, 79  
 575)

**Strontium chlorate,  $\text{Sr}(\text{ClO}_3)_2 + 5\text{H}_2\text{O}$** 

Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Topsoe, W A B 66, 2 29)

Sp gr of solution sat at  $18^\circ$  containing 63.3%  $\text{Sr}(\text{ClO}_3)_2 = 1.839$  (Mylius, B 1897, 30 1718)

Easily sol in  $\text{H}_2\text{O}$ , less in alcohol, but more sol in alcohol than  $\text{SrCl}_2$  (Souhay, A 102 381)

Insol in absolute alcohol (Wachter)

**Thallous chlorate,  $\text{TlClO}_3$** 

Sol in  $\text{H}_2\text{O}$ , but decomp by heating

100 pts  $\text{H}_2\text{O}$  dissolve at

$0^\circ$   $20^\circ$   $50^\circ$   $80^\circ$   $100^\circ$

2.80 3.92 12.67 36.65 57.31 pts  $\text{TlClO}_3$   
(Murr, Chem Soc 29 857)

1.1  $\text{TlClO}_3 + \text{Aq}$  sat at  $10^\circ$  contains 25.637 g  $\text{TlClO}_3$  (Roozeboom, Z phys Ch 8 532)

1.1  $\text{H}_2\text{O}$  dissolves 0.134 equivalents  $\text{TlClO}_3$  at  $20^\circ$ , or 38.51 g in 1.1 of the solution (mean of 10 experiments) (Noyes and Farrell, J Am Chem Soc 1911, 33 1657)

Solubility in  $\text{Ti}_2\text{SO}_4 + \text{Aq}$  at  $20^\circ$

G equiv per l		Solid phase
$\text{HClO}_3$	$\text{Ti}_2\text{SO}_4$	
0.1058	0.1366	$\text{TlClO}_3 + \text{Ti}_2\text{SO}_4$

(Noyes and Farrell, *l c*)

**Thallic chlorate,  $\text{H}(\text{ClO}_3)_3 + 4\text{H}_2\text{O}$** 

Very deliquescent, sol in  $\text{H}_2\text{O}$  Decomp slowly in the air (Gewecke, Z anorg 1912, 75 273)

**Ytterbium chlorate**

Sol in  $\text{H}_2\text{O}$  (Popp, A 131 179)

**Yttrium chlorate,  $\text{Y}(\text{ClO}_3)_3 + 8\text{H}_2\text{O}$** 

Deliquescent Easily sol in alcohol Sl sol in ether (Clève)

**Zinc chlorate,  $\text{Zn}(\text{ClO}_3)_2 + 4\text{H}_2\text{O}$** 

Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

$+15^\circ$   $30^\circ$   $40^\circ$   $55^\circ$   
66.52 67.66 69.06 75.44%  $\text{Zn}(\text{ClO}_3)_2$

Sp gr of solution containing 66.52%  $\text{Zn}(\text{ClO}_3)_2$  at  $15^\circ = 1.916$

(Meusser, B 1902, 35 1417)

More sol in  $\text{H}_2\text{O}$  than chlorates of Mg, Co, Ni or Cu, less sol than chlorate of Cd, more sol than  $\text{Zn}(\text{NO}_3)_2$  (Meusser, *l c*)

$+6\text{H}_2\text{O}$  Very deliquescent Easily sol in  $\text{H}_2\text{O}$  and alcohol Melts in crystal  $\text{H}_2\text{O}$  at  $60^\circ$  (Vauquelin, A ch 95 113)

**Solubility in  $\text{H}_2\text{O}$** 

Sat solution contains at

$-18^\circ$   $0^\circ$   $8^\circ$   $15^\circ$   
55.62 59.19 60.20 67.32%  $\text{Zn}(\text{ClO}_3)_2$   
(Meusser, *l c*)

Sp gr of solution sat at  $18^\circ$  containing 65%  $\text{Zn}(\text{ClO}_3)_2 = 1.914$  (Mylius, B 1897, 30 1718)

**Zinc chlorate ammonia,  $\text{Zr}(\text{ClO}_3)_2 \cdot 4\text{NH}_3$** 

$\text{Zn}(\text{ClO}_3)_2 \cdot 6\text{NH}_3$  Ppt (Ephram, B 1915, 48 48)

**Perchloric acid**

See Perchloric acid

**Chlorides**

Most chlorides are sol in  $\text{H}_2\text{O}$ , a few, however, are insol or nearly so therein, the chief of which are  $\text{AgCl}$ ,  $\text{Hg}_2\text{Cl}_2$ ,  $\text{Cu}_2\text{Cl}_2$ ,  $\text{PtCl}_2$ , and  $\text{AuCl}$ . Several chlorides are decomp into insol basic salts or hydroxides, either by the addition of  $\text{H}_2\text{O}$ , as in the case of  $\text{BiCl}_3$  and  $\text{SbCl}_3$ , or on evaporating the aqueous solution, as  $\text{AlCl}_3$ ,  $\text{ZnCl}_2$ ,  $\text{MgCl}_2$ , etc

Some chlorides are sol in alcohol or ether  
See under each element

**Chlorine,  $\text{Cl}_2$** 

The maximum solubility of  $\text{Cl}$  in  $\text{H}_2\text{O}$  is at  $10^\circ$  (Schonfeld), at  $8-10^\circ$  (Gay-Lussac), at  $9-10^\circ$  (Pelouze)

Solubility decreases from  $9-0^\circ$ , at  $100^\circ$  the solubility = 0 (Gay-Lussac)

$\text{Cl}_2 + \text{Aq}$  sat at  $6^\circ$  has sp gr = 1.003 (Berthelot)

1 vol  $\text{H}_2\text{O}$  at  $t^\circ$  absorbs vols  $\text{Cl}$  reduced to  $0^\circ$  and 760 mm pressure

t	Vols Cl	t	Vols Cl
10	2.5852	26	1.9099
11	2.5413	27	1.8695
12	2.4977	28	1.8295
13	2.4543	29	1.7895
14	2.4111	30	1.7499
15	2.3681	31	1.7104
16	2.3253	32	1.6712
17	2.2828	33	1.6322
18	2.2405	34	1.5934
19	2.1984	35	1.5550
20	2.1565	36	1.5166
21	2.1148	37	1.4785
22	2.0734	38	1.4406
23	2.0322	39	1.4029
24	1.9912	40	1.3655
25	1.9504		

(Schonfeld, A 93 26)

1 vol H<sub>2</sub>O absorbs vols Cl at t° (not corrected)

Vols Cl	t°	Vols Cl	t°	Vols Cl	t°
1 43	0	3 04	8	1 19	50
1 52	3	3 00	10	0 71	70
2 08	6 5	2 37	17	0 15	100
2 17	7	1 61	35		

(Gay-Lussac, A ch (3) 7 124)

1 vol H<sub>2</sub>O at 8° absorbs 3 04 vols Cl which is the maximum of solubility. At 50° 1 09 vols are absorbed and at 0 15 vols (Pelouze and Fremy)

1 vol H<sub>2</sub>O at t dissolves vols Cl (not corrected)

t°	Vols Cl	t°	Vols Cl	t°	Vols Cl
0	1 75-1 80	12	2 50-2 60	40	1 55-1 60
9	2 70-2 75	14	2 45-2 50	50	1 15-1 20
10	2 70-2 75	30	2 00-2 10	70	0 60-0 65

(Pelouze A ch (3) 7 188)

1 vol H<sub>2</sub>O absorbs vols Cl at t°

t°	Vols Cl	t°	Vols Cl	t°	Vols Cl
0	1 5-1 6	9	2 65-2 70	14	2 6-2 65
5	2 05-2 1	10	2 9-3 0	16	2 35-2 4
8	2 5-2 6	12	2 65-2 75	30	1 8-1 85

(Land and Walz Berz J B 1846 72)

Solubility in H<sub>2</sub>O  $\alpha$  = coefficient of solubility

t°	$\alpha$	t°	$\alpha$	t°	$\alpha$
6 9	2 2931	10 1	2 8741	21 7	2 0422
8 4	2 5469	11 2	2 7267	32 1	1 5766
9 3	2 7135	13 7	2 5079	36 7	1 3802

(Goodwin, B 15 3040)

Goodwin also gives tables for solubility of Cl in HCl and various chlorides, but they do not show evidence of accurate work (A M C)

Cl<sub>2</sub>+Aq contains at 760 mm pressure

1 44% Cl at 0°  
1 07% " " 6°  
0 95% " " 9°  
0 87% " " 12°

(Roozeboom, R t c 1884, 3 29)

See also Cl<sub>2</sub>+8H<sub>2</sub>O

Solubility of Cl<sub>2</sub> in H<sub>2</sub>O

$\beta^1$  = Vol of Cl (reduced to 0° and 760 mm) absorbed by 1 vol H<sub>2</sub>O under a total pressure of 760 mm

$q$  = g Cl<sub>2</sub> absorbed by 100 g H<sub>2</sub>O under a total pressure of 760 mm

t°	$\beta^1$	$q$	t°	$\beta^1$	$q$
10	3 095	0 980	25	1 985	0 630
11	2 996	948	26	1 937	615
12	2 900	918	27	1 891	600
13	2 808	889	28	1 848	587
14	2 720	861	29	1 808	574
15	2 635	835	30	1 769	562
16	2 553	809	35	1 575	501
17	2 474	784	40	1 414	451
18	2 399	760	45	1 300	415
19	2 328	738	50	1 204	386
20	2 260	716	60	1 006	324
21	2 200	698	70	0 848	274
22	2 143	680	80	0 672	219
23	2 087	662	90	0 380	125
24	2 035	646	100	0 000	000

(Winkler, Landolt and Bornstein, Tab 4th Ed 1912, 597)

1 l HCl+Aq (38% HCl) dissolves 17 3 g Cl, 1 l HCl+Aq (33% HCl) dissolves 11 g Cl, 1 l HCl+Aq (3% HCl) dissolves 6 5 g Cl (Berthelot, C R 91 191)

Solubility of Cl<sub>2</sub> in HCl+Aq at 20-21° and 759-761 mm pressure

g HCl per l	g Cl <sub>2</sub> per l	Coefficient of absorption	Solubility
0	7 23	2 1157	2 2799
3 134	5 30	1 5496	1 6698
6 248	4 94	1 4433	1 5607
9 402	4 76	1 3942	1 5013
12 540	4 85	1 4200	1 5292
15 670	5 10	1 4933	1 6092
31 340	5 81	1 6736	1 8033
62 680	6 38	1 8682	2 0131
94 020	7 19	2 1044	2 2677
125 360	7 76	2 2711	2 4473
156 700	8 58	2 5095	2 7043
188 040	9 23	2 7020	2 9117
219 380	9 93	2 9243	3 1312
250 720	10 68	3 1272	3 3677
282 060	11 87	3 3278	3 5859
313 401	12 03	3 5492	3 8224

(Mellor, Chem Soc 1901, 75 227)

Solubility of Cl in NaCl+Aq  $\alpha$  = coefficient of solubility  
NaCl = 9 97%

t°	$\alpha$	t	$\alpha$
7 9	1 8115	18 8	1 2785
11 9	1 5879	22 6	1 0081
15 4	1 3684		

Solubility of Cl in NaCl + Aq — *Continued*

NaCl = 16.01%

t°	$\alpha$	t°	$\alpha$
6	1 5866	21 4	0 8732
11 6	1 2227	26 9	0 7017
16 4	1 0121		

NaCl = 19.66%

t°	$\alpha$	t°	$\alpha$
0	1 6978	15 4	0 9511
9 2	1 2145	20 4	0 7758
9 3	1 2068	21 9	0 7385
14 8	0 9740		

(Kumpf, W Ann Bebl 6 276)

## Solubility of Cl in sat NaCl + Aq at t° and 760 mm pressure

t°	Coefficient of absorption at 0° and 760 mm	Solubility at 0° and 760 mm
14 5	0 3607	0 3898
29 0	0 3125	0 3458
60 0	0 1332	0 1625
82 0	0 0586	0 0763

(Kohn and O'Brien, J Soc Chem Ind 1898, 17 1100)

Sat KCl + Aq absorbs  $\frac{1}{3}$  less Cl at 15° than pure H<sub>2</sub>O (Dettmer, A 38 35)1 l of a solution of CaCl<sub>2</sub> (1 pt in 15 pts H<sub>2</sub>O) dissolves 2.45 g Cl at 12°1 l of a solution of MgCl<sub>2</sub> (1 pt in 15 pts H<sub>2</sub>O) dissolves 2.33 g Cl at 12°1 l of a solution of MnCl<sub>2</sub> (1 pt in 15 pts H<sub>2</sub>O) dissolves 2.00 g Cl at 12°

Sl sol in KOH + Aq (Fremy)

Somewhat sol in liquid NO (Frankland, Chem Soc 1901, 79 1361)

CCl<sub>4</sub> absorbs 10% of Cl at 13° (Perkins, Chem Soc 1894 65 20)

1 mol CrOCl dissolves at 0°, 0.70 atom Cl, at -14°, 1.24 atoms, at -21°, 2.31 atoms, and at -24°, 3.00 atoms Cl (Roozeboom, R t c 4 379)

Sulphuryl chloride absorbs 71 vols Cl or 0.136 pt Cl by weight at t° (Schulze, J pr (2) 27 168)

Insol in benzene (Moride)

Sl sol in chloral and iodol (Dumas)

Sol in perchlorethylene (Faraday)

Sol in a very large quantity of ether with decomp

Coefficient of solubility of Cl<sub>2</sub> in organic liquids at 15°

Substance	Coefficient of Solubility
Carbon tetrachloride	51 7
Acetic anhydride	39 6
Acetic acid (99.84%)	36 7
" (90 vol %)	25 3
" (75 vol %)	16 43
" (65 vol %)	13 43

(Jones, Chem Soc 1911, 99 392)

+8H<sub>2</sub>O Critical temp of decomposition in open vessel = 9.6°, in closed vessel = 28.7°Solubility in H<sub>2</sub>O% Cl<sub>2</sub> = % of Cl<sub>2</sub> in Cl<sub>2</sub> + Aq sat at t° and 760 mm in presence of Cl<sub>2</sub> + 8H<sub>2</sub>O

t°	% Cl <sub>2</sub>	t°	% Cl
0	0 505	12 5	1 10
3	0 64	20	1 82
6	0 709	28 5	3 50
9	0 900		

(Roozeboom, R t c 1884, 3 57)

Chlorine monoxide, Cl<sub>2</sub>OSol in H<sub>2</sub>O At 0°, H<sub>2</sub>O absorbs at least 200 times its volume of Cl<sub>2</sub>O gasChlorine trioxide, Cl<sub>2</sub>O<sub>3</sub>

Decomp on air at 57° with explosion

H<sub>2</sub>O absorbs 5-6 vols Cl<sub>2</sub>O<sub>3</sub> (Millon, A ch (3) 7 298)H<sub>2</sub>O absorbs at 8.5° and 753 mm press 8.591 vols Cl<sub>2</sub>O<sub>3</sub> (Brandan)100 g H<sub>2</sub>O dissolve at8.5° and 752.9 mm press 4.7655 g Cl<sub>2</sub>O<sub>3</sub>

14° " 756 3 " " 5.0117 "

21° " 754 " " 5.4447 "

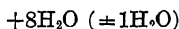
93° " 760 " " 5.6508 "

(Brandan, A 151 340)

Does not exist, and above data are for mixture of ClO<sub>2</sub> and Cl (Garzaroli-Turnhakh, A 209 184)Chlorine tetroxide, ClO<sub>4</sub>H<sub>2</sub>O at 4° absorbs about 20 vols ClO<sub>4</sub> with formation of HClO<sub>4</sub> and HClO<sub>3</sub>H<sub>2</sub>SO<sub>4</sub> at -18° absorbs about 20 vols ClO<sub>4</sub> (Millon, A ch (3) 7 285)Solubility of ClO<sub>2</sub> in H<sub>2</sub>O

t	$\alpha$ ClO <sub>2</sub> per l
1	> 108 6
10 7	116 7
14 0	> 107 9

(Bray, Z phys Ch 1906, 54 569)

Solubility in  $\text{H}_2\text{O}$ 

t°	g $\text{ClO}_2$ per l	t°	g $\text{ClO}_2$ per l
0 79*	26 98	10	60 06
0	27 59	15 3	60 06
1	29 48	18 2	107 9
5 7	42 10		

\* Entertic

(Bray)

**Chlorine oxide,  $\text{Cl}_2\text{O}_{17}$** 

Very easily decomp (Millon, A 46 281)  
Probably a mixture of  $\text{ClO}_2$  and O

**Chlorine heptoxide,  $\text{Cl}_2\text{O}_7$** 

Explosive, decomp by  $\text{H}_2\text{O}$ , sol in well cooled benzene with sl decomp (Michael, Am Ch J 1909, 23 447)

**Chlorirididramine chloride,**

Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  (Skobkoff, A 84 275)

**— nitrate,  $\text{Cl}_2\text{Ir}(\text{N}_2\text{H}_5\text{NO}_3)_2$** Sol in  $\text{H}_2\text{O}$ **— sulphate,  $\text{Cl}_2\text{Ir}(\text{N}_2\text{H}_5\text{SO}_4)$** 

Sl sol in cold, much more easily in hot H O

**Chloriridic acid****Chloriridates**

Most of the chloriridates are very difficultly sol in H O, but a little more sol than the corresponding chloroplatinates. Insol or nearly so in alcohol, but not so difficultly sol as the chloroplatinates (Rose)

**Ammonium chloriridate,  $(\text{NH}_4)_2\text{IrCl}_6$** 

Sol in 20 pts cold  $\text{H}_2\text{O}$  (Vauquelin), sl sol in cold, much more in hot  $\text{H}_2\text{O}$  (Claus), sol in  $\text{HCl} + \text{Aq}$  (Soblewsky), insol in cold  $\text{NH}_4\text{Cl} + \text{Aq}$  (Claus), insol in alcohol (Berzelius)

100 pts H O dissolve at

14 4° 26 8° 39 4°

0 699 0 905 1 226 pts  $(\text{NH}_4)_2\text{IrCl}_6$ ,

52 2° 61 2° 69 3°

1 608 2 130 2 824 pts  $(\text{NH}_4)_2\text{IrCl}_6$ 

(Rimbach and Korten, Z anorg 1907, 52 407)

**Cæsium chloriridate,  $\text{Cs}_2\text{IrCl}_6$** 

Only sl sol in H O (Delepine, C R 1908, 146 1268)

**Lithium chloriridate,  $\text{Li}_2\text{IrCl}_6$** 

Somewhat deliquescent, very sol in  $\text{H}_2\text{O}$  (Antony, Gazz ch it 23, 1 190)

**Potassium chloriridate,  $\text{K}_2\text{IrCl}_6$** 

Sl sol in cold  $\text{H}_2\text{O}$ , sol in 15 pts boiln  $\text{H}_2\text{O}$ , less sol in  $\text{H}_2\text{O}$  containing  $\text{HCl}$ , insol in alcohol or sat  $\text{KCl}$  and  $\text{CaCl}_2 + \text{Aq}$ . Insol in liqnd  $\text{NH}_3$  (Gore, Am Ch 1898, 20 829)

**Rubidium chloriridate,  $\text{Rb}_2\text{IrCl}_6$** 

Very sl sol in  $\text{H}_2\text{O}$  (Rimbach, Z anorg 1907, 52 408)

**Sodium chloriridate,  $\text{Na}_2\text{IrCl}_6 + 6\text{H}_2\text{O}$** 

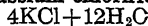
Easily sol in  $\text{H}_2\text{O}$ , sol in alcohol of 0.8 sp gr

**Thallium chloriridate,  $\text{Tl}_2\text{IrCl}_6$** 

Decomp by hot  $\text{HCl}$  forming  $\text{Tl}_3\text{IrCl}_6$  (Delépine, C R 1909, 149 1073)

**Chloriridium pentamine comps**

See Iridopentamine chloro comps

**Chloriridosulphurous acid****Potassium chloriridosulphite,  $\text{K}_4\text{Ir}_2\text{Cl}_2(\text{SO}_3)_4$** Insol in cold, decomp by hot  $\text{H}_2\text{O}$ 

$\text{K}_4\text{Ir}_2\text{Cl}_2(\text{SO}_3)_4, 2\text{K}_2\text{SO}_3$  Decomp by  $\text{H}_2\text{O}$   
 $\text{Cl}_2\text{Ir}_2(\text{SO}_3)_2, 8\text{KCl} + 4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  insol in alcohol (Claus, J p 42 354)

**Chloriridous acid****Ammonium chloriridite,  $(\text{NH}_4)_3\text{IrCl}_6$** 

Decomp by  $\text{H}_2\text{O}$  (Delepine, C R 190 146 1268)

+  $1\frac{1}{2}\text{H}_2\text{O}$  Sol in H O (Claus) $\text{IrCl}_6(\text{H}_2\text{O})(\text{NH}_4)_2$  (Delepine)**Cæsium chloriridite,  $\text{IrCl}_6(\text{H}_2\text{O})\text{Cs}$** 

(Delepine)

**Lithium chloriridite,  $\text{Li}_2\text{IrCl}_6 + 12\text{H}_2\text{O}$** 

Deliquescent, sol in H O and alcohol (Delepine, C R 1914, 158 1277)

**Lithium sodium chloriridite,  $\text{LiNaIrCl}_6 - 12\text{H}_2\text{O}$** 

Stable in aq solution in the presence of excess of lithium salt (Delepine, C R 1914, 158 1278)

$\text{LiNa}_2\text{IrCl}_6 + 12\text{H}_2\text{O}$  Stable in aq solution in the presence of excess of sodium salt (Delepine, C R 1914, 158 1278)

**Potassium chloriridite,  $\text{K}_3\text{IrCl}_6$** Decomp by  $\text{H}_2\text{O}$  (Delepine)

+  $3\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$ , insol in alcohol, insol in sat  $\text{KCl} + \text{Aq}$  (Berzelius)  
 $\text{IrCl}_6(\text{H}_2\text{O})\text{K}_2$  (Delepine)

**Rubidium chloriridite**,  $\text{IrCl}_5(\text{H}_2\text{O})\text{Rb}_2$ 

(Delepine)

**Silver chloriridite**,  $\text{Ag}_2\text{IrCl}_6$ Insol in  $\text{H}_2\text{O}$  or acids, sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$ 

Ppt (Delépine, Bull Soc 1910, (4), 7 55)

**Sodium chloriridite**,  $\text{Na}_2\text{IrCl}_6 + 12\text{H}_2\text{O}$ Efflorescent, sol in  $\frac{1}{2}$  pt  $\text{H}_2\text{O}$  Insol in alcohol Melts in crystal  $\text{H}_2\text{O}$  at  $50^\circ$ **Thallium chloriridite**,  $\text{Tl}_3\text{IrCl}_6$ Sol in hot  $\text{HCl}$ , pptd on cooling (Delepine, C R 1909, 149 1073)**Chlorotetramine chromium comps**

See Chlorotetramine chromium comps

**Chloro-azouimide**,  $\text{N}_3\text{Cl}$ Sl sol in  $\text{H}_2\text{O}$  (Raschig, B 1908, 41 4194)**Chlorobromo comps**

See Bromochloro comps

**Chlorocarbonic acid**

See Carbonyl chloride

**Chlorochromic acid**  $\text{CrO}_2\frac{\text{OH}}{\text{Cl}}$ 

Known only in its salts

 $\text{CrOCl}_2$  See Chromyl chloride**Ammonium chlorochromate**,  $\text{NH}_4\text{CrO}_3\text{Cl} = \text{CrO}_2\frac{\text{Cl}}{\text{ONH}_4}$ More sol in  $\text{H}_2\text{O}$  than the K salt (Peligot, A ch 52 283)**Barium chlorochromate chloride**, $\text{Ba}(\text{CrO}_3\text{Cl})$ ,  $\text{BaCl}$ Deliquescent Very sol in  $\text{H}_2\text{O}$  (Pratorius A 201 1) $+ \text{H}_2\text{O}$  Not deliquescent**Calcium chlorochromate**,  $\text{Ca}(\text{CrO}_3\text{Cl})$ 

Deliquescent (Peligot)

 $+ 5\text{H}_2\text{O}$  Very deliquescent (Pratorius)**Chromous chlorochromate**

See Trichromyl chloride

**Cobalt chlorochromate**,  $\text{Co}(\text{CrO}_3\text{Cl}) + 9\text{H}_2\text{O}$ Deliquescent, melts at  $10^\circ$  in crystal  $\text{H}_2\text{O}$  (Pratorius)**Lithium chlorochromate**,  $\text{LiCrO}_3\text{Cl}$ Sol in  $\text{H}_2\text{O}$  acidified with  $\text{HCl}$  without decomp (Lowenthal, Z anorg 1894, 6 357)**Magnesium chlorochromate**,  $\text{Mg}(\text{CrO}_3\text{Cl})_2$ 

Deliquescent (Peligot)

 $+ 9\text{H}_2\text{O}$  Less deliquescent than the other chlorochromates (Pratorius, A 201 1)Very hygroscopic, sol in  $\text{H}_2\text{O}$  acidified with  $\text{HCl}$  without decomp (Lowenthal, Z anorg 1894, 6 359)**Nickel chlorochromate**,  $\text{Ni}(\text{CrO}_3\text{Cl}) + 9\text{H}_2\text{O}$ Deliquescent, melts in its crystal  $\text{H}_2\text{O}$  at  $46-48^\circ$  (Pratorius)**Potassium chlorochromate**,  $\text{KCrO}_3\text{Cl} = \text{CrO}_2(\text{Cl})\text{OK}$ Sol in  $\text{H}_2\text{O}$  with decomp Cryst from  $\text{H}_2\text{O}$  containing  $\text{HCl}$  without decomp (Peligot)

Sol in acetone (Naumann B 1904, 37 4328)

**Sodium chlorochromate**,  $\text{NaCrO}_3\text{Cl}$ 

Deliquescent (Peligot)

 $+ 2\text{H}_2\text{O}$  Deliquescent (Pratorius)**Strontium chlorochromate**,  $\text{Sr}(\text{CrO}_3\text{Cl})_2 + 4\text{H}_2\text{O}$ Deliquescent, melts in crystal  $\text{H}_2\text{O}$  at  $72^\circ$  (Pratorius)**Thalious chlorochromate**,  $\text{TlCrO}_3\text{Cl}$ Decomp by  $\text{H}_2\text{O}$  (Lachaud and Leprieux, C R 103 198)**Zinc chlorochromate**,  $\text{Zn}(\text{CrO}_3\text{Cl}) + 9\text{H}_2\text{O}$ Deliquescent, melts at  $37.5^\circ$  in crystal  $\text{H}_2\text{O}$  (Pratorius)Very hygroscopic, very sol in  $\text{H}_2\text{O}$  and acids (Lowenthal, Z anorg 1894, 6 360)**Dichlorochromium bromide**, $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Br}$ Vlry deliquescent Sol in fuming  $\text{HBr}$  in a mixture of equal volumes ether and fuming  $\text{HBr}$ , in alcohol and in acetone (Bjerrum, B 1907, 40 2919)**Chlorochromotetrammonium comps**

See Chlorotetramine chromium comps

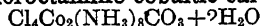
**Chlorocolumbium bromide**,  $(\text{C}^{10}\text{Cl}_{12})\text{Br} + 7\text{H}_2\text{O}$ Sol in a small quantity of cold  $\text{H}_2\text{O}$  (Harned, J Am Chem Soc 1913, 35 1083)**Chlorocolumbium chloride**,  $(\text{C}^{10}\text{Cl}_{12})\text{Cl} + 7\text{H}_2\text{O}$ Insol in cold, sol in boiling  $\text{H}_2\text{O}$ Not easily decomp by boiling with  $\text{NH}_4\text{OH}$  Conc  $\text{HNO}_3$  decomp a boiling solution of this comp Completely sol in conc alkalies (Harned, J Am Chem Soc 1913, 35 1080)



**Chlorocolumbium hydroxide**,  $(\text{Cb}_2\text{Cl}_{12})(\text{OH})_2 + 8\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in acids and alkalis (Harned, J Am Chem Soc 1913, **35** 1082)

**Chloroctamine cobaltic carbonate**,



Very sol in  $\text{H}_2\text{O}$  (Vortmann and Blasberg, B **22** 2651)

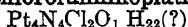
$\text{Cl}_2\text{Co}_2(\text{NH}_3)_8(\text{CO}_3)_2 + \text{H}_2\text{O}$  (Vortmann and Blasberg)

**Chloroferrous acid**

**Calcium chloroferite**,  $\text{CaO}$ ,  $\text{CaCl}_2$ ,  $\text{Fe}_2\text{O}_3$

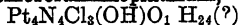
Insol in  $\text{H}_2\text{O}$  (le Chatelier, C R **99** 276)

**Dichlorofulminoplatinum**,



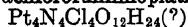
Insol in  $\text{H}_2\text{O}$  (v Meyer, J pr (2) **18** 305)

**Trichlorofulminoplatinum**,



Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$  (v Meyer)

**Tetrachlorofulminoplatinum**



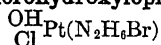
Insol in  $\text{H}_2\text{O}$  (v Meyer)

**Chlorohydroxylonitroplatinsamid-**

**amine nitrate**,  $(\text{OH})\text{ClNO}_2\text{Pt}(\text{NH}_3)_2\text{NO}_2$

Easily sol in hot  $\text{H}_2\text{O}$  (Cleve)

**Chlorohydroxyloplatin diamine bromide**,



Sl sol in  $\text{H}_2\text{O}$

— **carbonate**,  $\frac{\text{OH}}{\text{Cl}}\text{Pt}(\text{N}_2\text{H}_5)\text{CO}_3$

Insol in  $\text{H}_2\text{O}$  (Cleve)

— **chloride**,  $\frac{\text{OH}}{\text{Cl}}\text{Pt}(\text{N}_2\text{H}_5\text{Cl})$

Sl sol in  $\text{H}_2\text{O}$  (Cleve)

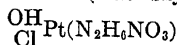
— **chromate**,  $\frac{\text{OH}}{\text{Cl}}\text{Pt}(\text{N}_2\text{H}_5)\text{CrO}_4$

Nearly insol in  $\text{H}_2\text{O}$

— **dichromate**,  $\frac{\text{OH}}{\text{Cl}}\text{Pt}(\text{N}_2\text{H}_5)_2\text{Cr}_2\text{O}_7$

Ppt (Cleve)

— **nitrate** (Raewsky's nitrate),



Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  (Gerhardt)

**Chlorohyposulphuric acid**,  $\text{S}_2\text{O}_3\text{Cl}_4$

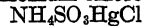
See Sulphur oxytetrachloride

**Chloromanganic acid**

See Manganic hydrogen chloride

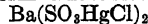
**Chloromercurosulphrous acid**

**Ammonium chloromercurosulphite**,



Sol in  $\text{H}_2\text{O}$  (Barth, Z phys Ch **9** 205)

**Barium chloromercurosulphite**,



Insol in  $\text{H}_2\text{O}$  (Barth)

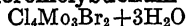
**Potassium chloromercurosulphite**,  $\text{KSO}_3\text{HgCl}$

Sol in  $\text{H}_2\text{O}$  (Barth)

**Sodium chloromercurosulphite**,  $\text{NaSO}_3\text{HgCl} + \text{H}_2\text{O}$

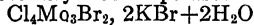
Very sol in  $\text{H}_2\text{O}$  (Barth)

**Chloromolybdenum bromide**,



Insol in  $\text{H}_2\text{O}$  and dil acids, sol in alcohol  $+ 6\text{H}_2\text{O}$  At first easily sol in  $\text{H}_2\text{O}$ , but a precipitate soon forms Can be crystallized from dil  $\text{HBr} + \text{Aq}$  Sol in alcohol and ether (Blomstrand)

**Chloromolybdenum potassium bromide**,



Decomp by  $\text{H}_2\text{O}$  Can be cryst from  $\text{HBr} + \text{Aq}$  (Blomstrand)

**Chloromolybdenum chloride**,  $\text{Cl}_4\text{Mo}_3\text{Cl}_2 =$   
**molybdenum dichloride**,  $\text{MoCl}_2$

Insol in  $\text{H}_2\text{O}$ , easily sol in  $\text{HCl} + \text{Aq}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , sl sol in  $\text{HNO}_3$ , sol in  $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{NaOH} + \text{Aq}$ , or  $\text{KOH} + \text{Aq}$ , with separation of precipitate on boiling, sol in alcohol and ether (Blomstrand, J pr **77** 96)

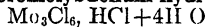
Very sol in conc  $\text{HCl}$  (Rosenham and Kohn, Z anorg **1910** **66** 2)

$+ 3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$

$+ 4\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Lucht and Kempe, A **170** 351)

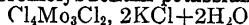
$+ 6\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , alcohol, or ether (Blomstrand)

**Chloromolybdenum hydrogen chloride**,



Sol in  $\text{H}_2\text{O}$ , but ppt forms after a few minutes (Rosenham and Kohn, Z anorg **1910**, **66** 5)

**Chloromolybdenum potassium chloride**,



Decomp by pure  $\text{H}_2\text{O}$ , can be recrystallized from  $\text{HCl} + \text{Aq}$  (Blomstrand, J pr **77** 108)

**Chloromolybdenum hydroxide**,  $\text{Cl}_4\text{Mo}_3(\text{OH})_2 + 2\text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$  or alcohol Easily sol in strong acids if fresh, and washed only with cold  $\text{H}_2\text{O}$  If washed with warm  $\text{H}_2\text{O}$ , it is less sol in acids If precipitated hot, is insol in acids, even  $\text{H}_2\text{SO}_4$  or fuming  $\text{HNO}_3$  (Blomstrand, J pr 77 100)  
 $+8\text{H}_2\text{O}$

**Chloromolybdenum iodide**,  $\text{Cl}_4\text{Mo}_3\text{I}_2 + 3\text{H}_2\text{O}$ 

Precipitate  
 $+6\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  and alcohol

**Chloromolybdenum potassium iodide**,  $\text{Cl}_4\text{Mo}_3\text{I}_2, 2\text{KI} + 2\text{H}_2\text{O}$ 

Decomp by  $\text{H}_2\text{O}$  Recryst from  $\text{HI} + \text{Aq}$  (Blomstrand)

**Chloromolybdenum oxybromide**,  $\text{Cl}_4\text{Mo}_3\text{OH Br} + 2\text{H}_2\text{O}$ 

Insol in alcohol (Blomstrand, J pr 77 116)

**Chloromolybdic acid**,  $\text{MoOCl}_3(\text{OH}) + 7\text{H}_2\text{O}$ 

Very hygroscopic (Weinland, B 1904, 37 572)

**Diammonium tetrachloromolybdate**,  $\text{MoCl}_4(\text{ONH}_4)_2 + 2\text{H}_2\text{O}$ 

Hygroscopic Decomp by  $\text{H}_2\text{O}$  Sol in dilute acids, alkalis and ammonia (Weinland, Z anorg 1905, 44 83)

**Cæsium chlorotrimolybdate, acid**,  $\text{Mo}_3\text{O}_{11}\text{Cl}_{14}(\text{Cs O}) + 22\text{H}_2\text{O}$ 

Hygroscopic Decomp by  $\text{H}_2\text{O}$  Sol in dilute acids, alkalis, and ammonia (Weinland, l c)

**Monocæsium trichloromolybdate**,  $\text{MoOCl}_3(\text{OCs}) + \text{H}_2\text{O}$ 

Hygroscopic Decomp by  $\text{H}_2\text{O}$  Sol in dilute acids, alkalis and ammonia (Weinland)

**Dicæsium tetrachloromolybdate**,  $\text{MoCl}_4(\text{OCs})_2$ 

Hygroscopic Sol in  $\text{H}_2\text{O}$  with decomp Sol in dilute acids, alkalis, and ammonia (Weinland, Z anorg 1905, 44 83)

**Monopotassium trichloromolybdate**,  $\text{MoOCl}_3(\text{OK}) + \text{H}_2\text{O}$ 

Hygroscopic Decomp by  $\text{H}_2\text{O}$  Sol in dilute acids, alkalis, and ammonia (Weinland)

**Dipotassium tetrachloromolybdate**,  $\text{M Cl}_4(\text{OK}) + 2\text{H}_2\text{O}$ 

Hygroscopic Decomp by  $\text{H}_2\text{O}$  Sol in dilute acids, alkalis, and ammonia (Weinland)

**Potassium hydrogen chlorotrimolybdate**,  $\text{Mo}_3\text{O}_{11}\text{Cl}_{14}, \text{K}_2\text{O} + 6\text{H}_2\text{O}$ 

Hygroscopic Decomp by  $\text{H}_2\text{O}$  Sol in dilute acids, alkalis, and ammonia (Weinland)

**Monorubidium trichloromolybdate**,  $\text{MoOCl}_3(\text{ORb}) + \text{H}_2\text{O}$ 

Hygroscopic Decomp by  $\text{H}_2\text{O}$  Sol in dilute acids, alkalis, and ammonia (Weinland)

**Dicubidium tetrachloromolybdate**,  $\text{MoCl}_4(\text{ORb})_2$ 

Hygroscopic Decomp by  $\text{H}_2\text{O}$  Sol in dilute acid, alkalis, and ammonia (Weinland)

**Chloronitratoplatinamine nitrite**,  $\text{Cl Pt}(\text{NH}_3\text{NO}_2)_2$ 

Easily sol in  $\text{H}_2\text{O}$

**Chloronitratoplatin diamine nitrate**,  $\text{Cl Pt}(\text{N}_2\text{H}_5\text{NO}_3)_2$ 

Decomp by  $\text{H}_2\text{O}$  with formation of  $\text{Cl Pt}[(\text{NH}_3)_2\text{NO}_3]_2$

**— sulphate**,  $\text{Cl Pt}(\text{N}_2\text{H}_5)_2\text{SO}_4 + \text{H}_2\text{O}$ 

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$

**Chloronitritotetramine cobaltic chloride**,  $\text{Cl}(\text{NO})\text{Co}(\text{NH}_3)_4\text{Cl}$ 

Not very sol in cold  $\text{H}_2\text{O}$  (Jørgensen, Z anorg 5 195)

**Chloronitritoplatin semidiamine chloride**,  $\text{Cl}_2(\text{NO}_2)\text{Pt}(\text{NH}_3)_2\text{Cl}$ 

100 pts solution in  $\text{H}_2\text{O}$  sat at  $18^\circ$  contain 18 pts salt, sat at  $100^\circ$ , 6 pts

Insol in abs alcohol or ether Not decomp by conc  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{C O}_4 + \text{Aq}$ , and by  $\text{H}_2\text{SO}_4$  only at a high heat

Formula given was  $\text{PtNH}_4\text{Cl}_6\text{O}_5$  (Peyson, J B 1855 421)

**— nitrite**,  $\text{Cl}(\text{NO}_2)\text{Pt}(\text{NH}_3)_2\text{NO}_2$ 

Sol in  $\text{H}_2\text{O}$  (Blomstrand)

**Chlorophosphatoplatin diamine phosphate**,  $\text{ClPt}(\text{N H}_3)_2 + 2\text{H}_2\text{O}$ 

Nearly insol in cold, and only very sl sol in hot  $\text{H}_2\text{O}$  (Raewsky)

**Chloronitrous acid****Iridium potassium chloronitrite**,  $\text{Ir}_2\text{Cl}_2(\text{NO})_4, 6\text{KCl}$ 

Ppt, decomp by boiling  $\text{H}_2\text{O}$  Sol in cold  $\text{H}_2\text{O}$  (Leidic, C R 1902, 134 1583)

$\text{Ir}_3\text{K}_{12}\text{Cl}_{16}(\text{NO}_2)_8 + 4\text{H}_2\text{O}$  Ppt (Quen-  
nessen, C R 1905, 141 258)

### Chloropalladic acid

#### Chloropalladates

The chloropalladates are generally very sol  
in  $\text{H}_2\text{O}$ , and sol in alcohol (v Bonsdorff,  
Pogg 17 264)

**Ammonium chloropalladate**,  $(\text{NH}_4)_2\text{PdCl}_6$   
Sl sol in  $\text{H}_2\text{O}$  (Berzelius)

**Barium chloropalladate**  
Sol in  $\text{H}_2\text{O}$  and alcohol (v Bonsdorff)

**Cadmium chloropalladate**  
As above

**Cæsium chloropalladate**,  $\text{Cs}_2\text{PdCl}_6$   
Nearly insol in cold  $\text{H}_2\text{O}$  Decomp by  
boiling with  $\text{H}_2\text{O}$  or by hot conc  $\text{H}_2\text{SO}_4$   
(Gutbier, B 1905, 38 2386)

**Calcium chloropalladate**  
Deliquescent, sol in  $\text{H}_2\text{O}$  and alcohol (v  
Bonsdorff, 1829)

**Glucinum chloropalladate**,  $\text{GIPdCl}_6 + 8\text{H}_2\text{O}$   
ic, and sol in  $\text{H}_2\text{O}$   
**uropalladate**,  $\text{MgPdCl}_6 +$   
cent, sol in  $\text{H}_2\text{O}$

**Nickel chloropalladate**,  $\text{NiPdCl}_6 + 6\text{H}_2\text{O}$   
Extremely deliquescent

**Potassium chloropalladate**,  $\text{K}_2\text{PdCl}_6$   
Sl sol in cold  $\text{H}_2\text{O}$  Decomp by long boil-  
ing with  $\text{H}_2\text{O}$  Sl sol in dil  $\text{HCl} + \text{Aq}$  with-  
out decomp Insol in  $\text{NH}_4\text{Cl}$ ,  $\text{KCl}$ , or  $\text{NaCl}$   
 $+ \text{Aq}$  Insol in alcohol (Berzelius)

**Rubidium chloropalladate**,  $\text{Rb}_2\text{PdCl}_6$   
Insol in cold  $\text{H}_2\text{O}$  Decomp by boiling  
with  $\text{H}_2\text{O}$  or by hot conc  $\text{H}_2\text{SO}_4$  (Gutbier,  
B 1905, 38 2387)

**Zinc chloropalladate**,  $\text{ZnPdCl}_6 + 6\text{H}_2\text{O}$   
Very deliquescent (v Bonsdorff)

### Chloropalladous acid

**Aluminum chloropalladite**,  $\text{Al}_2\text{Pd}_2\text{Cl}_{10} +$   
 $20\text{H}_2\text{O}$   
Deliquescent Sol in  $\text{H}_2\text{O}$ , alcohol, or  
ether (Welkow, B 7 804)

**Ammonium chloropalladite**,  $(\text{NH}_4)_2\text{PdCl}_4 +$   
 $\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol Sol  
in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Claus)

Easily sol in  $\text{H}_2\text{O}$  (Gutbier, B 1905, 38  
2386)

**Barium chloropalladite**  
Easily sol in  $\text{H}_2\text{O}$  or alcohol

**Cadmium chloropalladite**  
Not deliquescent

**Cæsium chloropalladite**,  $\text{Cs}_2\text{PdCl}_4$   
Can be cryst from hot  $\text{H}_2\text{O}$  (Gutbier, B  
1905, 38 2386)

**Calcium chloropalladite**  
Deliquescent Sol in  $\text{H}_2\text{O}$  or alcohol

**Glucinum chloropalladite**,  $\text{GIPdCl}_4 + 6\text{H}_2\text{O}$   
Very hygroscopic, very sol in  $\text{H}_2\text{O}$ , alcohol,  
or ether (Welkow)

**Magnesium chloropalladite**  
Deliquescent Easily sol in  $\text{H}_2\text{O}$  (v  
Bonsdorff)

**Manganese chloropalladite**  
Sol in  $\text{H}_2\text{O}$  and alcohol

**Nickel chloropalladite**  
Sol in  $\text{H}_2\text{O}$

**Potassium chloropalladite**,  $\text{K}_2\text{PdCl}_4$   
Much more sol in hot than cold  $\text{H}_2\text{O}$   
(Joannis, C R 95 295) Sol in  $\text{NH}_4\text{OH} +$   
 $\text{Aq}$  (Berzelius) Sol in cold sat  $\text{KCl} + \text{Aq}$   
(Gibbs, Sill Am J (2) 31 70) Insol in al-  
cohol (Wollaston) Somewhat sol in al-  
cohol of 0.84 sp gr, but insol in absolute al-  
cohol, decomp on boiling (Berzelius)

**Rubidium chloropalladite**,  $\text{Rb}_2\text{PdCl}_4$   
Can be cryst from hot  $\text{H}_2\text{O}$  (Gutbier, B  
1905, 38 2387)

**Sodium chloropalladite**  
Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol

**Zinc chloropalladite**  
Very deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol  
(v Bonsdorff)

**Chlorophosphoarsenouridic acid**,  $2\text{IrCl}_3,$   
 $3\text{H}_3\text{PO}_3, 3\text{H}_3\text{PO}_4, 5\text{H}_3\text{AsO}_4(?)$   
Very sol in  $\text{H}_2\text{O}$  (Geisenheimer)

**Lead chlorophosphoarsenouridate**,  $4\text{IrCl}_3,$   
 $3\text{Pb}_2\text{H}_2(\text{PO}_3)_2, 3\text{Pb}_3(\text{PO}_4)_2,$   
 $5\text{Pb}_2\text{H}_2(\text{AsO}_4)_2$   
Insol in  $\text{H}_2\text{O}$

**Chlorophosphouridic acid**,  $2\text{IrCl}_3, 3\text{H}_3\text{PO}_4,$   
 $3\text{H}_3\text{PO}_3$   
Very sol in  $\text{H}_2\text{O}$  Insol in alcohol  
(Geisenheimer, A ch (6) 23 254)  
 $2\text{IrCl}_3, 3\text{H}_3\text{PO}_4$  Sol in  $\text{H}_2\text{O}$  and alcohol

**Ammonium chlorophosphoride**,  $2\text{IrCl}_3$ ,  
 $3(\text{NH}_4)_3\text{PO}_4$ ,  $3(\text{NH}_4)_2\text{HPO}_3$

Very deliquescent Very sol in  $\text{H}_2\text{O}$   
 (Geisenheimer)

**Lead chlorophosphoride**,  $4\text{IrCl}_3$ ,  
 $3\text{Pb}_3(\text{PO}_4)_2$ ,  $3\text{PbH}_3(\text{PO}_3)_2$

Insol in  $\text{H}_2\text{O}$  or acetic acid, very sol in dil  
 $\text{HNO}_3 + \text{Aq}$  (Geisenheimer)

**Silver chlorophosphoride**,  $2\text{IrCl}_3$ ,  
 $3\text{AgH}_2\text{PO}_4$ ,  $3\text{AgH}_2\text{PO}_3$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3 + \text{Aq}$ , and  
 $\text{NH}_4\text{OH} + \text{Aq}$  (Geisenheimer)

### Chlorophosphoplatinic acid

See Chloroplatinophosphoric acid

### Chlorophosphoric acid

**Thorium chlorophosphate**,  $3\text{ThO}_2$ ,  $\text{ThCl}_4$ ,  
 $2\text{P}_2\text{O}_5$

Insol in  $\text{H}_2\text{O}$  and acids, decomp by boil-  
 ing with  $\text{H}_2\text{SO}_4$  and fusing with alkali car-  
 bonates (Colani, C R 1909, 149 208)

**Chloroplatinamine chloride**,  $\text{Cl}_2\text{Pt}$ ,  $\frac{\text{NH}_3\text{Cl}}{\text{NH}_3\text{Cl}}$

Sol in about 700 pts  $\text{H}_2\text{O}$  at  $0^\circ$ , and 33–34  
 pts at  $100^\circ$  Not attacked by boiling conc  
 $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$  Sol in boiling  $\text{KOH} + \text{Aq}$   
 with decomp Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Cleve,  
 Sv V A H 10, 9 30)

— **nitrite**,  $\text{Cl}_2\text{Pt}(\text{NH}_3\text{NO}_2)$

Sl sol in cold, easily in hot  $\text{H}_2\text{O}$

— **nitrite silver nitrite**,  $\text{Cl}_2\text{Pt}(\text{NH}_3\text{NO}_2)_2$ ,  
 $\text{AgNO}_2$

Easily sol in hot, sl sol in cold  $\text{H}_2\text{O}$   
 (Cleve)

— **nitritochloride**,  $\text{Cl}_2\text{Pt}$ ,  $\frac{\text{NH}_3\text{NO}_2}{\text{NH}_3\text{Cl}}$

Sol in  $\text{H}_2\text{O}$  (Cleve)

**Chloroplatinamine bromide**,  
 $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_6\text{Br})$

Sl sol in hot  $\text{H}_2\text{O}$  (Cleve)

— **chloride** (Gros' chloride),  
 $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_6\text{Cl})_2$

Nearly insol in cold, and only sl sol in hot  
 $\text{H}_2\text{O}$  Sol in hot conc  $\text{KOH} + \text{Aq}$ , with de-  
 comp (Grimm)

Sol in cold  $\text{KOH} + \text{Aq}$  without decomp  
 Nearly insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Buckton)  
 $+ \text{H}_2\text{O}$  (Ruswsky)

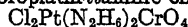
— **chloroplatinate**,  $\text{NCl}_2\text{Pt}(\text{N}_2\text{H}_6\text{Cl})_2$ ,  $\text{PtCl}_4$

Easily sol in hot  $\text{H}_2\text{O}$

— **chloroplatinite**,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_6\text{Cl})_2$ ,  $\text{PtCl}_2$

Sl sol in  $\text{H}_2\text{O}$  (Cleve)

**Chloroplatinamine chromate**,



Nearly insol in  $\text{H}_2\text{O}$  (Cleve)

— **dichromate**,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_6)_2\text{Cr}_2\text{O}_7$

Sl sol in cold, more sol in hot  $\text{H}_2\text{O}$   
 (Cleve)

— **nitrate** (Gros' nitrate),  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_6\text{NO}_3)_2$

Much more easily sol in hot than in cold  
 $\text{H}_2\text{O}$  Sol in hot  $\text{KOH} + \text{Aq}$  with decomp  
 Nearly insol in conc  $\text{HNO}_3 + \text{Aq}$

— **nitritochloride**,  $\text{Cl}_2\text{Pt}$ ,  $\frac{\text{N}_2\text{H}_6\text{NO}_2}{\text{N}_2\text{H}_6\text{Cl}}$

Ppt (Jorgensen)

— **phosphate**

See Chlorophosphatoplatinamine phos-  
 phate

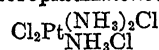
— **sulphate**,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_6)_2\text{SO}_4$

Sl sol in both cold or hot  $\text{H}_2\text{O}$  (Cleve)  
 $+ x\text{H}_2\text{O}$  Sl sol in cold, easily in hot  
 $\text{H}_2\text{O}$  (Grimm)

— **sulphocyanide**,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_6)_2(\text{CNS})_2$   
 $+ \text{H}_2\text{O}$

Ppt (Cleve)

**Chloroplatinmonodiamine chloride**,



Quite easily sol in  $\text{H}_2\text{O}$  (Cleve)

**Chloroplatinsemidiamine carbonate chlo-  
 ride**,  $2\text{Pt}(\text{NH}_3)_2\text{Cl}_2$ ,  $\text{Pt}_2(\text{NH}_3)_4\text{Cl}_2(\text{CO}_3)$

Sl sol in  $\text{H}_2\text{O}$ , insol in alcohol and ether  
 Decomp by cold  $\text{HCl} + \text{Aq}$  (Schon, Z anorg  
 1897, 13 37)

**Chloroplatinsemidiamine chloride**,



Sol in 300 pts  $\text{H}_2\text{O}$  at  $0^\circ$ , and 65 pts at  
 $100^\circ$  Not decomp by conc  $\text{H}_2\text{SO}_4$  Sol in  
 $\text{KOH} + \text{Aq}$  without decomp (Cleve)

**Chloroplatinic acid**,  $\text{H}_2\text{PtCl}_6 + 6\text{H}_2\text{O}$

Deliquescent Sol in  $\text{H}_2\text{O}$ , alcohol, or ether  
 $+ 4\text{H}_2\text{O}$  Deliquescent (Pigeon, C R  
 112 1218)

$\text{PtCl}_4$ ,  $\text{HCl} + 2\text{H}_2\text{O}$  (Pigeon)

**Aluminum chloroplatinate**,  $\text{AlCl}_3$ ,  $\text{PtCl}_4 +$   
 $15\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  and alcohol (Welkow, B  
 7 304)  
 Insol in ether

**Ammonium chloroplatinate**,  $(\text{NH}_4)_2\text{PtCl}_6$

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$   
 (Fresenius)

100 pts  $\text{H}_2\text{O}$  dissolve 0.666 pt at ord  
 temp and 12.5 pts at  $100^\circ$  (Crookes, C N  
 9 37)

Insol in cold HCl + Aq. Separates out on cooling from solution in hot HCl, HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub>. (Fischer)

Very sl sol in cold, easily in hot NH<sub>4</sub>OH + Aq. (Fresenius)

Conc NH<sub>4</sub>Cl + Aq ppts it almost completely from aqueous solution. (Bottger)

Sol in NH<sub>4</sub> succinate + Aq. (Döpping)

Less sol in H<sub>2</sub>PtCl<sub>6</sub> + Aq than in H<sub>2</sub>O. (Rogojski, A. ch (3) 41 452)

Sol in SnCl<sub>2</sub> + Aq. (Fischer)

Very sol with decomp in KCNS + Aq. (Claus)

At 15–20°, sol in 26,535 pts 97.5% alcohol, in 1476 pts 76% alcohol, and in 665 pts 55% alcohol. If free HCl is present, it is sol in 672 pts 76% alcohol. (Fresenius, A. 59 118)

Insol in absolute alcohol or ether

**Barium chloroplatinate**, BaPtCl<sub>6</sub> + 6H<sub>2</sub>O

Permanent, sol in H<sub>2</sub>O, decomp by alcohol. (v. Bonsdorff, Pogg 17 250)

**Barium monochloroplatinate**, PtCl(OH)<sub>2</sub>Ba + H<sub>2</sub>O

Insol in H<sub>2</sub>O and in org solvents. (Bellucci, C. C. 1903, I 131)

**Barium pentachloroplatinate**, OH PtCl<sub>5</sub>Ba + H<sub>2</sub>O

(Miolati, Chem. Soc. 1900, 78 (2) 732)

**Cadmium chloroplatinate**, CdPtCl<sub>6</sub> + 6H<sub>2</sub>O

Deliquescent, and easily sol in H<sub>2</sub>O. (v. Bonsdorff)

**Cæsium chloroplatinate**, Cs<sub>2</sub>PtCl<sub>6</sub>

100 pts H<sub>2</sub>O dissolve it

0°	10°	20°	30°
0.024	0.050	0.079	0.110 pts Cs <sub>2</sub> PtCl <sub>6</sub> ,
40°	50°	60°	70°
0.142	0.177	0.213	0.251 pts Cs <sub>2</sub> PtCl <sub>6</sub> ,
80°	90°	100°	
0.291	0.332	0.377	pts Cs <sub>2</sub> PtCl <sub>6</sub>
(Bunsen, Pogg 113 337)			

Sol in 1308 pts H<sub>2</sub>O at 15°, and 261 pts at 100°. (Crookes, C. N. 9 205)

**Calcium chloroplatinate**, CaPtCl<sub>6</sub> + 8H<sub>2</sub>O

Deliquescent, easily sol in H<sub>2</sub>O. (v. Bonsdorff)

**Calcium monochloroplatinate**, PtCl(OH)Ca + H<sub>2</sub>O

Insol in H<sub>2</sub>O and in org solvents. (Bellucci, C. C. 1903, I 131)

**Cerium chloroplatinate**, CeCl<sub>3</sub>, PtCl<sub>4</sub> + 13H<sub>2</sub>O

Deliquescent, very sol in H<sub>2</sub>O or alcohol, insol in ether.

4CeCl<sub>3</sub>, 3PtCl<sub>4</sub> + 5H<sub>2</sub>O. Deliquescent, easily sol in H<sub>2</sub>O or alcohol, insol in ether. (Holzmann, J. pr. 84 80)

**Chromium chloroplatinate**, CrCl<sub>3</sub>, PtCl<sub>4</sub> + 10½H<sub>2</sub>O

Deliquescent. (Nilson, B. 9 1056)

+ 10H<sub>2</sub>O. Very sol in H<sub>2</sub>O and alcohol. Nearly insol in acetone. (Higley, J. Am. Chem. Soc. 1904, 26 617)

**Cobalt chloroplatinate**, CoPtCl<sub>6</sub> + 6H<sub>2</sub>O

Very deliquescent. (Jørgensen)

**Copper chloroplatinate**, CuPtCl<sub>6</sub> + 6H<sub>2</sub>O

Deliquescent in moist air. (v. Bonsdorff)

**Didymium chloroplatinate**, D<sub>2</sub>Cl<sub>3</sub>, PtCl<sub>4</sub> + 13H<sub>2</sub>O

Less deliquescent than the cerium salt. (Marignac)

+ 10½H<sub>2</sub>O. Deliquescent. (Cleve, Bull. Soc. (2) 43 361)

**Erbium chloroplatinate**, ErCl<sub>3</sub>, PtCl<sub>4</sub> + 11H<sub>2</sub>O

Very deliquescent. (Cleve)

**Gadolinium chloroplatinate**, GdCl<sub>3</sub>, PtCl<sub>4</sub> + 10H<sub>2</sub>O

Ppt. (Benedicko, Z. anorg. 1900, 22 204)

**Glucinum chloroplatinate**, GlPtCl<sub>6</sub> + 8H<sub>2</sub>O

Deliquescent in moist air. Very sol in H<sub>2</sub>O, moderately in alcohol. Insol in ether. (Welkow, B. 6 1288)

**Indium chloroplatinate**, 2InCl<sub>3</sub>, 3PtCl<sub>4</sub> + 36H<sub>2</sub>O

Deliquescent. (Nilson)

**Iron (ferrous) chloroplatinate**, FePtCl<sub>6</sub> + 6H<sub>2</sub>O

Deliquescent. (Lopsoc)

**Iron (ferric) chloroplatinate**, FeCl<sub>3</sub>, PtCl<sub>4</sub> + 10½H<sub>2</sub>O

Deliquescent. (Nilson)

**Lanthanum chloroplatinate**, LaCl<sub>3</sub>, PtCl<sub>4</sub> + 13H<sub>2</sub>O

Deliquescent, extremely sol in H<sub>2</sub>O. (Cleve)

**Lead chloroplatinate**, PbPtCl<sub>6</sub> + 3H<sub>2</sub>O

Easily sol in H<sub>2</sub>O and alcohol. (Lopsoc) with decomp. (Bunsen, Z. anorg. Chem. 1867 520)

**Lead monochloroplatinate**, [PtCl(OH)]Pb, Pb(OH)

Ppt. (Bellucci, Chem. Soc. 1902, 82, II 155)

**Lead pentachloroplatinate, basic**, PtCl(OH)Pb, Pb(OH)

(Miolati, Chem. Soc. 1900, 78 (2) 732)

**Lithium chloroplatinate**, Li<sub>2</sub>PtCl<sub>6</sub> + 6H<sub>2</sub>O

Extremely deliquescent. (Jørgensen), efflorescent. Easily sol in H<sub>2</sub>O, alcohol, or ether-alcohol, insol in ether. (Scheibler)

**Lithium pentachloroplatinate**, OH PtCl<sub>5</sub>Li

Very hygroscopic. (Miolati, Chem. Soc. 1900, 78 (2) 732)

**Magnesium chloroplatinate,  $\text{MgPtCl}_6 \cdot 6\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  and abs alcohol  
+12 $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

**Manganese chloroplatinate,  $\text{MnPtCl}_6 \cdot 6\text{H}_2\text{O}$** 

Not deliquescent, sol in  $\text{H}_2\text{O}$   
+12 $\text{H}_2\text{O}$  Sl efflorescent

**Nickel chloroplatinate,  $\text{NiPtCl}_6 \cdot 6\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$

**Potassium chloroplatinate,  $\text{K}_2\text{PtCl}_6$** 

100 pts  $\text{H}_2\text{O}$  dissolve at

0° 10° 20° 30° 40° 50°  
0.74 0.90 1.12 1.41 1.76 2.17 pts  $\text{K}_2\text{PtCl}_6$ ,  
60° 70° 80° 90° 100°  
2.64 3.19 3.79 4.45 5.18 pts  $\text{K}_2\text{PtCl}_6$   
(Bunsen, Pogg 113 337)

100 pts  $\text{H}_2\text{O}$  dissolve 0.926 pt at 15°, and  
5.26 pts at 100° (Crookes, C N 9 205)

100 g  $\text{H}_2\text{O}$  dissolve at  
2° 16° 25° 35° 48°  
0.4812 0.6718 0.8641 1.132 1.745 g  $\text{K}_2\text{PtCl}_6$ ,  
59° 68° 78° 92°  
2.396 2.913 3.589 4.484 g  $\text{K}_2\text{PtCl}_6$   
(Archibald, J Am Chem Soc 1908, 30 752)

Not attacked by cold conc  $\text{H}_2\text{SO}_4$  (Las-  
saigne)

Sl sol in cold, more easily in hot dil acids  
Less sol in  $\text{KCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ , and nearly  
insol in sat  $\text{KCl} + \text{Aq}$  (Schrotter, W A B  
50, 2 268)

**Solubility in  $\text{KCl} + \text{Aq}$  at 20°**

G mol $\text{KCl}$ per l of $\text{KCl} + \text{Aq}$	G $\text{K}_2\text{PtCl}_6$ in 100 g of solution
0 00	0 7742
0 20	0 0236
0 25	0 0207
0 50	0 0109
1 00	0 0046
2 00	0 0045
3 00	0 0043
4 00	0 0042
sat	0 0034

(Archibald, J Am Chem Soc 1908, 30 757)

**Solubility in  $\text{NaCl} + \text{Aq}$  at 16°**

( mol $\text{NaCl}$ per litre of $\text{NaCl} + \text{Aq}$	G $\text{K}_2\text{PtCl}_6$ in 100 g of solution
0 00	0 672
0 05	0 700
0 10	0 729
0 25	0 758
0 50	0 775
0 75	0 791
1 00	0 805
2 00	0 834

(Archibald, J Am Chem Soc 1908, 30 757)

Sol in  $\text{KOH} + \text{Aq}$  Insol in cold or hot  
alkali carbonates or bicarbonates +  $\text{Aq}$  (Rosa)

Easily sol in warm  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Himly)

Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Brett)

Sol in  $\text{NH}_4$  succinate +  $\text{Aq}$  (Dopping)

At 15–20°, sol in 12,083 pts absolute al-  
cohol, in 3775 pts 76% absolute alcohol, and  
in 1053 pts 55% absolute alcohol (Fresen-  
ius)

Sol in 1835 pts 76% alcohol containing  
 $\text{HCl}$  at 15–20° (Fresenius)

Nearly absolutely insol in alcohol con-  
taining ether

Sol in 42,600 pts absolute alcohol Precht  
Z anal 18 509)

1 l methyl alcohol dissolves 0.072 g at 20  
(Pelgrot, Monat Sci 1892, (4) 6 I 573)

**Solubility in methyl alcohol +  $\text{Aq}$  at 20**

% alcohol by wt	G $\text{K}_2\text{PtCl}_6$ in 100 g of solution
0	0 7742
5	0 5350
10	0 4120
20	0 2642
30	0 1831
40	0 1165
50	0 0625
60	0 0325
70	0 0152
80	0 0124
90	0 0035
100	0 0027

(Archibald, J Am Chem Soc 1908 30 755)

**Solubility in ethyl alcohol— $\text{Aq}$  at 20**

% alcohol by wt	G $\text{K}_2\text{PtCl}_6$ in 100 g of solution
0	0 7742
5	0 4910
10	0 3720
20	0 2180
30	0 1540
40	0 0760
50	0 0491
60	0 0265
70	0 0128
80	0 0085
90	0 0025
100	0 0009

(Archibald, J Am Chem Soc 1908 30 755)

**Solubility in isobutyl alcohol— $\text{Aq}$  at 20**

alcohol	G $\text{K}_2\text{PtCl}_6$
0	0 7742
8 20	0 6250
sat	0 1831

(Archibald, J Am Chem Soc 1908 30 755)

**Potassium pentachlorohydroplatinate,**  
 $K_2(PtCl_5OH)$ Easily sol in  $H_2O$  (Ruff, B 1913 46 925)**Praseodymium chloroplatinate,**  $PrCl_3, PtCl_4 + 12H_2O$ Very sol in  $H_2O$  Sol in conc  $HCl$  (von Scheele, Z anorg 1898, 18 353)**Rubidium chloroplatinate,**  $Rb_2PtCl_6$ 

100 pts  $H_2O$  dissolve at

0°	10°	20°
0 184	0 154	0 141 pts $Rb_2PtCl_6$ ,
30°	40°	50°
0 145	0 166	0 203 pts $Rb_2PtCl_6$ ,
60°	70°	80°
0 253	0 329	0 417 pts $Rb_2PtCl_6$ ,
90°	100°	
0 521	0 634	pts $Rb_2PtCl_6$

(Bunsen, Pogg 113 337)

Sol in 740 pts  $H_2O$  at 15°, and 157 pts at 100° (Crookes, C N 9 205)  
Insol in alcohol**Samarium chloroplatinate,**  $SmCl_3, PtCl_4 + 10\frac{1}{2}H_2O$ Deliquescent Very sol in  $H_2O$  (Cleve, Bull Soc (2) 43 165)**Silver chloroplatinate,**  $Ag_2PtCl_6$ Ppt Gradually decomp by  $H_2O$  into  $AgCl$  and  $PtCl_4$  (Jorgensen, J pr (2) 16 345)  
 $Ag PtCl_4(OH)_2$  Ppt**Silver monochloroplatinate,**  $[PtCl(OH)_5]Ag_2$ 

Ppt (Bellucci, Chem Soc 1902, 82 (2) 155)

**Silver pentachloroplatinate,**  $(OH)PtCl_5Ag_2$ Ppt, stable in boiling  $H_2O$  (Miolati, Chem Soc 1900, 78 (2) 732)**Silver chloroplatinate ammonia,**  $Ag_2PtCl_6, 2NH_3$ Insol in  $H_2O^*$  (Birnbaum)**Sodium chloroplatinate,**  $Na_2PtCl_6 + 6H_2O$ Easily sol in  $H_2O$  Sat solution at 15° contains 39.77 g  $Na_2PtCl_6$  and has sp gr of 1.368 Sol in  $NaCl + Aq$  More sol in absolute alcohol than in 95% alcohol Sat solution in abs alcohol contains 11.90%, 95% alcohol, 6.34% Mixture of equal parts of alcohol and ether dissolve 2.43% Insol in ether (Precht, Z anal 18 502)**Sodium pentachloroplatinate,**  $(OH)PtCl_5Na_2$ 

Exists only in solution (Miolati, l c)

**Strontium chloroplatinate,**  $SrPtCl_6 + 8H_2O$ Very sol in  $H_2O$ **Strontium monochloroplatinate,**  $PtCl(OH)_5Sr + H_2O$ Insol in  $H_2O$  and org solvents (Bellucci, C C 1903, I 131)**Thallium chloroplatinate,**  $Tl_2PtCl_6$ Very sl sol in  $H_2O$  Sol in 15,585 pts  $H_2O$  at 15°, and 1948 pts at 100° (Crookes)**Thallium monochloroplatinate,**  $[PtCl(OH)_5]Tl$ 

Ppt (Bellucci, Chem Soc 1902, 82 (2) 155)

**Thallium pentachloroplatinate,**  $(OH)PtCl_5Tl_2$ 

(Miolati, Chem Soc 1900, 78 (2) 732)

**Thorium chloroplatinate,**  $ThCl_4, PtCl_4 + 12H_2O$ 

Very deliquescent (Cleve, Bull Soc (2) 21 118)

**Tin (stannic) chloroplatinate,**  $SnCl_4, PtCl_4 + 12H_2O$ 

(Nilson B 9 1142)

**Ytterbium chloroplatinate,**  $2YbCl_3, PtCl_4 + 22H_2O$ , and  $+35H_2O$ 

Ppt (Cleve, Z anorg 1902, 32 137)

**Vanadyl chloroplatinate,**  $(VO)PtCl_4 + 10\frac{1}{2}H_2O$ Sol in  $H_2O$ , cryst from  $PtCl_4 + Aq$  (Brauner, M 3 58)**Yttrium chloroplatinate,**  $4YCl_3, 5PtCl_4 + 52H_2O$ Very deliquescent (Cleve)  
 $2YCl_3, 3PtCl_4 + 30H_2O$  (Nilson, B 9 1059)  
 $2YCl_3, PtCl_4 + 21H_2O$  (Nilson)**Zinc chloroplatinate,**  $ZnPtCl_6 + 6H_2O$ Deliquescent, sol in  $H_2O$  and alcohol**Zinc tetrachloroplatinate,**  $ZnPt(OH)Cl_4 + 5H_2O$ Extremely sol in  $H_2O$  and alcohol (Miolati, Z anorg 1900, 22 458)**Zirconyl chloroplatinate,**  $(ZrO)PtCl_6 + 12H_2O$   
(Nilson)**Chloroplatinocyanhydripyrophosphoric**

acid,  $ClPtP O_5H_4 = ClPt \begin{cases} \nearrow P(OH)_2 \\ \searrow O \\ \nearrow PO(OH)_2 \end{cases}$

Not deliquescent Sol in  $H_2O$  (Schutzenberger, Bull Soc (2) 18 154)**Chloroplatinocyanhydric acid,**  
 $H_2Pt(CN)_4Cl_2$ 

See Perchloroplatinocyanhydric acid

**Potassium chloroplatinocyanide**,  $5K_2Pt(CN)_4$ ,  
 $K_2Pt(CN)_4Cl_2 + 21H_2O$   
 Sol in  $H_2O$ , insol in alcohol

**Silver chloroplatinocyanide**,  
 $Ag_2(PtCl_2(CN)_4)_2$   
 Ppt (Miolati, C C 1901, I 500)

**Chloroplatinophosphoric acid**,  
 $Cl_2PtP(OH)_3$   
 Very deliquescent, and sol in  $H_2O$   
 (Schutzenberger, Bull Soc (2) 17 493)

**Lead chloroplatinophosphate**,  $Pb_3(Cl_2PtPO_3)_2$   
 $+ 8H_2O$

Ppt  
 $Pb_3(Cl_2PtPO_3)_2$ ,  $2PbO + 4H_2O$  Ppt  
 (Schutzenberger, Bull Soc (2) 17 494)

**Silver chloroplatinophosphate**,  $Ag_2HPO_3$ ,  
 $PtCl_2$   
 Ppt (Schutzenberger, Bull Soc (2) 17 494)

**Chloroplatinodiphosphoric acid**,  $PtCl_2$ ,  
 $P_2(OH)_6$   
 Very deliquescent, and easily sol in  $H_2O$   
 (Schutzenberger, Bull Soc (2) 18 153)

**Chloroplatinopyrophosphoric acid**,  
 $ClPt \begin{array}{c} \nearrow P(OH)_2 \\ \searrow O \\ \searrow P(OH)_3 \end{array}$   
 Less deliquescent than chloroplatinodiphosphoric acid

**Chloroplatinous acid**,  $H_2PtCl_4$   
 Known only in solution

**Aluminum chloroplatinite**,  $AlPtCl_5 + 10\frac{1}{2}H_2O$   
 Very deliquescent, sol in  $H_2O$  (Nilson, J pr (2) 15 260)

**Ammonium chloroplatinite**,  $(NH_4)_2PtCl_4$   
 Sl sol in cold, easily in hot  $H_2O$  Insol in alcohol (Peyrone, A 55 206)

**Barium chloroplatinite**,  $BaPtCl_4 + 3H_2O$   
 Not deliquescent, sol in  $H_2O$  Very sl sol in 93% alcohol

**Cadmium chloroplatinite ammonia**,  $CdPtCl_4$ ,  
 $4NH_3$   
 Insol in  $H_2O$  or  $NH_4OH + Aq$  Sol in  $HCl + Aq$  (Thomson, B 2 668)

**Cæsium chloroplatinite**,  $Cs_2PtCl_4$   
 Sl sol in cold, easily in hot  $H_2O$   
 100 pts  $H_2O$  dissolve 3 4 pts salt at 20°  
 " " 6 73 " " 40°  
 " " 8 68 " " 60°  
 " " 10 92 " " 80°  
 " " 12 10 " " 100°  
 (Godeffroy, A 181 176)

$Cs_2PtCl_4$  Ppt Very sensitive to sunlight Decomp by  $H_2O$  into the higher and lower chlorides (Wohler, B 1909, 42 4104)

**Calcium chloroplatinite**,  $CaPtCl_4 + 8H_2O$   
 Deliquescent, sol in  $H_2O$

**Cerium chloroplatinite**,  $CeCl_3$ ,  $2PtCl_2 + 10\frac{1}{2}H_2O$   
 Deliquescent, easily sol in  $H_2O$  (Nilson, B 9 1847)

**Chromium chloroplatinite**,  $Cr_2Pt_3Cl_{12} + 18H_2O$   
 Deliquescent

**Cobalt chloroplatinite**,  $CoPtCl_4 + 6H_2O$   
 Sl deliquescent in moist, efflorescent in dry air

**Copper chloroplatinite**,  $CuPtCl_4 + 6H_2O$   
 Extremely deliquescent (Topsøe)

**Copper chloroplatinite ammonia** (cuprammonium chloroplatinite),  
 $Cu(NH_3)_4PtCl_4$   
 Insol in  $H_2O$  or  $NH_4OH + Aq$ , easily sol in  $H_2SO_4 + Aq$  (Millon and Commaillie, C R 57 822)

**Didymium chloroplatinite**,  $D_1Cl_3$ ,  $2PtCl_2 + 10H_2O$   
 Deliquescent, very sol in  $H_2O$  (Nilson)  
 $2D_1Cl_3$ ,  $3PtCl_2 + 18H_2O$  As above (Nilson)

**Erbium chloroplatinite**,  $ErPtCl_5 + 13\frac{1}{2}H_2O$   
 Deliquescent  
 $Er_2Pt_3Cl_{12} + 24H_2O$  Deliquescent in moist air

**Glucinum chloroplatinite**,  $GIPtCl_4 + 5H_2O$   
 Deliquescent in moist air Sol in  $H_2O$  in all proportions

**Iron (ferrous) chloroplatinite**,  $FePtCl_4 + 7H_2O$   
 Deliquescent Rather sl sol in cold, very sol in hot  $H_2O$  (Nilson)

**Lanthanum chloroplatinite**,  $L_1Pt_3Cl_{12} + 18$ ,  
 and  $27H_2O$   
 Deliquescent

**Lead chloroplatinite**,  $PbPtCl_4$   
 Insol in cold  $H_2O$

**Lithium chloroplatinite**,  $Li_2PtCl_4 + 6H_2O$   
 Sol in  $H_2O$

**Magnesium chloroplatinite**,  $MgPtCl_4 + 6H_2O$   
 Not very deliquescent, very sol in  $H_2O$



**Manganese chloroplatinite,  $\text{MnPtCl}_4 + 6\text{H}_2\text{O}$** 

As the Mg salt

**Mercurous chloroplatinite**

Ppt

**Nickel chloroplatinite,  $\text{NiPtCl}_4 + 6\text{H}_2\text{O}$** 

As the Co salt

**Potassium chloroplatinite,  $\text{K}_2\text{PtCl}_4$** Moderately sol in  $\text{H}_2\text{O}$ , insol in alcohol**Rubidium chloroplatinite,  $\text{Rb}_2\text{PtCl}_4$** Sl sol in cold, easily in hot  $\text{H}_2\text{O}$ **Silver chloroplatinite,  $\text{Ag}_2\text{PtCl}_4$** Insol in  $\text{H}_2\text{O}$   $\text{NH}_4\text{OH} + \text{Aq}$  dissolves out  $\text{AgCl}$  (Lang) $\text{AgCl}$ ,  $\text{PtCl}_2$ (?) As above (Commaille, Bull Soc (2) 6 262)**Silver chloroplatinite ammonia,  $\text{Ag}_2\text{PtCl}_4, 4\text{NH}_3$** 

(Thomsen)

**Sodium chloroplatinite,  $\text{Na}_2\text{PtCl}_4 + 4\text{H}_2\text{O}$** Deliquescent, very sol in  $\text{H}_2\text{O}$ **Strontium chloroplatinite,  $\text{SrPtCl}_4 + 6\text{H}_2\text{O}$** y sol in  $\text{H}_2\text{O}$ **Tantalum chloroplatinite,  $\text{TaPtCl}_4$** sol even in boiling  $\text{H}_2\text{O}$ **Thallium chloroplatinite,  $\text{Th}_2\text{Pt}_2\text{Cl}_{14} + 24\text{H}_2\text{O}$** 

very deliquescent

**Yttrium chloroplatinite,  $\text{Y}_2\text{Pt}_2\text{Cl}_{12} + 24\text{H}_2\text{O}$** 

Deliquescent

**Zinc chloroplatinite,  $\text{ZnPtCl}_4 + 6\text{H}_2\text{O}$** Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$ , insol in alcohol**Zinc chloroplatinite ammonia,  $\text{ZnPtCl}_4, 4\text{NH}_3$** Sl sol in  $\text{H}_2\text{O}$ , easily sol in  $\text{HCl} + \text{Aq}$   
Insol in alcohol (Thomsen, J B 1868 278)**Zirconyl chloroplatinite,  $(\text{ZrO})\text{PtCl}_4 + 8\text{H}_2\text{O}$** 

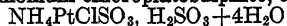
(Nilson)

**Trichloroplatinous acid,  $\text{H}_2\text{Pt}(\text{OH})\text{Cl}_3$** Sol in  $\text{H}_2\text{O}$  (Miolati, Z anorg 1902, 33 265) $+ \text{H}_2\text{O}$  (Nilson, J pr (2) 15 260)**Lead trichloroplatinite,  $\text{PbPt}(\text{OH})\text{Cl}_3$** 

Ppt (Miolati)

**Silver trichloroplatinite,  $\text{Ag}_2\text{Pt}(\text{OH})\text{Cl}_3$** 

Ppt (Miolati)

**Chloroplatosulphurous acid****Ammonium chloroplatosulphite, acid,**Sol in  $\text{H}_2\text{O}$  (Birnbbaum, A 152 149)**Ammonium chloroplatosulphite chloride sulphite,  $\text{NH}_4\text{PtClSO}_3, (\text{NH}_4)_2\text{SO}_3, \text{NH}_4\text{Cl}$** 

Very deliquescent (Birnbbaum)

**Ammonium chloroplatosulphite sulphite,**Sol in  $\text{H}_2\text{O}$  (Birnbbaum)**Barium chloroplatosulphite chloride ammonium chloride,  $\text{Ba}(\text{ClPtSO}_3)_2,$** Sol in  $\text{H}_2\text{O}$  (Birnbbaum)**Potassium chloroplatosulphite ammonium chloride,  $\text{KPtClSO}_3, 2\text{NH}_4\text{Cl}$** 

Very deliquescent (Birnbbaum, A 152 142)

**Potassium chloroplatosulphite chloride,  $\text{KPtClSO}_3, 2\text{KCl}$** Deliquescent, sol in  $\text{H}_2\text{O}$  (Birnbbaum, A 152 145)**Potassium chloroplatosulphite ammonium potassium sulphite,  $\text{KPtClSO}_3, (\text{NH}_4)\text{KSO}_3 + 3\text{H}_2\text{O}$** 

Very deliquescent (Birnbbaum, A 159 120)

**Sodium chloroplatosulphite ammonium chloride,  $\text{NaPtClSO}_3, 2\text{NH}_4\text{Cl}$** 

Very deliquescent (Birnbbaum, A 159 117)

**Chloroplumbic acid,  $\text{H}_2\text{PbCl}_6$** 

Decomp in solution on standing (Gutbier, J pr 1914, (2) 90 497)

**Ammonium chloroplumbate,  $(\text{NH}_4)_2\text{PbCl}_6$** Ppt Difficultly sol in v small amount of  $\text{H}_2\text{O}$  Solution decomp slowly when cold more rapidly when warmedDecomp by a large amount of  $\text{H}_2\text{O}$  Sol without decomp in 20%  $\text{HCl}$  Decomp by dil acids and alkalis (Elbs, Z Elektrochem 1903, 9 778)Difficultly sol in small amount of  $\text{H}_2\text{O}$  and solution decomp slowly in the cold, more rapidly when warmed Decomp by a large amount of  $\text{H}_2\text{O}$  (Gutbier, J pr 1914, (2) 90 498)Sol in cold  $\text{HNO}_3$  without decomp (Friedrich, M 1893, 14 511)Insol in conc  $\text{NH}_4\text{Cl} + \text{Aq}$  (Nikoljukin B 18 370 R) $5\text{NH}_4\text{Cl}, 2\text{PbCl}_4$  Not hygroscopic Decomp by  $\text{H}_2\text{O}$  with pptn of  $\text{PbO}_2$  Sol in  $\text{HCl} + \text{Aq}$  and in cold  $\text{HNO}_3 + \text{Aq}$  without

decomp (Classen and Zahorski, Z anorg 4 100)

Composition is  $2\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_4$  (Friedrich, W A B 102, 2b 527)

**Cæsium chloroplumbate**,  $\text{Cs}_2\text{PbCl}_6$

Nearly absolutely insol in conc  $\text{CsCl} + \text{Aq}$  in presence of  $\text{Cl}$  (Wells, Z anorg 4 335)

1 ccm conc  $\text{HCl} + \text{Aq}$  containing  $\text{PbCl}_4$  dissolves 0.000049 g  $\text{Cs}_2\text{PbCl}_6$  (Wells, Z anorg 4 341)

Reacts with  $\text{H}_2\text{O}$  as the corresponding ammonium salt (Gutbier, J pr 1914, (2) 90 500)

**Potassium chloroplumbate**,  $\text{K}_2\text{PbCl}_6$

Decomp by  $\text{H}_2\text{O}$ , sol in  $\text{KCl} + \text{Aq}$  (Wells, Z anorg 4 335)

Readily decomp in the air (Gutbier, J pr 1914, (2) 90 499)

**Rubidium chloroplumbate**,  $\text{Rb}_2\text{PbCl}_6$

Decomp by  $\text{H}_2\text{O}$ , sl sol in conc  $\text{RbCl} + \text{Aq}$  (Wells, Z anorg 4 335)

1 ccm conc  $\text{HCl} + \text{Aq}$  containing  $\text{PbCl}_4$  dissolves 0.003 g  $\text{Rb}_2\text{PbCl}_6$  (Wells, Z anorg 4 341)

Reacts with  $\text{H}_2\text{O}$  as the corresponding ammonium salt (Gutbier, J pr 1914, (2) 90 499)

Decomp by conc  $\text{H}_2\text{SO}_4$ , Insol in 96% alcohol (Erdmann, A 1896, 294 76)

**Chloropurpureochromium bromide**,



Somewhat more easily sol in  $\text{H}_2\text{O}$  than the chloride (Jorgensen, J pr (2) 20 105)

— **chloride**,  $\text{CrCl}(\text{NH}_3)_5\text{Cl}_2$

Difficultly sol in cold, and decomp by hot  $\text{H}_2\text{O}$

1 pt dissolves in 154 pts  $\text{H}_2\text{O}$  at  $16^\circ$  Insol in conc  $\text{HCl} + \text{Aq}$  More sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  than in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp (Jorgensen, J pr (2) 20 105)

— **mercuric chloride**,  $\text{CrCl}(\text{NH}_3)_5\text{Cl}$ ,  $3\text{HgCl}_2$

Very difficultly sol in  $\text{H}_2\text{O}$  (Jorgensen)

— **chloroplatinate**,  $\text{CrCl}(\text{NH}_3)_5(\text{PtCl}_6)$

Extremely difficultly sol in  $\text{H}_2\text{O}$  (Jorgensen)

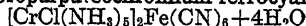
— **chromate**,  $\text{CrCl}(\text{NH}_3)_5(\text{CrO}_4)$

Sl sol in  $\text{H}_2\text{O}$ , sl more sol than chloropurpureocobalt chromate (Jorgensen)

— **dithionate**,  $\text{CrCl}(\text{NH}_3)_5(\text{S}_2\text{O}_6)$

Very sl sol in cold, but much more easily in hot  $\text{H}_2\text{O}$  (Jorgensen)

**Chloropurpureochromium ferrocyanide**,



Very difficultly sol in cold  $\text{H}_2\text{O}$  (Jorgensen)

— **fluosilicate**,  $\text{CrCl}(\text{NH}_3)_5(\text{SiF}_6)$

Very difficultly sol in  $\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{SiF}_6 + \text{Aq}$  (Jorgensen, J pr (2) 20 105)

— **mercuric iodide**,  $\text{CrCl}(\text{NH}_3)_5\text{I}_2$ ,  $2\text{HgI}_2$

Decomp by  $\text{H}_2\text{O}$ , sol in alcohol and warm  $\text{KCN} + \text{Aq}$

$\text{CrCl}(\text{NH}_3)_5\text{I}_2$ ,  $\text{HgI}_2$  Very difficultly sol in cold  $\text{H}_2\text{O}$ , easily sol in  $\text{KCN} + \text{Aq}$  (Jorgensen, l c)

— **nitrate**,  $\text{CrCl}(\text{NH}_3)_5(\text{NO}_3)$

Sol in 71 pts  $\text{H}_2\text{O}$  at  $17.5^\circ$  Insol in  $\text{HNO}_3 + \text{Aq}$  (Jorgensen)

— **oxalate**,  $\text{CrCl}(\text{NH}_3)_5\text{C}_2\text{O}_4$

Very sl sol in cold  $\text{H}_2\text{O}$  (Jorgensen, l c)

— **sulphate**,  $\text{CrCl}(\text{NH}_3)_5\text{SO}_4 \cdot 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , precipitated by alcohol (Jorgensen)

— **sulphate, acid**,  $[\text{CrCl}(\text{NH}_3)_5]_2\text{SO}_4(\text{HSO}_4)_6$

Quite sol in  $\text{H}_2\text{O}$  (Jorgensen, J pr (2) 20 185)

— **pentasulphide**,  $\text{CrCl}(\text{NH}_3)_5\text{S}_5$

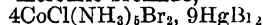
Very sl sol in cold, easily sol in warm  $\text{H}_2\text{O}$  Decomp by dil  $\text{HCl} + \text{Aq}$  Insol in alcohol (Jorgensen)

**Chloropurpureocobaltic bromide**,



Properties resemble the chloride very closely Sol in 214 pts  $\text{H}_2\text{O}$  at  $14.3^\circ$  (Jorgensen, J pr (2) 18 205)

— **mercuric bromide**,



Ppt (J)

— **bromoplatinate**,  $\text{CoCl}(\text{NH}_3)_5\text{Br}_2$ ,  $\text{PtBr}_4$

Very sl sol in  $\text{H}_2\text{O}$  (J)

— **carbonate**,  $\text{CoCl}(\text{NH}_3)_5\text{CO}_3 \cdot 4\frac{1}{2}\text{H}_2\text{O}$

Efflorescent, very easily sol in  $\text{H}_2\text{O}$  (J)

— **chloride**,  $\text{CoCl}(\text{NH}_3)_5\text{Cl}_2$

Very sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  Sol in 244 pts  $\text{H}_2\text{O}$  at  $15.5^\circ$  (Claudet, Phil Mag J (4) 2 253). In 287 pts  $\text{H}_2\text{O}$  at  $10.2^\circ$  and 255 pts at  $11.5^\circ$  (Rose, Pogg 20 152) 100 pts  $\text{H}_2\text{O}$  dissolve 0.232 pt  $\text{CoCl}_2$ ,  $5\text{NH}_3$ , at  $0^\circ$ , and 1.031 pts at  $46.6^\circ$  (Kurnakoff, J Russ Soc 24 629)

Sl decomp by cold, completely by boiling  $\text{H}_2\text{O}$ , decomp prevented by a little  $\text{HCl}$  Pptd from aqueous solution by alcohol,  $\text{HCl}$ ,

or sat KCl or NaCl + Aq, not deromp by boiling HCl + Aq (Claudet, *l c*) Nearly insol in cold, but sol in hot  $H_2O$ , to which a few drops of HCl have been added Less sol in dil HCl + Aq than luteocobaltic chloride (Rogojski, A ch (3) 41 447)

Insol in alcohol (Gibbs and Genth)

**Chloropurpureocobaltic antimony chloride,**  
 $2CoCl(NH_3)_5Cl_2, SbCl_3$

Ppt Decomp by  $H_2O$  (Gibbs)

— **bismuth chloride**

Insol in conc HCl Easily decomp by  $H_2O$  (Gibbs)

— **mercuric chloride,  $CoCl(NH_3)_5Cl_2, 3HgCl_2$**

Insol in cold, less sol in hot  $H_2O$  than chloropurpureocobaltic chloride Insol in cold fuming HCl + Aq, sl sol in hot HCl + Aq, separating on cooling, sl sol in hot aqua regia, moderately sol in hot  $HNO_3$  + Aq, partly sol in cold conc  $H_2SO_4$ , wholly on warming Easily sol in warm  $H_2C_2O_4$  + Aq Insol in  $HgCl_2$  + Aq

Moderately sol in  $NH_4OH$  + Aq or  $(NH_4)_2CO_3$  + Aq (Carstanjen)

$CoCl(NH_3)_5Cl_2, 2HgCl_2$  Sl sol in cold, but much more easily in hot  $H_2O$  (Gibbs, Proc Am Acad 10 33)

— **chloropalladite,  $CoCl(NH_3)_5Cl, PdCl_2$**

Sl sol in cold, moderately sol in hot  $H_2O$  (Carstanjen)

— **chloroplatinate,  $CoCl(NH_3)_5Cl_2, PtCl_4$**

Nearly insol in cold Very sl sol in hot  $H_2O$  (Gibbs and Genth, Sill Am J (2) 23 319)

— **chromate,  $CoCl(NH_3)_5CrO_4$**

Very sl sol in  $H_2O$  (J)

— **dichromate,  $CoCl(NH_3)_5Cr_2O_7$**

Much more easily sol in  $H_2O$  than the neutral salt (J)

— **dithionate,  $CoCl(NH_3)_5S_2O_6$**

Very sl sol in cold, more easily in hot  $H_2O$  (J)

— **manganic fluoride**

Ppt Sl sol in dil  $HCl$  + Aq (Christensen, J pr (2) 35 161)

— **fluosilicate,  $CoCl(NH_3)_5SiF_6$**

Very sl sol in  $HCl$  + Aq

— **iodide,  $CoCl(NH_3)_5I$**

Much more sol in  $H_2O$  than bromide or chloride Sol in 54.5 pts  $H_2O$  at  $15.6^\circ$ , and 50 pts at  $19.3^\circ$  (J)

**Chloropurpureocobaltic mercuric iodide,**  
 $CoCl(NH_3)_5I_2, 2HgI_2$

Sl sol in  $H_2O$  (J)

$CoCl(NH_3)_5I_2, HgI_2$  Very sl sol in cold  $H_2O$  (J)

— **nitrate,  $CoCl(NH_3)_5(NO_3)_2$**

Sol in 80 pts  $H_2O$  at  $15^\circ$  Rather easily sol in hot  $H_2O$  (Jorgensen J pr (2) 18 209)

— **oxalate,  $CoCl(NH_3)_5C_2O_4$**

Sl sol in  $H_2O$  (J)

— **pyrophosphate,  $CoCl(NH_3)_5(H_2P_2O_7)$**

Sl and very slowly sol in cold, much more easily in warm  $H_2O$  (J)

$[CoCl(NH_3)_5]_2P_2O_7 + xH_2O$  Quite easily sol in  $H_2O$

— **diphosphopentamolybdate,**

$[CoCl(NH_3)_5]_2(5MoO_3, 2HPO_4)$

Ppt Nearly insol in pure  $H_2O$ , more sol in dil  $H_2SO_4$  + Aq without decomp (J)

$[CoCl(NH_3)_5]_2(5MoO_3, 2NH_4PO_4)$  Ppt As above

— **sulphate,  $CoCl(NH_3)_5SO_4$**

Anhydrous Slowly sol in 125-131.9 pts  $H_2O$  at  $16^\circ$

+  $2H_2O$  Sol in 133.4 pts  $H_2O$  at  $17.3^\circ$  Rather easily sol in hot  $H_2O$ , and much more rapidly in conc  $H_2SO_4$  (J)

Decomp by  $H_2O$  into neutral sulphate Sol in  $H_2SO_4$

— **tartrate,  $CoCl(NH_3)_5(C_4H_4O_6)_2 + 2\frac{1}{2}H_2O$**

Moderately sol in  $H_2O$ , insol in alcohol

— **thiosulphate,  $CoCl(NH_3)_5S_2O_3$**

Nearly insol in cold  $H_2O$ , very sl sol in boiling  $H_2O$  with partial decomp (J)

**Chloropurpureoiridium comps**

See Iridopentamine comps

**Chloropurpureorhodium carbonate,**

$ClRh(NH_3)_5CO_3 + H_2O$

Easily sol in  $H_2O$  (Jorgensen)

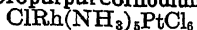
— **chloride,  $ClRh(NH_3)_5Cl$**

Sol in 179 pts  $H_2O$  at  $17^\circ$  and more easily in hot  $H_2O$  Sol in conc  $H_2SO_4$  or boiling  $N_2OH$  + Aq without decomp Very sl sol in cold dil  $HCl$  + Aq (1:1) Sl sol in hot  $HCl$  + Aq Insol in alcohol (Jorgensen, J pr (2) 27 433, 34 394)

— **rhodium chloride,**  
 $3ClRh(NH_3)_5Cl_2, 2RhCl_3$

Ppt (Jorgensen, Z anorg 5 75)

**Chloropurpleorhodium chloroplatinate,**



Insol in cold  $\text{H}_2\text{O}$  (J)

**fluosilicate,  $\text{ClRh}(\text{NH}_3)_5\text{SiF}_6$**

Very sl sol in cold  $\text{H}_2\text{O}$  Sol in  $\text{NaOH} + \text{Aq}$  as roseo salt (J)

**hydroxide,  $\text{ClRh}(\text{NH}_3)_5(\text{OH})_2$**

Known only in solution (J)

**nitrate,  $\text{ClRh}(\text{NH}_3)_5(\text{NO}_3)_2$**

Sl sol in cold  $\text{H}_2\text{O}$ , but more easily than the chloride Sol in boiling  $\text{NaOH} + \text{Aq}$  as roseo salt (J)

**sulphate,  $\text{ClRh}(\text{NH}_3)_5\text{SO}_4 + 2\text{H}_2\text{O}$**

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  (J)  
 $4\text{ClRh}(\text{NH}_3)_5\text{SO}_4 \cdot 3\text{H}_2\text{SO}_4$  Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  (J)

**Chlororhodous acid**

**Ammonium chlororhodite,  $(\text{NH}_4)_2\text{RhCl}_6 + \text{H}_2\text{O}$**

(Guthrie, B 1908, 41 213)  
 Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Wollaston)  
 Not obtainable (Leidie, A ch (6) 17 275)  
 $(\text{NH}_4)_2\text{RhCl}_6 + 1\frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , but less easily than Na salt, insol in alcohol Sol in dil  $\text{NH}_4\text{Cl} + \text{Aq}$  (Claus, J B 1855 423) (Guthrie, l c)

**Ammonium chlororhodite nitrate,**



Very sol in  $\text{H}_2\text{O}$  Decomp by boiling with  $\text{H}_2\text{O}$  Sl sol in  $\text{HNO}_3 + \text{Aq}$  (Leidie, C R 107 234)

**Barium chlororhodite,  $\text{Ba}_2(\text{RhCl}_6)$**

Resembles the Na salt (Bunsen, A 146 276)

**Cæsium chlororhodite,  $\text{Cs}_2\text{RhCl}_6 + \text{H}_2\text{O}$**

Difficulty sol in  $\text{H}_2\text{O}$  (Guthrie, B 1908, 41 214)

**Lead chlororhodite,  $\text{Pb}_2(\text{RhCl}_6)_2$**

Ppt Insol in  $\text{H}_2\text{O}$  (Claus) Not obtainable (Leidie)

**Mercurous chlororhodite,  $\text{Hg}_2\text{RhCl}_6$**

Ppt Insol in  $\text{H}_2\text{O}$  (Claus) Not obtainable (Leidie)

**Potassium chlororhodite,  $\text{K}_2\text{RhCl}_6 + \text{H}_2\text{O}$**

Not efflorescent Sl sol in  $\text{H}_2\text{O}$  Sl sol in  $\text{KCl} + \text{Aq}$  (Gibbs) Insol or sl sol in alcohol (Berzelius)  
 Salt is anhydrous (Leidie)  
 Contains  $1\text{H}_2\text{O}$  (Seubert and Kobbé, B 23 2556)

Can be cryst from  $\text{H}_2\text{O}$  containing a little  $\text{HCl}$  (Guthrie, B 1908 41 212)

$\text{K}_2\text{RhCl}_6 + 3\text{H}_2\text{O}$  Efflorescent Sl sol in  $\text{H}_2\text{O}$  Aqueous solution decomp to above on standing (Claus)

Not obtainable (Leidie)

Also obtained by Seubert and Kobbé B 23 2556)

$+1\frac{1}{2}\text{H}_2\text{O}$  (Leidie, C R 111 106)

**Rubidium chlororhodite,  $\text{Rb}_2\text{RhCl}_6 + \text{H}_2\text{O}$**

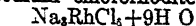
Difficulty sol in  $\text{H}_2\text{O}$  (Guthrie B 1908, 41, 214)

**Silver chlororhodite,  $\text{Ag}_2\text{RhCl}_6$**

Ppt Insol in  $\text{H}_2\text{O}$  (Claus)

Not obtainable (Leidie)

**Sodium chlororhodite,  $\text{Na}_4\text{RhCl}_{12} + 15\text{H}_2\text{O}$**



Efflorescent Sol in 15 pts  $\text{H}_2\text{O}$  Melts in crystal  $\text{H}_2\text{O}$  at  $50^\circ$  Insol in alcohol (Claus)

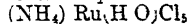
$+12\text{H}_2\text{O}$  (Guthrie, B 1908 41 213)

**Chlororuthenic acid**

**Ammonium chlororuthenate,  $\text{NH}_4\text{RuCl}_6$**

Easily sol in  $\text{H}_2\text{O}$  (Claus)  
 Formula is  $(\text{NH}_4)\text{Ru}(\text{NO})\text{Cl}$  (Joh C R 107 994)  
 Sol in  $\text{H}_2\text{O}$  with decomp sol in  $\text{HCl}$  (Howe, J Am Chem Soc 1904 26 549)

**Ammonium aquochlororuthenate,**



Ppt (Howe J Am Chem Soc 1904 26 548)

**Cæsium chlororuthenate,  $\text{Cs}_2\text{RuCl}_6$**

Sl sol in  $\text{H}_2\text{O}$  Sol in hot dil  $\text{HCl} + \text{Aq}$  (Howe, J Am Chem Soc 1901 23 754)

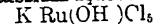
**Potassium chlororuthenate,  $\text{K}_2\text{RuCl}_6$**

Very sol in  $\text{H}_2\text{O}$  Very sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  Insol in  $70^\circ\text{C}$  (Claus)  
 Formula is  $\text{K}_2\text{Ru}(\text{NO})\text{Cl}$  (Joh C R 107 994)  
 Very sl sol in cold  $\text{H}_2\text{O}$  Insol in alcohol (Claus)

Partially decomp in hot  $\text{Aq}$  (Antonov, Gazz ch it 1899 29 52)

Easily sol in  $\text{H}_2\text{O}$  with decomp Sol in  $\text{HCl}$  (Howe J Am Chem Soc 1904, 26 549)

**Potassium aquochlororuthenate,**



Sol in  $\text{H}_2\text{O}$  (Howe J Am Chem Soc 1904, 26 547)

**Rubidium chlororuthenate,  $\text{Pb}_2\text{RuCl}_6$**

Sl sol in  $\text{H}_2\text{O}$ , sol in hot dil  $\text{HCl} + \text{Aq}$  (Howe, J Am Chem Soc 1901 23 754)

**Chlororuthenious acid**

**Ammonium chlororuthenite**,  $(\text{NH}_4)_4\text{Ru}_2\text{Cl}_{10}$   
Sl sol in  $\text{H}_2\text{O}$  Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$  or alcohol (Claus, J pr 80 282)

**Cæsium chlororuthenite**,  $\text{Cs}_2\text{RuCl}_6 + \text{H}_2\text{O}$   
Sl sol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$  (Howe, J Am Chem Soc 1901, 23 785)

**Potassium chlororuthenite**,  $\text{K}_4\text{Ru}_2\text{Cl}_{10}$   
Moderately sol in cold, more easily in hot  $\text{H}_2\text{O}$  Decomp easily by heating Insol in conc  $\text{NH}_4\text{Cl} + \text{Aq}$  Insol in 80% alcohol

**Rubidium chlororuthenite**,  $\text{Rb}_2\text{RuCl}_6 + \text{H}_2\text{O}$   
Sl sol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$  (Howe, J Am Chem Soc 1901, 23 786)

**Sodium chlororuthenite**,  $\text{Na}_4\text{Ru}_2\text{Cl}_{10}$   
Deliquescent Sol in  $\text{H}_2\text{O}$  or alcohol

**Trichlorosilcomercaptane**

See Silicon chlorohydrosulphide

**Chlorosmic acid**

**Chlorosmate**,  $(\text{NH}_4)_2\text{OsCl}_6$   
 $\text{H}_2\text{O}$  Insol in alcohol and  $\text{H}_2\text{O}$   
Jl.

**Ammonium chlorosmate**,  $\text{K}_2\text{OsCl}_6$   
Properties as the  $\text{NH}_4$  salt

**Potassium amino chlorosmate**,  
 $(\text{NH}_4)_2\text{OsCl}_6 \cdot 2\text{KCl}$   
Ppt (Brizard, A ch 1900, (7) 21 375)

**Potassium ammo. chlorosmate hydrogen chloride**,  $(\text{NH}_4)_2\text{CsCl}_3 \cdot 2\text{KCl} \cdot \text{HCl}$   
Ppt (Brizard, A ch 1900, (7) 21 378)

**Silver chlorosmate**,  $\text{Ag}_2\text{OsCl}_6$   
Insol in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$  (Claus and Jacoby)

**Silver chlorosmate ammonia**,  $\text{Ag}_2\text{OsCl}_6 \cdot 2\text{NH}_3$   
Sol in much  $\text{H}_2\text{O}$  Sl sol in  $\text{KOH} + \text{Aq}$   
Easily sol in  $\text{KCN} + \text{Aq}$  (C and J)

**Sodium chlorosmate**,  $\text{Na}_2\text{OsCl}_6 + 2\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  or alcohol

**Chlorosmious acid**

**Ammonium chlorosmite**,  
 $(\text{NH}_4)_4\text{Os}_2\text{Cl}_{10} + 3\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  and alcohol, insol in ether (Claus and Jacoby, J pr 90 65)

**Potassium chlorosmite**,  $\text{K}_4\text{Os}_2\text{Cl}_{12} + 6\text{H}_2\text{O}$   
Very easily sol in  $\text{H}_2\text{O}$  or alcohol Insol in ether (C and J)

**Chlorosmisulphurous acid**

**Potassium hydrogen chlorosmisulphite**,  
 $\text{OsCl}_4(\text{SO}_3)_4 \cdot \text{K}_6\text{H}_2$   
Ppt (Rosenheim, Z anorg 1900, 24 422)

**Sodium chlorosmisulphite**,  
 $\text{OsCl}_2(\text{SO}_3)_4 \cdot \text{Na}_6 + 10\text{H}_2\text{O}$   
Ppt (Rosenheim, Z anorg 1900, 24 420)

**Chloropyroselenious acid**

**Ammonium chloropyroselenite**,  $\text{NH}_4\text{Cl}$ ,  
 $2\text{SeO}_2 + 2\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Muthmann and Schafer, B 26 1008)

**Potassium chloropyroselenite**,  $\text{KCl}$ ,  $2\text{SeO}_2 + \text{H}_2\text{O}$   
As  $\text{NH}_4$  salt (M and S)

**Rubidium chloropyroselenite**,  $\text{RbCl}$ ,  
 $2\text{SeO}_2 + 2\text{H}_2\text{O}$   
As  $\text{NH}_4$  salt (M and S)

**Chlorostannic acid**,  $\text{SnO}(\text{OH})\text{Cl}$   
(Mallet, Chem Soc 35 524)  
 $\text{H}_2\text{SnCl}_6 + 6\text{H}_2\text{O}$  Extremely deliquescent,  
sol in  $\text{H}_2\text{O}$  (Seubert, B 20 793)

**Ammonium chlorostannate**,  $(\text{NH}_4)_2\text{SnCl}_6$   
(pink salt)  
Sol in 3 pts  $\text{H}_2\text{O}$  at  $14.5^\circ$  Solution decomp on boiling when dilute, but not when conc (Bollev)

**Barium chlorostannate**,  $\text{BaSnCl}_6 + 5\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Lewy, A ch (3) 16 308)

**Cæsium chlorostannate**,  $\text{Cs}_2\text{SnCl}_6$   
Nearly insol in conc  $\text{HCl} + \text{Aq}$  (Sharples, Sil Am J (2) 47 178)

**Calcium chlorostannate**,  $\text{CaSnCl}_6 + 5\text{H}_2\text{O}$   
Very deliquescent (Lewy, A ch (3) 16 308)

**Cerium chlorostannate**,  $\text{CeSnCl}_7 + 9\text{H}_2\text{O}$   
Deliquescent Sol in  $\text{H}_2\text{O}$  (Cleve, Bull Soc (2) 31 197)

**Cobalt chlorostannate**,  $\text{CoSnCl}_6 + 6\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Jorgensen)

**Didymium chlorostannate**,  $\text{DlCl}_3$ ,  $\text{SnCl}_4 + 10\frac{1}{2}\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Cleve)

**Glucinum chlorostannate**,  $\text{GlSnCl}_6 + 8\text{H}_2\text{O}$   
Deliquescent Sol in  $\text{H}_2\text{O}$  (Atterberg Sv V A Handl 12 No 4 14)

**Lanthanum chlorostannate**,  $4\text{LaCl}_3, 5\text{SnCl}_4 + 45\text{H}_2\text{O}$

Deliquescent Sol in  $\text{H}_2\text{O}$  (Cleve)

**Lithium chlorostannate**,  $\text{Li}_2\text{SnCl}_6 + 8\text{H}_2\text{O}$

Sol in little  $\text{H}_2\text{O}$  without decomp, but decomp by dilution (Chassevant, A ch (6) 30 42)

**Magnesium chlorostannate**,  $\text{MgSnCl}_6 + 6\text{H}_2\text{O}$

Very deliquescent (Lewy)

**Manganous chlorostannate**,  $\text{MnSnCl}_6 + 6\text{H}_2\text{O}$

Deliquescent in moist, efflorescent in dry air (Jorgensen)

**Nickel chlorostannate**,  $\text{NiSnCl}_6 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Jorgensen)

**Potassium chlorostannate**,  $\text{K}_2\text{SnCl}_6$

Sol in  $\text{H}_2\text{O}$

**Sodium chlorostannate**,  $\text{Na}_2\text{SnCl}_6 + 6\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Topsoe, Gm K Handb 6te auf III 149)

**Strontium chlorostannate**,  $\text{SrSnCl}_6 + 8\text{H}_2\text{O}$

Sl deliquescent, and easily sol in  $\text{H}_2\text{O}$  (Topsoe)

**Yttrium chlorostannate**,  $\text{YCl}_3, \text{SnCl}_4 + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Cleve, Bull Soc (2) 31 197)

**Zinc chlorostannate**,  $\text{ZnSnCl}_6 + 6\text{H}_2\text{O}$

(Bron, C C 1904, II 410)

**Chlorosulphobismuthous acid**

**Cuprous chlorosulphobismuthite**,  
 $2\text{Cu}_2\text{S}, \text{Bi}_2\text{S}_3, 2\text{BiSCl}$

Stable in air and insol in  $\text{H}_2\text{O}$  at ord temp

Decomp by boiling  $\text{H}_2\text{O}$

Decomp by mineral acids with evolution of  $\text{H}_2\text{S}$  (Ducatte, C R 1902, 134 1212)

**Lead chlorosulphobismuthite**,  $\text{PbS}, \text{Bi}_2\text{S}_3, 2\text{BiSCl}$

Stable in the air Insol in  $\text{H}_2\text{O}$ , decomp by boiling  $\text{H}_2\text{O}$ , sol in dil acids with decomp and evolution of  $\text{H}_2\text{S}$  (Ducatte)

**Chlorosulphonic acid**,  $\text{HClSO}_3$

See Sulphuryl hydroxyl chloride

**Chloropyrosulphonic acid**

**Ammonium chloropyrosulphonate**,  
 $\text{ClS}_2\text{O}_6\text{NH}_4$

Fumes in the air

Decomp by  $\text{H}_2\text{O}$  and alcohol (Traube, B 1913, 46 2519)

**Sodium chloropyrosulphonate**,  $\text{ClS}_2\text{O}_6\text{Na}$

Fumes in the air

Decomp by  $\text{H}_2\text{O}$  and alcohol (Traube)

**Chlorosulphuric acid**,  $\text{HSO}_3\text{Cl}$

See Sulphuryl hydroxyl chloride

$\text{SO}_2\text{Cl}_2$  See Sulphuryl chloride

**Aluminum chlorosulphate**,  $\text{Al}(\text{SO}_4)\text{Cl} + 6\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Nearly insol in abs alcohol (Recoura, Bull Soc 1902, (3) 27 1155)

**Chromium chlorosulphate**,  $\text{CrClSO}_4 + 5\text{H}_2\text{O}$

Green (Weinland, Z anorg 1905, 48 253) (Recoura, C R 1902, 135 164)

Violet (Weinland, Z anorg 1905, 48 254)

Very sol in  $\text{H}_2\text{O}$  Insol in a mixture of alcohol and acetone (Recoura, C R 1902, 135 164)

+  $8\text{H}_2\text{O}$  Two isomeric modifications

(a) Green needles Easily sol in  $\text{H}_2\text{O}$  (Weinland, Z anorg 1906, 48 251)

(b) Violet plates Easily sol in  $\text{H}_2\text{O}$  (Weinland)

**Chlorosulphurous acid**

**Ammonium palladious trichlorosulphite**,  
 $(\text{NH}_4)_2\text{PdCl}_3\text{SO}_3 + \text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1900, 23 30)

**Chlorotelluric acid**

**Ammonium chlorotellurate**,  $(\text{NH}_4)_2\text{TeCl}_6$

Sol without decomp in a small amt of  $\text{H}_2\text{O}$ , but decomp by much  $\text{H}_2\text{O}$  or alcohol

**Cæsium chlorotellurate**,  $\text{Cs}_2\text{TeCl}_6$

Decomp by  $\text{H}_2\text{O}$  Sol in dil  $\text{HCl} + \text{Aq}$   
100 pts  $\text{HCl} + \text{Aq}$  (sp gr 1.2) dissolve 0.05 pt at  $22^\circ$

100 pts  $\text{HCl} + \text{Aq}$  (sp gr 1.05) dissolve 0.78 pt at  $22^\circ$

Insol in alcohol (Wheeler, Sill Am J 145 267)

**Potassium chlorotellurate**,  $\text{K}_2\text{TeCl}_6$

Deliquescent, decomp by  $\text{H}_2\text{O}$  and absolute alcohol (Berzelius)

The most sol in  $\text{H}_2\text{O}$  of the chloro- or bromo-tellurates Easily sol in dil  $\text{HCl} + \text{Aq}$ , conc  $\text{HCl} + \text{Aq}$  ppts  $\text{KCl}$  (Wheeler, Sill Am J 145 267)

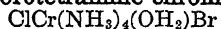
**Rubidium chlorotellurate**,  $\text{Rb}_2\text{TeCl}_6$

Decomp by  $\text{H}_2\text{O}$  Much more sol in dil  $\text{HCl} + \text{Aq}$  than  $\text{Cs}_2\text{TeCl}_6$

100 pts  $\text{HCl} + \text{Aq}$  (sp gr 1.2) dissolve 0.34 pt at  $22^\circ$

100 pts  $\text{HCl} + \text{Aq}$  (sp gr 1.05) dissolve, 13.99 pts at  $22^\circ$

Sl sol in alcohol (Wheeler)

**Chlorotetramine chromium bromide,**

Very easily sol in  $\text{H}_2\text{O}$  (Cleve, 1861, (Jorgensen, J pr (2) 42 210)

— **chloride**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH}_2)\text{Cl}_2$ 

Sol in  $\text{H}_2\text{O}$ , but decomp by boiling. Sol in  $\text{HCl} + \text{Aq}$ , and this solution may be boiled without decomp (Cleve)

Sol in 15.7 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Jorgensen, J pr 42 208)

— **chromate**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH}_2)\text{CrO}_4$ 

Precipitate (Cleve)

— **fluosilicate**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH}_2)\text{SiF}_6$ 

Sl sol in  $\text{H}_2\text{O}$  (Jorgensen, J pr (2) 42 218)

— **hydroxide**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH})_2$ 

Known only in solution (Cleve)

— **iodide**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH})\text{I}$ 

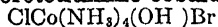
Easily sol in  $\text{H}_2\text{O}$  (Cleve)

— **nitrate**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH})(\text{NO}_3)$ 

Very easily sol in  $\text{H}_2\text{O}$  (Cleve), (Jorgensen, J pr (2) 42 209)

— **sulphate**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH})\text{SO}_4$ 

Very difficultly sol in cold, more easily in hot  $\text{H}_2\text{O}$  (Cleve)

**Chlorotetramine cobaltic bromide,**

More sol in  $\text{H}_2\text{O}$  than chloride. Nearly insol in  $\text{HBr} + \text{Aq}$  (1:1) (Jorgensen, J pr (2) 42 215)

— **chloride**,  $\text{ClCo}(\text{NH}_3)_4(\text{OH})\text{Cl}$ 

Sol in about 40 pts  $\text{H}_2\text{O}$ , and is identical with octamine cobaltic purpurcochloride of Vortmann (Jorgensen, J pr (2) 42 211)

— **chloroplatinate**,  $\text{ClCo}(\text{NH}_3)_4(\text{OH})\text{PtCl}_6 + 2\text{H}_2\text{O}$ 

Sl sol in  $\text{H}_2\text{O}$  (Jorgensen)

— **chromate**,  $\text{ClCo}(\text{NH}_3)_4(\text{OH})\text{CrO}_4$ 

Easily sol in cold  $\text{H}_2\text{O}$  (Jorgensen, J pr (2) 42 216)

— **fluosilicate**,  $\text{ClCo}(\text{NH}_3)_4(\text{OH}_2)\text{SiF}_6$ 

Sl sol in  $\text{H}_2\text{O}$ . Nearly insol in  $\text{H}_2\text{SiF}_6 + \text{Aq}$  (Jorgensen, J pr (2) 42 219)

— **sulphate**,  $\text{ClCo}(\text{NH}_3)_4(\text{OH})\text{SO}_4$ 

Sol in  $\text{H}_2\text{O}$  (Jorgensen, J pr (2) 42 211)

**Chlorotitanic acid**,  $\text{TiCl}_4 \cdot 2\text{HCl} = \text{H}_2\text{TiCl}_6$ 

Known only in solution (Kowalewsky, Z anorg 1900, 25 192)

**Chlorous acid**,  $\text{HClO}_2$ 

Known only in aqueous solution.  $100 \text{ H}_2\text{O}$  at  $8.5^\circ$  and 753 mm pressure dissolves 4.7 g  $\text{ClO}_2$ . Hydrate with 50.07–67.43  $\text{H}_2\text{O}$ , perhaps  $\text{HClO}_2 \cdot \text{H}_2\text{O}$ , separates out at  $0^\circ$  (Brandan, A 151 340)

Pure  $\text{HClO}_2$  is not known even in solution (Garzaroli-Thurnlakh, A 209 184)

**Chlorites**

All chlorites are easily sol in  $\text{H}_2\text{O}$  and in alcohol, with gradual decomp

**Ammonium chlorite**

Known only in aqueous solution, which decomposes on evaporation or long standing

**Barium chlorite**,  $\text{Ba}(\text{ClO}_2)_2$ 

Deliquescent, easily sol in  $\text{H}_2\text{O}$ . Solution decomp on evaporation. Easily sol in alcohol (Millon, A ch (3) 7 298)

**Lead chlorite**,  $\text{Pb}(\text{ClO}_2)_2$ 

Nearly insol in cold  $\text{H}_2\text{O}$ , and only sl sol in hot  $\text{H}_2\text{O}$ . Sol in  $\text{KOH} + \text{Aq}$  (Garzaroli and Hayn, A 209 203)

**Lead chlorite chloride**,  $6\text{Pb}(\text{ClO})_2 \cdot 4\text{PbCl}_2$ 

Rather difficultly sol in  $\text{H}_2\text{O}$  (Schmel, 109 317)

**Potassium chlorite**,  $\text{KClO}_2$ 

Very deliquescent and sol in  $\text{H}_2\text{O}$ . Sol in alcohol of  $35^\circ$  (Millon, A ch (3) 7 323). Sol in  $\text{HClO} + \text{Aq}$

**Silver chlorite**,  $\text{AgClO}_2$ 

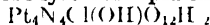
Sol in hot, less in cold  $\text{H}_2\text{O}$ . Easily decomp by heating above  $110^\circ\text{C}$ . Decomp by weakest acids (Millon, A ch (3) 7 329)

**Sodium chlorite**,  $\text{NaClO}_2$ 

Very deliquescent, and sol in  $\text{H}_2\text{O}$

**Strontium chlorite**,  $\text{Sr}(\text{ClO}_2)_2$ 

Deliquescent and sol in  $\text{H}_2\text{O}$ . Decomp by slow evaporation (Millon, A ch (3) 7 327)

**Chloroxyfulminoplatinum**,

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$  (V Meyer, J pr (2) 18 30)

**Chloruronic acid**,  $\text{H}_2\text{UO}_4 \cdot (\text{Cl} + 2\text{H}_2\text{O})$ 

Sol in  $\text{H}_2\text{O}$ , sl sol in alcohol (Mylius, Z 1901, 34 2776)

**Chromacichloride**,  $\text{Cr}(\text{OCl})_2$ 

See Chromyl chloride

**Chromatiodic acid**

See Chromiodic acid

**Chromic acid,  $H_2CrO_4$** 

Very sol in  $H_2O$  (Moissan, C R 98 1851)

Does not exist except in solution (Field, Chem Soc 61 405)

The composition of the hydrates formed by  $H_2CrO_4$  at different dilutions is calculated from determinations of the lowering of the fr-pt produced by  $H_2CrO_4$  and of the conductivity and sp gr of  $H_2CrO_4 + Aq$  (Jones, Am Ch J 1905, 34 333)

See also **Chromium trioxide**

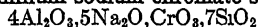
**Chromates**

Chromates of the alkali metals and of Ca, Mg, and Sr are sol in  $H_2O$ , the others are generally insol or sl sol in  $H_2O$ , but sol in  $HNO_3 + Aq$

**Aluminum chromate, basic,  $Al_2O_3, CrO_3 + 7H_2O$** 

Easily sol in  $NH_4OH + Aq$ , alum, or acetic acid + Aq Insol in  $NH_4Cl + Aq$  (Farne, Chem Soc 4 300)

Insol as such as  $H_2O$ , but easily decomp into  $H_2CrO_4$  and a basic insol comp Sol in alkaline solutions and acids Decomp by many salts (Eliot and Storer, Proc Am Acad 5 214)

**Aluminum sodium chromate silicate,**

(Weyberg, C B Miner, 1904 727)

**Ammonium chromate, basic,  $5(NH_4)_2O, 4CrO_3(?)$** 

Easily sol in cold  $H_2O$  (Pohl, W A B 6 592)

**Ammonium chromate,  $(NH_4)_2CrO_4$** 

Very sol in  $H_2O$ , pptd from aqueous solution by alcohol (Malaguti and Sarzeau)

100 g  $H_2O$  dissolve 40.46 g at  $30^\circ$  (Schrenemakers, Chem Weekbl 1905, 1 395)

Sol in  $H_2O$  without decomp (Schrenemakers, C C 1905, II 1067)

Sp gr of  $(NH_4)_2CrO_4 + Aq$  at  $t^\circ/4^\circ$

$t^\circ$	13°	13.7°	19.6°
% $(NH_4)_2CrO_4$	10.52	19.75	28.04
Sp gr	1.0633	1.1197	1.1727

(Slotte, W Ann 1881, 14 18)

Sl sol in liquid  $NH_3$  (Franklin, Am Ch J 1898, 20 826)

Difficulty sol in acetone (Naumann, B 1904, 37 4328)

**Ammonium dichromate,  $(NH_4)_2Cr_2O_7$** 

Less sol in  $H_2O$  than  $(NH_4)_2CrO_4$  (Moser)

100 g  $H_2O$  dissolve 47.17 g at  $30^\circ$

(Schrenemakers, Chem Weekbl 1905, 1 395)

Sp gr of  $(NH_4)_2Cr_2O_7 + Aq$  at  $t^\circ/4^\circ$

$t^\circ$	12°	10.5°	12°
% $(NH_4)_2Cr_2O_7$	6.85	13.00	19.93
Sp gr	1.0393	1.0782	1.1258

(Slotte, W Ann 1881, 14 18)

Sol in alcohol (Rautzer, Zeit angew ch 1913, 26 456)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Insol in acetone (Naumann, B 1904, 37 4328)

**Ammonium trichromate,  $(NH_4)_2Cr_3O_{10}$** 

Not deliquescent, but very sol in  $H_2O$  (Siewert)

Decomp by  $H_2O$  into chromic acid and dichromate (Jager and Kruss, B 22 2036)

Sol in acetone (Naumann, B 1904, 37 4328)

**Ammonium tetrachromate,  $(NH_4)_4Cr_4O_{13}$** 

Deliquescent Decomp by  $H_2O$  (Jager and Kruss, B 22 2037)

**Ammonium heptachromate  $(NH_4)_7Cr_7O_{19} +$** **Ammonium barium chromate,**

Ppt Decomp by  $H_2O$  (Groger, Z anorg 1908, 58 414)

**Ammonium cadmium chromate,  $(NH_4)_2O, 4CdO, 4CrO_3 + 3H_2O$** 

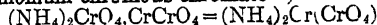
Ppt Decomp by boiling  $H_2O$  (Groger, M 1904, 25 533)

**Ammonium cadmium chromate ammonia,  $(NH_4)_2CrO_4, CdCrO_4, \frac{1}{2}NH_3 + 1\frac{1}{2}H_2O$** 

Decomp by  $H_2O$  (Groger, Z anorg 1908, 58 418)

$(NH_4)_2Cd(CrO_4)_2 \cdot 2NH_3$  Insol in cold decomp by hot  $H_2O$

Sol in dil acids or in  $NH_4OH + Aq$  (Briggs, Chem Soc 1903, 83 395)

**Ammonium chromous chromate(?)**

Difficultly sol in  $H_2O$  Insol in alcohol, ether, chloroform, or glacial acetic acid Easily sol in conc acids, from which it is separated on dilution Decomp by  $NaOH + Aq$  (Heintze, J pi (2) 4 220)

**Ammonium chromyl chromate,  $3(NH_4)_2O, 2CrO, 3CrO_3$** 

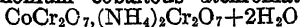
Nearly insol in  $H_2O$  (Pascal C R 1909, 148 1465)



**Ammonium cobaltous chromate**

Ppt Easily decomp (Briggs, Z anorg 1907, **56** 247)

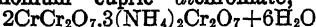
$(NH_4)_2O$ ,  $4CoO$ ,  $4CrO_3 + 3H_2O$  Insol in  $H_2O$  Sol in cold dil  $H_2SO_4$  (Groger, Z anorg 1906, **49** 202)

**Ammonium cobaltous dichromate,**

Sl hygroscopic, sol in  $H_2O$ , insol in alcohol (Kruss, Z anorg 1895, **8** 454)

**Ammonium cobaltous chromate ammonia,**

Ppt, decomp by  $H_2O$  (Groger, Z anorg 1908, **58** 422)

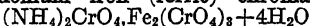
**Ammonium cupric dichromate,**

Sol in  $H_2O$  (Kruss, Z anorg 1895, **8** 455)

**Ammonium cupric chromate ammonia,**

Decomp by  $H_2O$  (Groger, Z anorg 1908, **58** 420)

Insol in cold, decomp by hot  $H_2O$  Sol in dil acids or in  $NH_4OH + Aq$  (Briggs, Chem Soc 1903, **83** 394)

**Ammonium iron (ferric) chromate,**

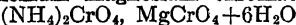
More easily decomp by  $H_2O$  than  $K_2CrO_4$ ,  $Fe_2(CrO_4)_3 + 4H_2O$  (Hensgen, B **12** 1300)  
 $6CrO_3$ ,  $5Fe_2O_3$ ,  $6(NH_4)_2O$ , and  $4CrO_3$ ,  $Fe_2O_3, (NH_4)_2O + 4H_2O$  Ppts (Lepierre, C R 1894, **119** 1217)

**Ammonium lithium chromate,  $NH_4LiCrO_4 + 2H_2O$** 

Not deliquescent (Rammelsberg)

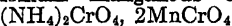
**Ammonium lead chromate,  $(NH_4)_2CrO_4, PbCrO_4$** 

Ppt Decomp by  $H_2O$  (Groger, Z anorg 1908, **58** 424)

**Ammonium magnesium chromate,**

Much more sol in  $H_2O$  than the corresponding sulphate (v Hauer)

Sol in  $H_2O$  (Groger, Z anorg 1908, **58** 416)

**Ammonium manganous chromate,**

Sol in  $H_2O$  (Hensgen, R t c **3** 433)

**Ammonium nickel chromate,  $(NH_4)_2CrO_4, NiCrO_4 + 6H_2O$** 

Sol in  $H_2O$  (Groger, Z anorg 1906, **51** 353)

Can be cryst from  $H_2O$  under  $40^\circ$  (Briggs, Chem Soc 1903, **83** 392)

**Ammonium nickel chromate ammonia,**

Decomp by  $H_2O$  (Groger, Z anorg 1906, **51** 354)

$(NH_4)_2Ni(CrO_4)_2$ ,  $2NH_3$  Insol in cold  $H_2O$  Decomp by hot  $H_2O$  Sol in dil acids or in  $NH_4OH + Aq$  (Briggs, Chem Soc 1903, **83** 393)

+  $6H_2O$  (Briggs, Proc Chem Soc 1902, **18** 254)

**Ammonium potassium chromate,  $NH_4KCrO_4$** 

Sol in  $H_2O$  (E Kopp, C N **11** 16)

+  $H_2O$  (Étard, C R **85** 443)  
 $2(NH_4)_2CrO_4$ ,  $3K_2CrO_4$  Very sol in  $H_2O$  (Zehenter, M 1897, **18** 51)

**Ammonium silver chromate,  $(NH_4)_2CrO_4, 3Ag_2CrO_4$** 

Decomp by  $H_2O$  (Groger, Z anorg 1908, **58** 423)

**Ammonium sodium chromate,  $NH_4NaCrO_4 + 2H_2O$** 

Very sol in  $H_2O$  (Zehenter, M 1897, **18** 54)

**Ammonium strontium chromate,  $(NH_4)_2CrO_4, SrCrO_4$** 

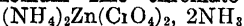
Ppt Decomp by  $H_2O$  (Groger, Z anorg 1908, **58** 415)

**Ammonium uranyl chromate,  $(NH_4)_2CrO_4, 2(UO_2)CrO_4 + 6H_2O$** 

Decomp by boiling with  $H_2O$  Sol in acidulated  $H_2O$  (Formanek, A **257**, 106)  
 +  $3H_2O$  (Formanek)

**Ammonium zinc chromate,  $(NH_4)_2O, 2ZnO, 2CrO_3 + H_2O$** 

Decomp by hot  $H_2O$  (Groger, M 1904, **25** 520)

**Ammonium zinc chromate ammonia,**

Insol in cold, decomp by hot  $H_2O$  Sol in dil acids or in  $NH_4OH + Aq$  (Briggs, Chem Soc 1903, **83** 394)

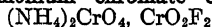
$4ZnCrO_4$ ,  $2(NH_4)_2CrO_4$ ,  $3NH_3 + 3H_2O$   
 Ppt Decomp by  $H_2O$  (Groger, Z anorg 1908, **58** 416)

**Ammonium dichromate chloride mercuric chloride,  $(NH_4)_2Cr_2O_7, 2NH_4Cl, 4HgCl_2 + 2H_2O$** 

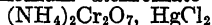
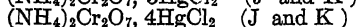
Ppt Sol in cold, more sol in warm  $H_2O$  (Stromholm, Z anorg 1912, **75** 280)

**Ammonium dichromate chloride mercuric cyanide,  $(NH_4)_2Cr_2O_7, 4NH_4Cl, 6Hg(CN) + 4H_2O$** 

(Stromholm, Z anorg 1913, **80** 157)

**Ammonium chromate chromyl fluoride,**Sol in  $\text{H}_2\text{O}$  (Varenne, C R 91 989)**Ammonium chromate iodate**

See Chromiodate, ammonium

**Ammonium dichromate mercuric chloride,**Cannot be recryst. from  $\text{H}_2\text{O}$  or  $\text{HgCl}_2 + \text{Aq}$ , but from  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 + \text{Aq}$  (Jäger and Kruss, B 22 2044)+  $\text{H}_2\text{O}$  (Richmond and Abel, Chem Soc Q J 3 199)Cannot be made to crystallize with  $\text{H}_2\text{O}$  (Jäger and Kruss)3  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7, \text{HgCl}_2$  Decomp by  $\text{H}_2\text{O}$  (J and K)4  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7, \text{HgCl}_2$  Decomp by  $\text{H}_2\text{O}$  (J and K)**Ammonium chromate phosphate**

See Phosphochromate, ammonium

**Ammonium chromate tellurate**

See Chromotellurate, ammonium

**Barium chromate,  $\text{BaCrO}_4$** Extremely sl sol in  $\text{H}_2\text{O}$ Calculated from electrical conductivity of  $\text{BaCrO}_4 + \text{Aq}$ , 1 l  $\text{H}_2\text{O}$  dissolves 3.8 mg  $\text{BaCrO}_4$  at  $18^\circ$  (Kohlrausch and Rose, Z phys Ch 12 241)When not ignited,  $\text{BaCrO}_4$  is sol in 86,957 pts  $\text{H}_2\text{O}$ , 22,988 pts  $\text{NH}_4\text{Cl} + \text{Aq}$  (0.5%  $\text{NH}_4\text{Cl}$ ), 3670 pts  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (5%  $\text{HC}_2\text{H}_3\text{O}_2$ ), 1986 pts  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (10%  $\text{HC}_2\text{H}_3\text{O}_2$ ), 1813 pts  $\text{H}_2\text{CrO}_4 + \text{Aq}$  (10%  $\text{CrO}_3$ ). When ignited, 160,000 pts  $\text{H}_2\text{O}$  are necessary for solution (Schweitzer, by Fresenius, Z anal 29 414)Sol in 23,000 pts boiling  $\text{H}_2\text{O}$  (Mescherzelski, Z anal 21 399)3.5 mg  $\text{BaCrO}_4$  are dissolved in 1 l of sat solution at  $18^\circ$  (Kohlrausch, Z phys Ch 1908, 64 168)Easily sol in  $\text{HNO}_3, \text{HCl}$ , or chromic acid +  $\text{Aq}$ , from which it is precipitated by  $\text{NH}_4\text{OH}$ , or by dilution with  $\text{H}_2\text{O}$  (Bahr)Insol in  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{Aq}$  (Schweitzer)Sol in 49,381 pts  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  (0.75% salt) at  $15^\circ$ , in 23,355 pts  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  (1.5% salt) at  $15^\circ$ , in 45,162 pts  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (0.5% salt) at  $15^\circ$  (Fresenius, Z anal 29 418)Easily sol in alkali tartrates, or citrates +  $\text{Aq}$  (Fleischer, J pr (2) 5 326)0.22  $\times 10^{-4}$  g equiv  $\text{BaCrO}_4$  are dissolved in 1 l of 45% alcohol at ord temp (Guerin, Dissert, 1912)Insol in acetic acid and in  $\text{M}_2\text{Cr}_2\text{O}_7 + \text{Aq}$ 

Partly sol in a mixture of the two, except

in presence of  $\text{MC}_2\text{H}_3\text{O}_2$  (Caron and Raquet, Bull Soc 1906, (3) 35 1064)

Not completely insol in acetic acid (Baubigny, Bull Soc 1907, (4) 1 58)

Insol in acetone (Naumann, B 1904, 37 4329)

Insol in methyl acetate (Naumann, B 1900, 42 3790)

**Barium dichromate,  $\text{BaCr}_2\text{O}_7 + 2\text{H}_2\text{O}$** Decomp by  $\text{H}_2\text{O}$  with separation of  $\text{BaCrO}_4$  Sol in  $\text{H}_2\text{CrO}_4 + \text{Aq}$  (Bahr, J B 1863 358)Sol in cold  $\text{H}_2\text{O}$  with formation of  $\text{BaCrO}_4$  and  $\text{CrO}_3$ 

Insol in glacial acetic acid (Mayer, B 1903, 36 1742)

**Barium calcium chromate,  $\text{BaCa}(\text{CrO}_4)_2$** 

(Bourgeois Bull Soc Min 1879, 2 124)

**Barium potassium chromate,  $\text{BaK}_2(\text{CrO}_4)_2$** Decomp by  $\text{H}_2\text{O}$  (Gieger, Z anorg 1907, 54 186)Decomp by  $\text{H}_2\text{O}$  Stable in  $\text{K}_2\text{CrO}_4 + \text{Aq}$ , containing2 181 pts K  $\text{CrO}_4$  per 100 pts  $\text{H}_2\text{O}$  at  $11.5^\circ$ 

3 395 " " " " " " " 27.5°

5 120 " " " " " " " 50.0°

7 119 " " " " " " " 76.0°

9 036 " " " " " " " 100.0°

(Barre, C R 1914, 158 497)

**Barium potassium trichromate,**

Extremely deliquescent (Bahr)

**Bismuth chromates, basic**These comps are insol in  $\text{H}_2\text{O}$  even in presence of  $\text{H}_2\text{CrO}_4$ , sol in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  (Lowe, J pr 67 288)100 pts  $\text{H}_2\text{O}$  dissolve 0.00008 pt "bismuth chromate", 100 pts acetic acid dissolve 0.00021 pt "bismuth chromate", 100 pts  $\text{HNO}_3 + \text{Aq}$  (sp gr = 1.038) dissolve 0.00024 pt "bismuth chromate", 100 pts  $\text{KOH} + \text{Aq}$  (sp gr = 1.33) dissolve 0.00016 pt "bismuth chromate" (Praison, Phil Mag (4) 11 206)Not insol in dil  $\text{HNO}_3 + \text{Aq}$  unless K  $\text{CrO}_4$  is present Less sol in hot  $\text{NaOH} + \text{Aq}$  than  $\text{PbCrO}_4$  (Storer)

"Bismuth chromate" is insol in acetone (Naumann, B 1904, 37 4329)

3  $\text{Bi}_2\text{O}_3, 2\text{CrO}_3 = 2(\text{BiO})_2\text{CrO}_4, \text{Bi}_2\text{O}_3$  Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HNO}_3 + \text{Aq}$  $\text{Bi}_2\text{O}_3, \text{CrO}_3 = (\text{BiO})_2\text{CrO}_4$  Insol in  $\text{H}_2\text{O}$ , easily sol in dil  $\text{HCl} + \text{Aq}$ , less in dil  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Murr) $\text{Bi}_2\text{O}_3, 2\text{CrO}_3 = (\text{BiO})_2\text{CrO}_4$  Insol in  $\text{H}_2\text{O}$ 5  $\text{Bi}_2\text{O}_3, 11\text{CrO}_3 + 6\text{H}_2\text{O}$  (Murr, Chem Soc 31 24)

$3\text{Bi}_2\text{O}_3, 7\text{CrO}_3$  Insol in  $\text{H}_2\text{O}$ , easily sol in mineral acids, especially  $\text{HCl} + \text{Aq}$  Partly sol in  $\text{KOH} + \text{Aq}$

**Bismuth chromate, acid**,  $\text{Bi}_2\text{O}_3, 4\text{CrO}_3 + \text{H}_2\text{O}$

Insol in hot or cold  $\text{H}_2\text{O}$  Sol in dil  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  (Muir, Chem Soc 30 17)

**Bismuth potassium chromate**,  $\text{Bi}_2(\text{CrO}_4)_3, \text{K}_2\text{CrO}_4$

Insol in  $\text{H}_2\text{O}$  Decomp with hot  $\text{H}_2\text{O}$   
 $\text{Bi}_2\text{O}_3, \text{K}_2\text{O}, 6\text{CrO}_3 + \text{H}_2\text{O}$  (Preis and Raymann, J B 1880 336)

**Bromomolybdenum chromate**

(Atterberg)

**Cadmium chromate, basic**,  $2\text{CdO}, \text{CrO}_3 + \text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$ , very slowly sol in  $\text{NH}_4\text{OH} + \text{Aq}$  with combination (Malaguti and Sarzeau, A ch (3) 9 431)

Composition as above (Freese, B 2 478)

**Cadmium chromate**,  $\text{CdCrO}_4$

Insol in  $\text{H}_2\text{O}$ , sol in acids, decomp by heating with  $\text{H}_2\text{O}$  (Schulz, Z anorg 1895,

$\text{O}_4 + \text{Aq}$  (Briggs,

sup by boiling  $\text{H}_2\text{O}$  (Schulz, 10 153)

**Chromate**,  $\text{CdO}, 2\text{CrO}_3 + \text{H}_2\text{O}$

sol in  $\text{H}_2\text{O}$  without decomp, hygroscopic (Schulz, Z anorg 1895, 10 152)

Easily sol in  $\text{H}_2\text{O}$  but decomp on evaporation (Groger, Z anorg 1910, 66 11)

**Cadmium trichromate**,  $\text{CdCr}_3\text{O}_{19} + \text{H}_2\text{O}$

Deliquescent (Groger, Z anorg 1910, 66 12)

**Cadmium chromate ammonia**,  $\text{CdCrO}_4, 4\text{NH}_3 + 3\text{H}_2\text{O}$

Efflorescent Decomp, by  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , insol in alcohol and ether (Malaguti and Sarzeau)

**Cadmium potassium chromate**,  $\text{CdK}(\text{CrO}_4)_2 + 2\text{H}_2\text{O}$

Ppt Decomp by  $\text{H}_2\text{O}$  (Groger, Z anorg 1907, 54 189)

$3\text{CdO}, \text{K}_2\text{O}, 3\text{CrO}_3 + 3\text{H}_2\text{O}$  Ppt (Preis and Raymann, Sitzungsb bohms Gesell 1880)

$4\text{CdO}, \text{K}_2\text{O}, 4\text{CrO}_3 + 3\text{H}_2\text{O}$  Ppt Slowly decomp by  $\text{H}_2\text{O}$  (Groger, M 1904, 25 533)

**Cadmium potassium dichromate**,

$\text{CdCr}_2\text{O}_7, \text{K}_2\text{Cr}_2\text{O}_7 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , sl hygroscopic (Krüss, Z anorg 1895, 8 454)

**Cadmium dichromate mercuric cyanide**,  
 $\text{CdCr}_2\text{O}_7, 2\text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  without decomp (Krüss, Z anorg 1895, 8 460)

**Cæsium chromate**,  $\text{Cs}_2\text{CrO}_4$

(Chabrié, C R 1901, 132 680)

Aq solution sat at  $30^\circ$  contains 47% (Schrenemakers, C C 1909, I 11)

**Cæsium dichromate**,  $\text{Cs}_2\text{Cr}_2\text{O}_7$

(Chabrié, C R 1901, 132 680)

Much more sol in hot  $\text{H}_2\text{O}$ , than in cold (Fraprie, Am J Sci 1906, (4) 21 309)

Aq solution sat at  $30^\circ$  contains 5.2% (Schrenemakers, C C 1909, I 11)

**Cæsium trichromate**,  $\text{Cs}_2\text{Cr}_3\text{O}_{10}$

Decomp by  $\text{H}_2\text{O}$  (Schrenemakers, Chem Weekbl 1908, 5 811)

Sol. in  $\text{H}_2\text{O}$  (Fraprie, Am J Sci 1906, (4) 21 315)

**Cæsium tetrachromate**,  $\text{Cs}_2\text{Cr}_4\text{O}_{13}$

Sol in  $\text{H}_2\text{O}$  with decomp (Schrenemakers, Chem Weekbl 1908, 5 811)

**Cæsium cobaltous chromate**,

$\text{Cs}_2\text{Co}(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$

(Briggs, Z anorg 1907, 56 248)

**Cæsium magnesium chromate**,

$\text{Cs}_2\text{Mg}(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$

(Briggs, Chem Soc 1904, 85, 680)

**Cæsium nickel chromate**,  $\text{Cs}_2\text{Ni}(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$

Sol in cold  $\text{H}_2\text{O}$  without much change, but decomp by warm  $\text{H}_2\text{O}$  (Briggs, Chem Soc 1904, 85 679)

**Calcium chromate basic**,  $\text{Ca}_2\text{CrO}_4 + 3\text{H}_2\text{O}$

Sol in 230 pts  $\text{H}_2\text{O}$  without decomp (Mylus and Wrochem, Gm K 3 I, 1385)

**Calcium chromate**,  $\text{CaCrO}_4$

*Anhydrous* Very sl sol in  $\text{H}_2\text{O}$  (Siewert, J B 1862 148)

Aq solution sat at  $18^\circ$  contains 2.3%  $\text{CaCrO}_4$ , sp gr = 1.023 (Mylus and Wrochem, B 1900, 33 3688)

Insol in acetone (Numann, B 1904, 37 4329)

$+\frac{1}{2}\text{H}_2\text{O}$  Aq solution sat at  $18^\circ$  contains 4.4%  $\text{CaCrO}_4$ , sp gr = 1.044 (Mylus and Wrochem, B 1900, 33 3688)

$+\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	$0^\circ$	$8^\circ$	$13^\circ$	$18^\circ$	$25^\circ$
% $\text{CaCrO}_4$	11.5	10.8	10.3	9.6	9.1

$t^\circ$	$40^\circ$	$60^\circ$	$75^\circ$	$90^\circ$	$100^\circ$
% $\text{CaCrO}_4$	7.8	5.7	4.6	3.6	3.1

(Mylus and Wrochem, Gm -K 3 I, 1386)

Sp gr of solution containing 9.6% by wt  $\text{CaCrO}_4$  at  $18^\circ = 1.096$  (Mylius and Wrochem, B 1900, **33**, 3688)  
 $+2\text{H}_2\text{O}$  Sol in 241.3 pts  $\text{H}_2\text{O}$  at  $14^\circ$  (Siewert)  
 Sol in 34 pts  $\text{H}_2\text{O}$  (Schwarz, Dingl 198 159)

Solubility of two modifications in  $\text{H}_2\text{O}$  at  $t^\circ$

$\alpha$  modification

$t^\circ$	$0^\circ$	$20^\circ$	$30^\circ$	$45^\circ$
% $\text{CaCrO}_4$	14.75	14.22	13.89	12.53

$\beta$  modification

$t^\circ$	$0^\circ$	$14^\circ$	$18^\circ$	$19.5^\circ$	$30^\circ$	$40^\circ$
% $\text{CaCrO}_4$	9.8	10	10.3	10.4	10.4	10.4

(Mylius and Wrochem Gm-K 3 I, 1387)

$\alpha$  modification Sp gr of the solution containing 14.3% by wt  $\text{CaCrO}_4$  at  $18^\circ = 1.149$  (Mylius and Wrochem, B 1900, **33**, 3688)

$\beta$  modification Sp gr of the solution containing 10.3% by wt  $\text{CaCrO}_4$  at  $18^\circ = 1.105$  (Mylius and Wrochem, B 1900, **33**, 3688)

Easily sol in  $\text{H}_2\text{O}$  containing  $\text{CrO}_3$

Insol in absolute alcohol

50 cc of alcohol (29%) dissolve 0.608 g  $\text{CaCrO}_4$ , 50 cc of alcohol (53%) dissolve 0.44 g  $\text{CaCrO}_4$  (Fresenius, Z anal **30**, 672)

Sol in acids and in dilute alcohol (Caron and Raquet, Bull Soc 1906, (3) **35**, 1064)

**Calcium dichromate**,  $\text{CaCr}_2\text{O}_7 + 3\text{H}_2\text{O}$

Very deliquescent (Bahr, J pr **60**, 60)

In sat solution at  $18^\circ$ , 61%  $\text{CaCr}_2\text{O}_7$  is present (Mylius and Wrochem, Gm-K 3 I, 1387)

Sol in acetone (Naumann, B 1904, **37**, 4328)

**Calcium potassium chromate**,  $\text{CaCrO}_4$ ,

$\text{K}_2\text{CrO}_4$

(Barre, C R 1914, **158**, 495)

$+ \text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Duncan)

Insol in  $\text{H}_2\text{O}$  when ignited

$+ 2\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$ , even after ignition Insol in alcohol (Duncan, J B **1850**, 313)

Formed below  $45^\circ$  (Barré, C R 1914, **158**, 495)

Sol in cold  $\text{H}_2\text{O}$  Sl sol in sat  $\text{K}_2\text{CrO}_4 + \text{Aq}$  (Groger, Z anorg 1907, **54**, 187)

Two modifications Solubility of  $\alpha$  modification is somewhat less than that of the  $\beta$  modification (Wyrouboff, Bull Soc Min 1891, **14**, 255)

Solubility of two modifications in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	$0^\circ$	$15^\circ$
Solubility of $\alpha$	23.06	25.06
" $\beta$	23.01	24.45

(Rakowski, C C **1909**, I 133)

$4\text{CaCrO}_4$ ,  $\text{K}_2\text{CrO}_4$

$5\text{CaCrO}_4$ ,  $\text{K}_2\text{CrO}_4$  Sol in much  $\text{H}_2\text{O}$  (Bahr)

**Calcium chromate potassium sulphate**,

$\text{CaCrO}_4$ ,  $\text{K}_2\text{SO}_4 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Hannay, Chem Soc **32**, 399)

$\text{CaCrO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{K}_2\text{CrO}_4$  As above (H)

**Cerous chromate**

Insol in  $\text{H}_2\text{O}$

**Calcium strontium chromate**,  $\text{CaSr}(\text{CrO}_4)_2$

(Bourgeois, Bull Soc Min 1879, **2**, 123)

**Ceric dichromate**,  $\text{CeO}_2$ ,  $2\text{CrO}_3 + 2\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , sol in acids, decomp completely by boiling  $\text{H}_2\text{O}$  (Bricout, C R 1894, **118**, 145)

**Chromic chromate**,  $\text{CrO}_2 = \text{Cr}_2\text{O}_3$ ,  $\text{CrO}_3$

Insol as such in  $\text{H}_2\text{O}$ , but decomp thereby into  $\text{CrO}_3$  and  $\text{Cr}_2\text{O}_3$ , decomp by alkaline and many saline solutions Easily sol in dil acids if recently pptd, but with difficulty if dried at a high temp (Eliot and Storer, Proc Am Acad **5**, 207)

$\text{Cr}_2\text{O}_{12} = \text{Cr}_2\text{O}_3$ ,  $3\text{CrO}_3$  Sol in  $\text{HCl} + \text{Aq}$  Very slowly sol in  $\text{HNO}_3 + \text{Aq}$  Slowly decomp by  $\text{H}_2\text{SO}_4$  or  $\text{NH}_4\text{OH} + \text{Aq}$  Easily decomp by  $\text{KOH} + \text{Aq}$

Does not exist (Eliot and Storer, l c)

$\text{Cr}_2\text{O}_{15} = 3\text{CrO}_3$ ,  $2\text{CrO}_3$  Easily sol in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  difficulty sol in acetic acid Easily sol in  $\text{KOH} + \text{Aq}$  (Traube, A **66**, 108)

Existence doubtful

$\text{Cr}_2\text{O}_9 = 2\text{Cr}_2\text{O}_3$ ,  $\text{Cr}_2\text{O}_3$  Insol in all acids, even aqua regia, slowly attacked by a boiling conc solution of alkali hydroxides (Geuther and Merz, A **118**, 62)  $\text{Cr}_2\text{O}_3$  according to Wohler

**Chromic cupric chromate**,  $\text{CuCr}_4\text{O}_9$ ,  $\text{Cr}_2\text{O}_3 + 12\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$  Sol in  $\text{HCl}$  and  $\text{HNO}_3$  (Rosenfeld, B 1879, **12**, 957)

$6\text{CuO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $\text{CrO}_3 + 9\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in acids (Rosenfeld, B 1879, **12**, 958)

**Chromic potassium chromate**,  $\text{Cr}_2\text{H}(\text{CrO}_4)_2$ ,  $\text{K}_2\text{CrO}_4(?)$

Insol in  $\text{H}_2\text{O}$ , alcohol, or acetic acid Not attacked by cold  $\text{HNO}_3 + \text{Aq}$ , sl oxidized when hot Insol in cold, easily sol in hot  $\text{H}_2\text{SO}_4$  Sl sol in  $\text{SO}_2 + \text{Aq}$  Sol in conc  $\text{HCl} + \text{Aq}$  (Tommasi, Bull Soc (2) **17**, 396)

**Chromous potassium chromate**,

$\text{K}_2\text{CrO}_4(\text{CrO}_2)_2 = \text{K}_2\text{Cr}(\text{CrO}_4)(?)$

Sat cold solution in  $\text{H}_2\text{O}$  contains 9% of the salt Insol in alcohol and ether (Heintze, J pr (2) **4**, 212)

**Cobaltous chromate, basic**,  $3\text{CoO}$ ,  $\text{CrO}_3 + 4\text{H}_2\text{O}$

Ppt Decomp by  $\text{H}_2\text{O}$  (Malaguti and Sarzeau, A ch (3) 9 431)

True formula is  $2\text{CoO}$ ,  $\text{CrO}_3 + 2\text{H}_2\text{O}$  (Freese, Pogg 140 252)

$4\text{CoO}$ ,  $3\text{CrO}_3 + 2\text{H}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$  (Gröger, Z anorg 1906, 49 203)

**Cobaltous chromate,  $\text{CoCrO}_4$**

Much more sol in  $\text{H}_2\text{O}$  than  $\text{NiCrO}_4$ . Easily sol in hot dil  $\text{HNO}_3 + \text{Aq}$  (Briggs, Z anorg 1909, 63 327)  
 $+ 2\text{H}_2\text{O}$  Ppt (Briggs, Z anorg 1909, 63 328)

**Cobaltous dichromate,  $\text{CoCr}_2\text{O}_7 + \text{H}_2\text{O}$**

Deliquescent Very sol in  $\text{H}_2\text{O}$  (Briggs, Z anorg 1907, 56 247)

**Cobaltous potassium chromate, basic**

$\text{K}_2\text{O}$ ,  $4\text{CoO}$ ,  $4\text{CrO}_3 + 3\text{H}_2\text{O}$

Sol in cold dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Groger, Z anorg 1906, 49 199)

**Cobaltous potassium chromate,  $\text{K}_2\text{Co}(\text{CrO}_4)_2 + 2\text{H}_2\text{O}$**

Decomp by  $\text{H}_2\text{O}$  (Groger, Z anorg 1906, 49 200)

**chromate, basic**,  $3\text{CuO}$ ,  $\text{CrO}_3 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Easily sol in dil  $\text{HNO}_3 + \text{Aq}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp by  $\text{KOH} + \text{Aq}$  (Malaguti and Sarzeau, A ch (3) 9 434)

$7\text{CuO}$ ,  $2\text{CrO}_3 + 5\text{H}_2\text{O}$  Ppt (Rosenfeld, B 13 1469)

$7\text{CuO}$ ,  $\text{CrO}_3 + 5\text{H}_2\text{O}$  Ppt (R)

**Cobaltous dichromate mercuric cyanide**,  $\text{CoCr}_2\text{O}_7$ ,  $2\text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$

Very stable Sol in  $\text{H}_2\text{O}$  (Kruss, Z anorg 1895, 8 458)

**Cupric chromate,  $\text{CuCrO}_4$**

Insol in  $\text{H}_2\text{O}$ , very sol in chromic acid and in other acids, decomp by boiling with  $\text{H}_2\text{O}$  (Schulz, Z anorg 1895, 10 152)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 827)

**Cupric dichromate, basic**,  $\text{CuCr}_2\text{O}_7$ ,  $2\text{CuO}$  (Stanley, C N 54 194)

**Cupric dichromate,  $\text{CuCr}_2\text{O}_7 + 2\text{H}_2\text{O}$**

Deliquescent Very easily sol in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ , and alcohol (Droge, A 101 39)

Aqueous solution is decomp by boiling (Malaguti and Sarzeau, A ch (3) 9 456)

Very hygroscopic Very sol in  $\text{H}_2\text{O}$  without decomp (Schulz, Z anorg 1895, 10 150)

**Cupric tetrachromate,  $\text{CuCr}_4\text{O}_{13} + 2\text{H}_2\text{O}$**

Deliquescent Decomp when its solution in  $\text{H}_2\text{O}$  is concentrated (Gröger, Z anorg 1910, 66 15)

**Cupric lead chromate**,  $2(\text{PbCrO}_4, \text{PbO})$

Min *Vauquelinite* Sol in acids

**Cupric potassium chromate, basic**,  $\text{KCu}_2(\text{OH})(\text{CrO}_4)_2 + \text{H}_2\text{O}$

Ppt (Gröger, M 1903, 24 485)

$3\text{CuO}$ ,  $\text{K}_2\text{O}$ ,  $3\text{CrO}_3 + 2\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{A}$  (Knop, A 70 52)

Does not exist (Rosenfeld, B 13 1472)  
 $4\text{CuO}$ ,  $\text{K}_2\text{O}$ ,  $4\text{CrO}_3 + \text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}$  (Gerhardt)  
 $+ 3\text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}$  (Gröger, Dissert 1880)

**Cupric potassium chromate ammonia**,  $\text{K}_2\text{Cu}(\text{CrO}_4)_2, 2\text{NH}_3$

Very sol in dil  $\text{NH}_3 + \text{Aq}$  decomp by  $\text{H}_4$  (Briggs, Chem Soc 1904, 85 672)

**Cupric chromate ammonia,  $\text{CuCrO}_4, 4\text{NH}_3$**

Decomp by  $\text{H}_2\text{O}$  Sol in dil  $\text{NH}_4\text{OH}$  Aq (Parravano and Pastre, Gazz ch 1 1907, 37 (2), 255)

$4\text{CuCrO}_4, 3\text{NH}_3 + 5\text{H}_2\text{O}$  Sol in  $\text{HCl}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ , insol in organic solvents, easily sol in  $\text{AgNO}_3 + \text{Aq}$  (Schuyten, C C 190 I 399)

$2\text{CuCrO}_4, 7\text{NH}_3 + \text{H}_2\text{O}$  Decomp by  $\text{H}_4$  Very sol in dil  $\text{NH}_4\text{OH} + \text{Aq}$  (Briggs, Chem Soc 1904, 85 673)

$3\text{CuO}$ ,  $2\text{CuO}$ ,  $10\text{NH}_3 + 2\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$ , sl sol or insol in alcohol, ether,  $\text{NH}_4\text{OH} + \text{Aq}$  (Malaguti and Sarzeau)  
Decomp by hot  $\text{H}_2\text{O}$ , insol in alcohol (Böttger)

**Cupric dichromate ammonia,  $\text{CuCr}_2\text{O}_7, 4\text{NH}_3 + 2\text{H}_2\text{O}$**

Decomp by  $\text{H}_2\text{O}$  Sol in dil  $\text{NH}_4\text{OH}$  Aq (Parravano and Pastre, Gazz ch 1 1907, 37 (2) 255)

**Cupric dichromate mercuric cyanide**,  $\text{CuCr}_2\text{O}_7, \text{Hg}(\text{CN})_2 + 5\text{H}_2\text{O}$

Not hygroscopic Sol in  $\text{H}_2\text{O}$  (Kruss, anorg 1895, 8 461)

**Didymium chromate,  $\text{Dy}_2(\text{CrO}_4)_3$**

Sl sol in  $\text{H}_2\text{O}$ , easily in dil acids (Friedrichs and Smith, A 191 353)  
 $+ 7\text{H}_2\text{O}$  (Cleve)

**Didymium potassium chromate**,  $\text{Dy}_2(\text{CrO}_4)_3, \text{K}_2\text{CrO}_4$

Precipitate Decomp by  $\text{H}_2\text{O}$  (Cleve)

**Dysprosium chromate**,  $\text{Dy}_2(\text{CrO}_4)_3 \cdot 10\text{H}_2\text{O}$ 

Very sl sol in  $\text{H}_2\text{O}$  1 0002 pt is sol in 100 pts  $\text{H}_2\text{O}$  at  $25^\circ$  (Jantsch, B 1911, 44 1276)

**Glucinum chromate, basic**,  $\text{GlCrO}_4 \cdot 13\text{H}_2\text{O}$ 

Ppt Insol in  $\text{H}_2\text{O}$  (Creuzberg, Dmgl 163 449)

$\text{GlCrO}_4 \cdot 6\text{H}(\text{OH}_2)$  Ppt Insol in  $\text{H}_2\text{O}$  (Glassmann, B 1907, 40 2603)

**Glucinum chromate**,  $\text{GlCrO}_4 + \text{H}_2\text{O}$ 

Decomp by  $\text{H}_2\text{O}$  with separation of the basic chromate (Glassmann, B 1907, 40 2603)

**Gold (auric) chromate**,  $\text{Au}(\text{CrO}_4)_3 \cdot \text{CrO}_3$ 

Ppt (Orloff, Ch Z 1907, 31 1182)

**Indium chromate**

Ppt (Meyer)

**Indium dichromate**

Very sol in  $\text{H}_2\text{O}$  Known only in solution

**Iron (ferric) chromate, basic**

Decomp by  $\text{H}_2\text{O}$  (Maus)

$\text{Fe}_2\text{O}_3 \cdot \text{CrO}_3$  Insol in  $\text{H}_2\text{O}$ , but decomp thereby, or by saline solutions, easily sol in acids Sol in  $\text{H}_2\text{CrO}_4 + \text{Aq}$  (Eliot and Stoici, Proc Am Acad 5 216)

**Iron (ferric) dichromate**

Sol in  $\text{H}_2\text{O}$  and alcohol (Maus, Pogg 9 132)

**Iron (ferric) potassium chromate, basic,**

$2\text{CrO}_3 \cdot 6\text{Fe}_2\text{O}_3 \cdot 3\text{K}_2\text{O}$

$4\text{CrO}_3 \cdot 3\text{Fe}_2\text{O}_3 \cdot 4\text{K}_2\text{O}$

$10\text{CrO}_3 \cdot 6\text{Fe}_2\text{O}_3 \cdot 7\text{K}_2\text{O}$

$11\text{CrO}_3 \cdot 3\text{Fe}_2\text{O}_3 \cdot 4\text{K}_2\text{O} + 9\text{H}_2\text{O}$

$9\text{CrO}_3 \cdot 2\text{Fe}_2\text{O}_3 \cdot 6\text{K}_2\text{O} + 6\text{H}_2\text{O}$

$9\text{CrO}_3 \cdot 2\text{Fe}_2\text{O}_3 \cdot 6\text{K}_2\text{O} + 10\text{H}_2\text{O}$

$10\text{CrO}_3 \cdot 3\text{Fe}_2\text{O}_3 \cdot 6\text{K}_2\text{O} + 5\text{H}_2\text{O}$

$7\text{CrO}_3 \cdot 2\text{Fe}_2\text{O}_3 \cdot 2\text{K}_2\text{O} + 7\text{H}_2\text{O}$

$4\text{CrO}_3 \cdot \text{Fe}_2\text{O}_3 \cdot \text{K}_2\text{O} + 4\text{H}_2\text{O}$

$6\text{CrO}_3 \cdot 2\text{Fe}_2\text{O}_3 \cdot 3\text{K}_2\text{O}$

$16\text{CrO}_3 \cdot 4\text{Fe}_2\text{O}_3 \cdot 5\text{K}_2\text{O} + 8\text{H}_2\text{O}$

Above compounds are ppts, insol in  $\text{H}_2\text{O}$ , alcohol and ether (Ispicre, C R 1894, 119, 1215-18)

**Iron (ferric) potassium chromate,**

$\text{Fe}_2(\text{CrO}_4)_3 \cdot \text{K}_2\text{CrO}_4 + 4\text{H}_2\text{O}$

Decomp by much  $\text{H}_2\text{O}$ , conc  $\text{HCl}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  Not decomp by alcohol (Hensgen, B 12 1300)

**Iron (ferric) sodium chromate, basic,**

$5\text{CrO}_3 \cdot 7\text{Fe}_2\text{O}_3 \cdot 4\text{Na}_2\text{O}$

Ppt (Lepierre, C R 1894, 119, 1217)

**Lanthanum chromate**,  $\text{La}_2(\text{CrO}_4)_3$ 

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$ , easily sol in acids (Ferichs and Smith, A 191 355)

$+8\text{H}_2\text{O}$  Ppt (Cleve)

**Lanthanum potassium chromate**

(Cleve)

**Lead chromate, basic**,  $2\text{PbO} \cdot \text{CrO}_3$  (*chrome red*)

Insol in  $\text{H}_2\text{O}$ , acetic acid dissolves out  $\frac{1}{2}$  the  $\text{PbO}$  Sol in  $\text{KOH} + \text{Aq}$  (Badams, Pogg 3 221)

Insol in acetone (Naumann, B 1904, 37 4329)

$3\text{PbO} \cdot \text{CrO}_3$  (Hermann, Pogg 28 162)  $+ \text{H}_2\text{O}$  Ppt (Stromholm, Z anorg 1904, 38 443)

Min *Melanochrome*, *Phaenochrome* Sol in acids

$\text{PbO}$ ,  $\text{PbCrO}_4$  Ppt (S)

**Lead chromate**,  $\text{PbCrO}_4$ 

Insol in  $\text{H}_2\text{O}$  Pptd from  $\text{Pb}(\text{NO}_3)_2$  in presence of 70,000 pts  $\text{H}_2\text{O}$  (Harting)

Calculated from electrical conductivity of  $\text{PbCrO}_4 + \text{Aq}$ , 1 l  $\text{H}_2\text{O}$  dissolves 0.2 mg  $\text{PbCrO}_4$  at  $18^\circ$  (Kohlrausch and Rose, Z phys Ch 12 241)

1 l  $\text{H}_2\text{O}$  dissolves  $1.2 \times 10^{-6}$  g  $\text{PbCrO}_4$  at  $25^\circ$  (Hevesy, Z anorg 1913, 82 328)

Sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Storer), sl sol in dil  $\text{HNO}_3 + \text{Aq}$

Sol in 560 pts  $\text{HNO}_3 + \text{Aq}$  of 1.12 sp gr, in 150 pts  $\text{HNO}_3 + \text{Aq}$  of 1.225 sp gr, in 130 pts  $\text{HNO}_3 + \text{Aq}$  of 1.265 sp gr, in 80 pts  $\text{HNO}_3 + \text{Aq}$  of 1.395 sp gr (Storei's Diet)

Solubility of  $\text{PbCrO}_4$  in  $\text{HNO}_3 + \text{Aq}$  at  $18^\circ$   
(Millimols per l)

0.1N	0.2N	0.3N	0.4N
0.506	0.844	1.13	1.44

(Beck and Stegmüller, l c)

Easily decomp by hot  $\text{HCl} + \text{Aq}$  (Fresenius)

Solubility of  $\text{PbCrO}_4$  in  $\text{HCl} + \text{Aq}$   
(Millimols per l)

$t^\circ$	0.1N	0.2N	0.3N	0.4N	0.5N	0.6N
18	0.186	0.393	0.654	1.07	1.56	2.20
25	0.239	0.485	0.839	1.32	1.96	2.90
37	0.357	0.744	1.31	2.10	3.28	4.60

(Beck and Stegmüller, Arb k Gesund Amt 1910, 34 446)

Insol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$

Easily sol in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  1 l  $\text{KOH} + \text{Aq}$  ( $\frac{1}{2}$  normal) dissolves 11.9 g  $\text{PbCrO}_4$  at  $15^\circ$ , 16.2 g at  $60^\circ$ , 26.1 g at  $80^\circ$

38.5 g at 102° (Lachaud and Lepierre, Bull Soc (3) 6 230)

Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Brett, 1837)

Sol in  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{Aq}$ , almost completely insol in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$

Not pptd in presence of Na citrate (Spiller)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Insol in acetone (Naumann, B 1904, 37 4329)

Min *Crocoite* Sol in hot  $\text{HCl} + \text{Aq}$ , difficultly sol in  $\text{HNO}_3 + \text{Aq}$ , sol in  $\text{KOH} + \text{Aq}$

#### Lead dichromate, $\text{PbCr}_2\text{O}_7$

Decomp by  $\text{H}_2\text{O}$

+ $2\text{H}_2\text{O}$  As above (Preis and Raymann, B 13 340)

#### Lead lithium chromate, $\text{PbCrO}_4$ , $\text{Li}_2\text{CrO}_4$

(Lachaud and Lepierre, C R 110 1035)

#### Lead potassium chromate, $\text{PbCrO}_4$ , $\text{K}_2\text{CrO}_4$

Insol in hot or cold  $\text{H}_2\text{O}$  or in alcohol Dil acids dissolve out  $\text{K}_2\text{CrO}_4$  (Lachaud and Lepierre, C R 110 1035)

Decomp by  $\text{H}_2\text{O}$  Stable in contact with solutions containing

8 950 pts	$\text{K}_2\text{CrO}_4$	per 100 pts	$\text{H}_2\text{O}$	at	10°
8 077	"	"	"	"	27 5°
7 629	"	"	"	"	37 5°
7 150	"	"	"	"	50 0°
6 145	"	"	"	"	76 0°
4 940	"	"	"	"	100 0°

(Barre, C R 1914, 158 497)

#### Lead sodium chromate, $\text{PbCrO}_4$ , $\text{Na}_2\text{CrO}_4$

Sol in  $\text{H}_2\text{O}$  (?) (Lachaud and Lepierre)

$\text{PbCrO}_4$ ,  $2\text{PbO}$ ,  $\text{Na}_2\text{CrO}_4$  (L and L)

#### Lithium chromate, $\text{Li}_2\text{CrO}_4$

100 cc of solution sat at 18° contain 85 g anhydrous salt (Kohlrausch, B A B 1897 90)

99.94 pts are sol in 100 pts  $\text{H}_2\text{O}$  at 30° (Schreinemakers, C C 1905 II, 1486)

+ $2\text{H}_2\text{O}$  Very easily sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 128 323)

100 g  $\text{H}_2\text{O}$  dissolve 111 g salt at 20° (Von Weimarn, C C 1911 II, 1300)

Sp gr of solution sat at 18° = 1.574, and contains 52.6%  $\text{Li}_2\text{CrO}_4$  (Mylius and Wrochem, B 1897, 30 1718)

#### Lithium dichromate, $\text{Li}_2\text{Cr}_2\text{O}_7$

130.4 pts are sol in 100 pts  $\text{H}_2\text{O}$  at 30° (Schreinemakers, C C 1905 II, 1486)

+ $2\text{H}_2\text{O}$  Deliquescent Sol in  $\text{H}_2\text{O}$  (Rammelsberg)

#### Lithium potassium chromate, $\text{K}_2\text{CrO}_4$ , $\text{Li}_2\text{CrO}_4 + \frac{1}{2}\text{H}_2\text{O}$

Hydroscopic (Zehenter, M 1897, 18 54)

#### Magnesium chromate, $\text{MgCrO}_4$

Sol in  $\text{H}_2\text{SO}_4$ , and  $\text{HCl}$ , insol in  $\text{H}_2\text{O}$  (Dufau, C R 1896, 123 888)

Sp gr of  $\text{MgCrO}_4 + \text{Aq}$  sat at t°/4°

t°	13 6°	14 5°	13
% $\text{MgCrO}_4$	12 31	21 86	27 1
Sp gr	1 0886	1 1641	1 170

(Slotte, W Ann 1881, 14 19)

Sol in acetone (Naumann, B 1904 37 4328)

+ $7\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Vauquelin) 100 cm of solution sat at 18° contain 0 g

$\text{MgCrO}_4$  (Kohlrausch, B A B 1897 9)

Sp gr of solution sat at 18° = 1.422, and contains 42%  $\text{MgCrO}_4$  (Mylius and Wrochem, B 1897, 30 1718)

+ $5\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Wyrouff, Bull Soc Min 12 60)

#### Magnesium dichromate, $\text{Mg}_2\text{Cr}_2\text{O}_7$

Sol in  $\text{H}_2\text{O}$

Sl sol in alcohol (Reinitzer, Zeit anorg 1913, 26 456)

#### Magnesium potassium chromate, $\text{MgCrO}_4$ , $\text{K}_2\text{CrO}_4 + 2\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve 28.2 pts at 20°, 4.3 pts at 60° (Schweitzer)

Sol in  $\text{H}_2\text{O}$  Sl sol in sat  $\text{K}_2\text{CrO}_4 + \text{Aq}$  (Gieger, Z anorg 1907, 54 188)

Insol in alcohol

+ $6\text{H}_2\text{O}$  Efflorescent (Briggs, C R Soc 1904, 85 679)

#### Magnesium rubidium chromate,

$\text{MgRb}_2(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$

(Briggs Chem Soc 1904, 85 679) (Bailey, Chem Soc 1911, 99 1327)

#### Magnesium sodium chromate

(Stanley, C N 54 194)

#### Manganous chromate, $2\text{MnO}$ , $\text{CrO}_3 + \frac{1}{2}\text{O}_2$

Ppt Sol in dil  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$  (Warrington and Reimschuesch, J 3 78)

#### Manganous potassium chromate, $\text{MnCrO}_4$ , $\text{K}_2\text{CrO}_4 + 2\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  Sol in dil  $\text{H}_2\text{O}$  (Gieger, Z anorg 1905, 44 459)

$2\text{MnCrO}_4$ ,  $\text{K}_2\text{CrO}_4 + 4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Hensgen, R t c 3 433)

#### Mercurous chromate, basic, $4\text{HgO}$ , $3\text{CrO}_3$

Very sl sol in cold, more in boiling  $\text{H}_2\text{O}$  Sl sol in  $\text{HNO}_3 + \text{Aq}$  Decomp by  $\text{H}_2\text{O}$

+ $\text{Aq}$  Sl sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett)

Does not exist (Richter, B 15 148)

$3\text{Hg}_2\text{O}$ ,  $\text{CrO}_3$  Sol in  $\text{HNO}_3 + \text{Aq}$  (Zehenter)

$3\text{Hg}_2\text{O}$ ,  $2\text{CrO}_3$  Ppt (Fichter, Z anorg 1912, **76** 350)

**Mercurous chromate,  $\text{Hg}_2\text{CrO}_4$**

Very sl sol in cold, more readily in hot  $\text{H}_2\text{O}$  Sl sol in dil  $\text{HNO}_3$ +Aq, sol in conc  $\text{HNO}_3$ , sol in  $\text{KCN}$ +Aq, insol in  $\text{Hg}_2(\text{NO}_3)_2$ +Aq (Rose, Pogg **53** 124)

Less sol in  $\text{K}_2\text{CrO}_4$ +Aq than in  $\text{H}_2\text{O}$  (Fichter, Z anorg 1912, **76** 349)

Insol in acetone (Naumann, B 1904, **37** 4329)

**Mercuric chromate, basic,  $2\text{HgO}$ ,  $\text{CrO}_3$**

Sol in  $\text{HCl}$ , and in  $\text{HNO}_3$ +Aq (Geuther)  $3\text{HgO}$ ,  $\text{CrO}_3$  Sl sol in  $\text{H}_2\text{O}$  (Millon)

The only true compound All others are mixtures of  $\text{HgO}$  or  $\text{HgCrO}_4$  with this compound (Cox, Z anorg 1904, **40** 155)

$4\text{HgO}$ ,  $\text{CrO}_3$  Sl sol in  $\text{H}_2\text{O}$  (Millon, A ch (3) **13** 365)

$7\text{HgO}$ ,  $2\text{CrO}_3$  Easily sol in warm  $\text{HNO}_3$ , when freshly precipitated Easily sol in  $\text{HCl}$ +Aq (Geuther, A **106** 247)

Does not exist (Freese, B **2** 477)  
 $5\text{HgO}$ ,  $\text{CrO}_3$  Easily sol in  $\text{HCl}$ +Aq  
Very sl sol in  $\text{HNO}_3$ +Aq Decomp by  $\text{H}_2\text{O}$  into—

$6\text{HgO}$ ,  $\text{CrO}_3$  Insol in  $\text{H}_2\text{O}$  (Jager and Kruss, B **22** 2049)

**Mercuric chromate,  $\text{HgCrO}_4$**

Decomp by  $\text{H}_2\text{O}$  and acids into basic salt (Geuther)

Sol in acids Sol in warm  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3$ +Aq Sol in  $\text{Hg}(\text{NO}_3)_2$ , or  $\text{HgCl}_2$ +Aq

Insol in ethyl acetate (Naumann, B 1910, **43** 314)

Insol in acetone (Naumann, B 1904, **37** 4329)

**Mercuric dichromate,  $\text{HgCr}_2\text{O}_7$**

Ppt (Gawłowski, C C **1906** II, 1307)

**Mercurous potassium chromate,**

$\text{Hg}_2\text{K}_2(\text{CrO}_4)_2$

Ppt, decomp by  $\text{H}_2\text{O}$  (Groger, Z anorg 1907, **54** 191)

**Mercuric chromate, basic, ammonia,  $12\text{HgO}$ ,  $3\text{CrO}_3$ ,  $2\text{NH}_3$ + $3\text{H}_2\text{O}$**

(Groger, Z anorg 1908, **58** 420)

**Mercuric chromate ammonia,  $\text{HgCrO}_4$ ,  $2\text{NH}_3$ + $\text{H}_2\text{O}$**

(Groger, Z anorg 1908, **58** 419)

**Mercuric chromate sulphide,  $2\text{HgCrO}_4$ ,  $\text{HgS}$**

Not attacked by weak acids (Palm, C C **1863** 121)

**Nickel chromate, basic,  $4\text{NiO}$ ,  $\text{CrO}_3$ + $6\text{H}_2\text{O}$**

Insol in  $\text{H}_2\text{O}$ , easily sol in  $\text{NH}_4\text{OH}$ +Aq (Malaguti and Sarzeau, A ch (3) **9** 451)

$3\text{NiO}$ ,  $\text{CrO}_3$ + $6\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in  $\text{NH}_4\text{OH}$ +Aq (Freese, J B **1869** 271)

$2\text{NiO}$ ,  $\text{CrO}_3$ + $6\text{H}_2\text{O}$  As above (Schmidt, A **156** 19)

$5\text{NiO}$ ,  $2\text{CrO}_3$ + $12\text{H}_2\text{O}$  As above (Schmidt)

**Nickel chromate,  $\text{NiCrO}_4$**

Not attacked by boiling  $\text{H}_2\text{O}$

Nearly insol in hot dil  $\text{HNO}_3$  Slowly sol in conc  $\text{HNO}_3$  and aqua regia

Somewhat sol in  $\text{NH}_3$ +Aq (Briggs, Z anorg 1909, **63** 326)

**Nickel dichromate,  $2\text{NiCr}_2\text{O}_7$ + $3\text{H}_2\text{O}$**

Slowly sol in cold, rapidly sol in hot  $\text{H}_2\text{O}$

Deliquescent (Briggs, Z anorg 1907, **56** 246)

**Nickel potassium chromate,  $\text{NiCrO}_4$ ,  $\text{K}_2\text{CrO}_4$ + $2\text{H}_2\text{O}$**

Decomp by  $\text{H}_2\text{O}$  (Groger, Z anorg 1906, **51** 353)

+ $6\text{H}_2\text{O}$  Efflorescent (Briggs, Chem Soc 1904, **85** 678)

**Nickel rubidium chromate,  $\text{NiRb}(\text{CrO}_4)_2$ + $6\text{H}_2\text{O}$**

Sl efflorescent at ord temp (Briggs, Chem Soc 1904, **85** 678)

**Nickel chromate ammonia,  $\text{NiCrO}_4$ ,  $6\text{NH}_3$ + $4\text{H}_2\text{O}$**

Decomp by  $\text{H}_2\text{O}$  Quite easily sol in  $\text{NH}_4\text{OH}$ +Aq of 0.96 sp gr (Schmidt) Insol in alcohol or ether

**Potassium chromate,  $\text{K}_2\text{CrO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ , etc**

System  $\text{K}_2\text{O}$ ,  $\text{CrO}_3$ ,  $\text{H}_2\text{O}$  at  $0^\circ$

100 g of the at solution contain		Solid phase
g $\text{K}_2\text{O}$	g $\text{Cr}_2\text{O}_3$	
31 18		$\text{K}_2\text{CrO}_4$
26 06	0 54	
19 31	4 27	
17 73	5 50	
17 06	11 77	"
17 18	11 91	
17 62	18 71	
17 63	18 72	
17 61	18 91	$\text{K}_2\text{CrO}_4$ + $\text{K}_2\text{Cr}_2\text{O}_7$
17 79	19 10	
17 80	19 10	
10 90	11 93	
8 07	8 93	$\text{K}_2\text{Cr}_2\text{O}_7$
1 87	3 13	
1 41	3 00	
1 42	3 01	
0 97	3 94	"
0 78	22 38	
1 02	38 83	
1 26	40 10	
1 36	40 41	"
1 22	41 70	



System  $K_2O, CrO_3, H_2O$  at  $0^\circ$ —Continued

100 g of the sat solution contain		Solid phase
g $K_2O$	g $CrO_3$	
1 28	41 75	$K_2Cr_2O_7$
1 40	42 10	"
1 23	42 11	"
1 33	42 16	"
1 31	42 28	"
1 38	42 48	"
1 40	42 68	"
1 47	42 93	$K_2C_2O_7 + K_2Cr_2O_7$
1 47	42 95	"
1 47	43 09	"
1 25	44 52	$K_2Cr_2O_7$
1 27	44 95	"
1 18	45 84	"
1 17	46 84	"
1 36	47 22	$K_2Cr_2O_7 + K_2Cr_4O_{13}$
1 36	47 31	"
1 40	47 67	"
1 24	48 23	$K_2Cr_4O_{13}$
1 35	51 66	"
1 10	53 81	"
1 08	55 63	"
1 16	56 93	"
0 96	57 63	"
1 16	59 46	"
0 91	59 87	"
0 81	60 16	"
0 70	61 76	$K_2C_4O_{13} + CrO_3$
0 62	61 77	"
0 57	61 78	"
0 67	61 86	"
	61 51	$CrO_3$
	61 52	"
	61 55	"
	61 57	"

(Koppel and Blumenthal, Z anorg 1907, 53  
245)System  $K_2O, CrO_3, H_2O$  at  $20^\circ$ 

100 g of the sat solution contain		Solid phase
g $K_2O$	g $CrO_3$	
2 21	42 92	$K_2Cr_2O_7 + K_2Cr_2O_7$
2 20	43 28	"
2 10	44 02	$K_2Cr_2O_7$
2 02	45 28	"
2 01	46 24	"
2 00	48 46	$K_2C_2O_7 + K_2C_4O_{13}$
1 94	48 62	$K_2Cr_4O_{13}$
1 62	49 01	"
0 62	62 80	$K_2Cr_4O_{13} + CrO_3$

(Koppel and Blumenthal, Z anorg 1907, 53  
243)System  $K_2O, CrO_3, H_2O$  at  $30^\circ$ 

100 g of the sat solution contain		Solid phase
g $K_2O$	g $CrO_3$	
46 8		$KOH, 2H_2O$
26 89	0 94	$K_2CrO_4$
22 25	3 06	"
19 52	6 99	"
18 65	13 72	"
18 60	17 00	"
18 70	17 03	"
19 12	20 30	"
19 35	21 00	$K_2CrO_4 + K_2Cr_2O_7$
15 04	16 85	$K_2Cr_2O_7$
14 77	16 51	"
12 28	14 57	"
11 20	13 11	"
4 98	10 48	"
3 07	19 34	"
2 42	28 21	"
2 35	33 77	"
2 30	36 78	"
2 30	40 41	"
2 50	44 50	$K_2Cr_2O_7 + K_2Cr_2O_7$
2 25	49 95	$K_2Cr_2O_7 + K_2Cr_4O_{13}$
1 35	53 39	$K_2Cr_4O_{13}$
0 69	62 81	$K_2C_4O_{13} + CrO_3$
	62 52	$CrO_3$

(Koppel and Blumenthal, Z anorg 1907, 53  
235)System  $K_2O, CrO_3, H_2O$  at  $60^\circ$ 

100 g of the sat solution contain		Solid phase
g $K_2O$	g $CrO_3$	
50 0		$KOH, H_2O$
32 98	0 53	$K_2CrO_4$
21 05	9 15	"
20 70	8 99	"
20 25	14 43	"
20 32	16 56	"
20 67	21 94	"
20 72	22 00	"
20 68	23 49	$K_2CrO_4 + K_2Cr_2O_7$
20 55	23 74	$K_2Cr_2O_7$
14 53	20 82	"
13 36	20 93	"
10 01	21 24	"
10 01	21 24	"
8 39	26 95	"
7 65	31 49	"
7 54	32 92	"
6 86	39 64	"
7 06	49 84	$K_2CrO_4 + K_2Cr_2O_7$
6 51	50 40	$K_2Cr_2O_7$
5 33	52 70	"
5 49	52 79	"
5 06	53 42	"
5 12	53 58	"
5 30	53 70	"

System  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at  $60^\circ$ —*Continued*

100 g of the sat solution contain		Solid phase
g $K_2O$	g $CrO_3$	
5 01	54 09	$K_2Cr_3O_{10} + K_2Cr_4O_{13}$
4 06	54 73	
3 29	54 91	"
2 95	55 43	"
3 01	56 41	"
2 50	58 05	"
2 31	58 69	"
2 00	60 69	"
2 05	61 25	"
1 70	61 27	"
1 79	61 29	"
1 57	62 57	"
1 27	65 77	$K_2Cr_4O_{13} + CrO_3$
	65 12	

(Koppel and Blumenthal, Z anorg 1907, **53** 240)System  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at the cryohydric pt

Cryohydric pt	100 g of the solution contain		Solid phase
	g $K_2O$	g $CrO_3$	
-11 $5^\circ$	17 18	18 11	$K_2CrO_4 + K_2Cr_2O_7$
-30 $0^\circ$	1 18	42 51	
-39 $0^\circ$	0 79	45 69	$K_2Cr_3O_{10} + K_2Cr_4O_{13}$

(Koppel and Blumenthal, Z anorg 1907, **53** 263-5)B-pt of solutions of  $CrO_3 + K_2O + Aq$ 

B pt	100 g of the solution contain		Solid phase
	g $K_2O$	g $CrO_3$	
109°	30 01	11 92	$K_2CrO_4$
105 8	23 8	25 3	
106 8	24 3	30 5	$K_2CrO_4 + K_2Cr_2O_7$
104 8	16 4	35 6	
114 0	16 8	59 2	$K_2Cr_3O_{10} + K_2Cr_4O_{13}$
127 0		71 2	

(Koppel and Blumenthal, Z anorg 1907, **53** 255)Potassium chromate,  $K_2CrO_4$ Easily sol in  $H_2O$ 

Sol in 2 pts  $H_2O$  at  $18.7^\circ$  (Abt.)  
 100 pts  $H_2O$  at  $1^\circ$  dissolve 43.87 pts  $K_2CrO_4$  and solution has sp gr of 1.3032 (Michel and Krafft A ch (3) 41 478)

1 pt dissolves in 2.07 pts  $H_2O$  at  $15.5^\circ$  (Thomson)1 pt dissolves in 1.75 pts  $H_2O$  at  $17.5^\circ$ , and in 1.67 pts  $H_2O$  at  $100^\circ$  (Moser)100 pts  $H_2O$  dissolve at—

$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$	
58 90	60 92	62 94	64 96	pts $K_2CrO_4$
40°	50°	60°	70°	
66 98	69 00	71 02	73 04	pts $K_2CrO_4$
80°	90°	100°		
75 06	77 08	79 10		pts $K_2CrO_4$

(Alluard, C R 59 500)

100 pts  $H_2O$  dissolve at—

$0^\circ$	$10^\circ$	$27.37^\circ$	$42.1^\circ$	
61 5	62 1	66 3	70 3	pts $K_2CrO_4$
63 6°	93 6°	106 1°		
74 9	79 7	81 8		pts $K_2CrO_4$

(Nordenskjöld and Lindström, Pogg 136 314)

100 pts  $K_2CrO_4 + Aq$  sat at  $10-12^\circ$  contain 37.14 pts salt (v Hauer, J pr 103 114)100 pts  $H_2O$  at  $19.5^\circ$  dissolve 62.3 pts  $K_2CrO_4$ , and solution has sp gr of 1.3787 (Schiff, A 109 326)Sat  $K_2CrO_4 + Aq$  contains at—

$34^\circ$	$53^\circ$	$79^\circ$
39 7	40 3	41 8%
96°	120°	157°
42 6	44 0	45 4%

(Étard, A ch 1894, (7) 2 550)

100 cc sat  $K_2CrO_4 + Aq$  contain 53 g  $K_2CrO_4$  at  $15^\circ$  (Kohlrausch, B A B 1897 90)100 pts  $H_2O$  dissolve 64.91 pts  $K_2CrO_4$  at  $30^\circ$ , or 100 g of solution contain 39.36 g  $K_2CrO_4$  (Schreinemakers, Chem Weekbl 1905, 1 837)100 g  $H_2O$  dissolve

54 57 g	$K_2CrO_4$	at $11.37^\circ$	(cryohydric pt)
57 11 g	"	"	"
65 13 g	"	"	"
74 60 g	"	"	"
88 80 g	"	"	"

(Koppel, Z anorg 1907, **53** 262)64.62 g  $K_2CrO_4$  at sol in 100 g  $H_2O$  at  $25^\circ$  (Amadori, Real Att Inc 1912, (5) **21**, I 667)

Sp gr of  $K_2CrO_4 + Aq$  at 19.5°

% $K_2CrO_4$	Sp gr	% $K_2CrO_4$	Sp gr	% $K_2CrO_4$	Sp gr
1	1.0080	15	1.1287	28	1.2592
2	1.0161	16	1.1380	29	1.2700
3	1.0243	17	1.1474	30	1.2808
4	1.0325	18	1.1570	31	1.2921
5	1.0408	19	1.1667	32	1.3035
6	1.0492	20	1.1765	33	1.3151
7	1.0576	21	1.1864	34	1.3268
8	1.0663	22	1.1964	35	1.3386
9	1.0750	23	1.2066	36	1.3505
10	1.0837	24	1.2169	37	1.3625
11	1.0925	25	1.2274	38	1.3746
12	1.1014	26	1.2379	39	1.3868
13	1.1104	27	1.2485	40	1.3991
14	1.1195				

(Kremers, and Schiff, calculated by Gerlach, Z anal 8 288)

$K_2CrO_4$  dissolved in 2 pts  $H_2O$  has sp gr, 1 28, 3 pts, 1 21, 4 pts, 1 18, 5 pts, 1 15, 6 pts, 1 12, 7 pts, 1 11, 8 pts, 1 10 (Moser)  
Sp gr of sat solution at 8° = 1.368 (Anthon, 1837)

Sp gr of sat  $K_2CrO_4 + Aq$  containing 24.26%  $K_2CrO_4$  = 1.2335 at 18°/4° (Slotte, W Ann 1881, 14 18)

Sp gr of  $K_2CrO_4 + Aq$  at 25°

Concentration of $K_2CrO_4 + Aq$	Sp gr
1-normal	1.0935
1/2- "	1.0475
1/4- "	1.0241
1/8- "	1.0121

(Wagner, Z phys Ch 1890, 5 36)

Sat  $K_2CrO_4 + Aq$  boils at 107° (Kremers)

Sat  $K_2CrO_4 + Aq$  boils at 104.2° under 718 mm pressure (Alluard)

Freezing point of sat  $K_2CrO_4 + Aq$  = -12.5° (Rudorff)

By dissolving  $K_2CrO_4$  in 2 pts  $H_2O$ , the temp is lowered 10° (Moser)

100 pts sat solution of  $K_2CrO_4$  and  $K_2SO_4$  contain 37.14 pts of the two salts at 10-12° (v Hauel, J pr 103 114)

Solubility of  $K_2CrO_4 + K_2SO_4$  in  $H_2O$  at 25° (G per 100 g  $H_2O$ )

$K_2CrO_4$	$K_2SO_4$	$K_2CrO_4$	$K_2SO_4$
63.09	0.76	20.83	5.75
61.39	1.17	14.65	7.12
58.40	1.84	7.81	8.98
51.81	2.36	4.36	10.25
40.93	3.33	1.94	10.86
27.36	4.82		

(Amadou, Real Att Line 1912, (5) 21, I 667)

Insol in liquid  $NH_3$  (Franklin, Am C J 1898, 20 829)

100 g sat solution in glycol at 15.4° contains 1.7 g  $K_2CrO_4$  (de Coninck, C C 19 II 183)

Insol in benzonitrile (Naumann, 1914, 47 1370)

Insol in methyl acetate (Naumann, 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3601)

Insol in acetone (Naumann, B 1904, 4329, Eidmann, C C 1899 II, 1014)

+4 $H_2O$  Easily sol in  $H_2O$  and in  $NH_4C$  + Aq (Wesch, Dissert 1909)

Potassium dichromate,  $K_2Cr_2O_7$ 

Sol in  $H_2O$ , with slight absorption of heat  
Less sol in  $H_2O$  than  $K_2CrO_4$

Sol in 9.6 pts  $H_2O$  at 17.3° (Thompson)  
10 13.7° (Moser)

100 pts  $H_2O$  at 15° dissolve 9.126 p  $K_2Cr_2O_7$ , and solution has sp gr = 1.06 (Michel and Krafft, A ch (3) 41 478)

100 pts  $H_2O$  dissolve pts  $K_2Cr_2O_7$  A = according to Alluard (C R 59 500), K according to Kremers (Pogg 92 497)

t°	A	K	t°	A	K
0	4.6	4.97	60	45.0	50.5
10	7.4	8.5	70	56.7	
20	12.4	13.1	80	68.6	73.0
30	18.4		90	81.1	
40	25.9	29.1	100	94.1	102.0
50	35.0				

Solubility in  $H_2O$  at high temperature  
100 pts  $H_2O$  dissolve pts  $K_2Cr_2O_7$  at t°

t	100 pts $K_2Cr_2O_7$	t	100 pts $K_2Cr_2O_7$
117	125.3	148	200.6
129	153.8	180	262.7

(Hilden und Shenstone, Phil Trans 1884 23)

Solubility of  $K_2Cr_2O_7$  in  $H_2O$  at t°

t	$K_2Cr_2O_7$	t	% $K_2Cr_2O_7$
-1	4.1	92	42.8
+1	4.3	97	44.0
6	5.6	101	48.0
7	6.1	120	52.0
12	7.2	130	54.4
15	8.5	150	60.8
20	10.4	157	62.8
29	14.2	178	66.6
36	16.6	215	76.9
57	28.2	291	89.7
61	30.2	312	91.8
65	32.0	360	97.4
70	34.4		

(Étard, A ch 1894, (7) 2 550)

100 g  $\text{H}_2\text{O}$  dissolve 10.1 g  $\text{K}_2\text{Cr}_2\text{O}_7$  at 15.5° (Greenish and Smith, Pharm J 1901, 66 774)

100 pts  $\text{H}_2\text{O}$  at 30° dissolve 18.12 pts  $\text{K}_2\text{Cr}_2\text{O}_7$  (Schreinemakers, Chem Weekbl 1905 1 837)

100 g  $\text{H}_2\text{O}$  dissolve  
 4.50 g  $\text{K}_2\text{Cr}_2\text{O}_7$  at -0.63° (cryohydric pt)  
 4.64 g " " 0°  
 18.13 g " " 30°  
 45.44 g " " 60°  
 108.2 g " " 104.8° (b-pt of sat sol)  
 (Koppel, Z anorg 1907, 53 263)

100 cc sat solution contain 11.43 g  $\text{K}_2\text{Cr}_2\text{O}_7$  at 20° (Sherrill and Eaton, J Am Chem Soc 1907, 29 1643)

100 g sat  $\text{K}_2\text{Cr}_2\text{O}_7$  contain  
 5.52 g  $\text{K}_2\text{Cr}_2\text{O}_7$  at 4.81°  
 15.17 " " 30.10°  
 17.77 " " 35.33°  
 (Le Blanc and Schmandt, Z phys Ch 1911, 77 614)

100 g sat  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{Aq}$  at 35.03° contains 17.72 g  $\text{K}_2\text{Cr}_2\text{O}_7$  (Le Blanc, Z phys Ch 1913, 86 335)

$\text{K Cr O} + \text{Aq}$  sat at 5 has sp gr 1.065 (Anthon 1837)

Sp gr of  $\text{K Cr}_2\text{O}_7 + \text{Aq}$  at 19.5°

% $\text{K Cr}_2\text{O}_7$	Sp gr	% $\text{K}_2\text{Cr}_2\text{O}_7$	Sp gr
1	1.007	9	1.065
2	1.015	10	1.073
3	1.022	11	1.080
4	1.030	12	1.085
5	1.037	13	1.097
6	1.043	14	1.102
7	1.050	15	1.110
8	1.056		

(Kiemers, calculated by Gerlach, Z anal 8 288)

Sp gr of  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{Aq}$  containing 4.71%  $\text{K}_2\text{Cr}_2\text{O}_7 = 1.0325$  at 11°/4°, containing 6.97%  $\text{K Cr O} = 1.0493$  at 10.6°/4° (Slotte, W Ann 1881, 14 18)

Sat  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{Aq}$  boils at 104° (Kiemers), 103.4° (Alluard)

Insol in alcohol  
 Sl sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Insol in alcohol (Reinutzer, Zeit angew Ch 1913, 26 456)

100 g sat solution in glycol contain 6 g  $\text{K}_2\text{Cr}_2\text{O}_7$  (de Coninck, Bull acad roy Belg 1905, 257)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Insol in acetone (Naumann, B 1904, 37 4329)

Insol in acetone and in methylal (Eidmann, C C 1899 II, 1014)

**Potassium trichromate,  $\text{K}_2\text{Cr}_3\text{O}_{10}$**

Easily sol in  $\text{H}_2\text{O}$  and alcohol (Bothe, J pr 46 184)

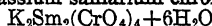
Not deliquescent, decomp by  $\text{H}_2\text{O}$  in chromic acid and  $\text{K}_2\text{Cr}_2\text{O}_7$  (Jager and Kruss, B 22 2041)

**Potassium tetrachromate,  $\text{K}_2\text{Cr}_4\text{O}_{13}$**

Very deliquescent, and easily sol in  $\text{H}_2\text{O}$  (Schwarz, Dingl 186 31)

Not deliquescent. Decomp by  $\text{H}_2\text{O}$  (Jager and Kruss, B 22 2042)

**Potassium samarium chromate,**



Precipitate (Cleve)

Insol in ethyl acetate (Naumann, B 1904, 37 3601)

**Potassium sodium chromate,  $3\text{K}_2\text{CrO}_4, \text{Na}_2\text{CrO}_4$**

Sol in  $\text{H}_2\text{O}$  (v Hauer, J pr 83 359)

64.2 pts are sol in 100 pts  $\text{H}_2\text{O}$  at 14° (Zehenter, M 1897, 18 49)

**Potassium strontium chromate,  $\text{K}_2\text{Sr}(\text{CrO}_4)_2$**

Ppt Decomp by  $\text{H}_2\text{O}$  (Groger, Z anorg 1907, 54 187)

Decomp by  $\text{H}_2\text{O}$  Stable in contact with solutions containing

at 11.5°, 2.914 pts  $\text{K}_2\text{CrO}_4$  per 100 pts  $\text{H}_2\text{O}$   
 at 27.5°, 4.123 " " " " "  
 at 50°, 5.942 " " " " "  
 at 76°, 7.920 " " " " "  
 at 100°, 9.784 " " " " "

(Barre, C R 1914, 158 496)

**Potassium thallium chromate,  $\text{K CrO}_4, \text{Tl}_2\text{CrO}_4$**

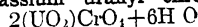
(Lachaud and Lepierre, Bull Soc (3) 6 232)

+2 $\text{H}_2\text{O}$  Rapidly hydrolyzed by  $\text{H}_2\text{O}$  unless a large excess of the  $\text{CrO}_4$  ion is present

Readily sol in dil mineral acids

Difficulty sol in  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{Aq}$  (Hawley, J Am Chem Soc 1907, 29 304)

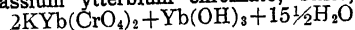
**Potassium uranyl chromate,  $\text{K}_2\text{CrO}_4,$**



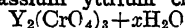
Decomp by boiling with  $\text{H}_2\text{O}$  Sol in acidified  $\text{H}_2\text{O}$  (Formanek, A 257 103)

$\text{K CrO}_4, (\text{UO}_2)\text{CrO}_4 + \text{H}_2\text{O}, 2\text{K CrO}_4, 3(\text{UO}_2)\text{CrO}_4 + 7\text{H}_2\text{O}, 3\text{K}_2\text{CrO}_4, 4(\text{UO}_2)\text{CrO}_4 + 7\text{H}_2\text{O}$ , and  $\text{K CrO}_4, 3(\text{UO}_2)\text{CrO}_4 + 14\text{H}_2\text{O}$   
 Precipitates (Wiesner, C C 1882 777)

**Potassium ytterbium chromate, basic,**



Ppt (Cleve, Z anorg 1902, 32 151)

**Potassium yttrium chromate,  $K_2CrO_4$ ,**

Ppt (Cleve)

**Potassium zinc chromate, basic,  $K_2O$ ,  $5ZnO$ ,  $4CrO_3 + 6H_2O$ , or  $K_2O$ ,  $4ZnO$ ,  $3CrO_3$ ,  $+ 3H_2O$** Slightly sol in cold, decomp by hot  $H_2O$  (Wohler) $K_2O$ ,  $4ZnO$ ,  $3CrO_3 + 3H_2O$  Insol in cold, decomp by hot  $H_2O$  (Groger, M 1904, 25 520)**Potassium zinc chromate,  $K_2Zn(CrO_4)_2 + 2H_2O$** Ppt Decomp by  $H_2O$  (Groger, Z anorg 1907, 54 189)**Potassium dichromate chloride mercuric chloride,  $K_2Cr_2O_7, 2KCl, 4HgCl_2 + 2H_2O$** Solution in  $H_2O$  sat at  $20.5^\circ$  contains 6.78% salt Salt is much more sol in hot  $H_2O$  (Stromholm, Z anorg 1912, 75 278)**Potassium chromate iodate**

See Chromoiodate, potassium

**Potassium chromate magnesium sulphate,  $K_2CrO_4, MgSO_4 + 9H_2O$** Sol in  $H_2O$  (Étard, C R 85 443)**Potassium chromate mercuric chloride,  $K_2CrO_4, 2HgCl_2$** Easily sol in  $H_2O$  Sol in dil  $HCl + Aq$  (Darby)**Potassium dichromate mercuric chloride,  $K_2Cr_2O_7, HgCl_2$** Ether or absolute alcohol dissolves out  $HgCl_2$  (Millon, A ch (3) 18 388)Can be crystallized from  $H_2O$  (Jager and Küss, B 22 2046)**Potassium chromate mercuric cyanide,  $2K_2CrO_4, 3Hg(CN)_2$** Easily sol in  $H_2O$  $+ H_2O$  (Dexter)Formula is  $K_2CrO_4, 2Hg(CN)_2$  (Clurke and Sterne, Am Ch J 3 352)**Potassium dichromate mercuric cyanide,  $K_2Cr_2O_7, Hg(CN)_2 + 2H_2O$** Sol in  $H_2O$  (Wyruboff, J B 1880 309)**Potassium chromate phosphate**

See Phosphochromate, potassium

**Potassium chromate sulphate,  $K_2CrO_4, 6K_2SO_4$** Easily sol in  $H_2O$  (Boutron-Chalaru)**Potassium chromate tellurate**

See Chromotellurate, potassium

**Rubidium chromate,  $Rb_2CrO_4$** Sol in  $H_2O$  (Piccard, J pr 86 455)**Solubility in  $H_2O$  at  $t^\circ$** 

$t^\circ$	% $Rb_2CrO_4$
— 7	36 65
0	38 27
10 3	40 22
20	42 42
30	44 11
40	46 13
50	47 44
60 4	48 90

(Schreinemakers and Filippo, Chem Weekbl 1906, 3 157)

**Rubidium dichromate,  $Rb_2Cr_2O_7$** Sol in  $H_2O$  (Grandeau, A ch (3) 67 227)Very sl sol in  $H_2O$ , 5% at  $10^\circ$ , 8% at  $26^\circ$ , 35% at  $60^\circ$  (Wyruboff, Bull Soc Mm 1881, 4 129)100 pts  $H_2O$  dissolve 10.46 pts  $Rb_2Cr_2O_7$  at  $30^\circ$  The solution contains 9.47% salt (Schreinemakers and Filippo, Chem Weekbl 1906, 3 157)Two forms of crystals Figures denote pts salt per 100 pts  $H_2O$  $t^\circ$  14° 26° 43°

Monoclinic form 4.45 8.00 16.52

Triclinic form 4.40 7.91 16.57

(Wyruboff, Bull Soc 1908, (4) 3 7)

**Solubility of monoclinic and triclinic forms**

$T, mp$	Pts of salt in 100 pts $H_2O$		$T, mp$	Pts of salt in 100 pts $H_2O$	
	Mono clinic	Tri clinic		Mono clinic	Tri clinic
18°	5.42	4.96	40°	13.22	12.90
24°	6.94	6.55	50°	18.94	18.77
30°	9.08	8.70	60°	28.1	27.3

(Stortenbeker, C C 1907, II 1558)

**Rubidium dichromate chloride mercuric chloride,  $Rb_2Cr_2O_7, 2RbCl, 4HgCl_2 + 2H_2O$** Sol in  $H_2O$ Solution sat at  $20.5^\circ$  contains 5.35% salt (Stromholm, Z anorg 1912, 75 284)**Silver (argentous) chromate,  $Ag_4CrO_4$** 

Sol in dil acids (Wohler und Rautenberg)

Existence very doubtful

**Silver chromate,  $Ag_2CrO_4$** Absolutely insol in  $H_2O$  Sol in acids, ammonia, and alkali chromates +  $Aq$  (Warrington, A 27 12)Appreciably sol in cold, and still more in hot  $H_2O$  (Memcke, A 261 341)100 ccm  $H_2O$  dissolve 0.064 gram  $Ag_2CrO_4$  at  $100^\circ$ , 100 ccm  $H_2O$  containing 50 grains

of the following salts dissolve the given amts of  $\text{Ag}_2\text{CrO}_4$  at  $100^\circ$   $\text{NaNO}_3$ , 0.064 gram,  $\text{KNO}_3$ , 0.192 gram,  $\text{NH}_4\text{NO}_3$ , 0.320 gram,  $\text{Mg}(\text{NO}_3)_2$ , 0.256 gram (Carpenter, J S C I **5** 236)

According to electrical conductivity of  $\text{Ag}_2\text{CrO}_4 + \text{Aq}$ , 1 l  $\text{H}_2\text{O}$  dissolves 28 mg  $\text{Ag}_2\text{CrO}_4$  at  $18^\circ$  (Kohlrausch and Rose, Z phys Ch **12** 241)

1 l  $\text{H}_2\text{O}$  dissolves 25 mg  $\text{Ag}_2\text{CrO}_4$  at  $18^\circ$  (Kohlrausch, Z phys Ch 1904, **50** 356)

25 mg are contained in 1 l of sat solution at  $18^\circ$  Solubility increases unusually rapidly with temp (Kohlrausch, Z phys Ch 1908, **64** 168)

Sol in 26,378 pts cold  $\text{H}_2\text{O}$  and 9116 pts  $\text{H}_2\text{O}$  at  $100^\circ$  (Koninek and Nihoul, Zeit anorg Ch 1891, **5** 295)

1 l  $\text{H}_2\text{O}$  dissolves  $1.2 \times 10^{-4}$  gram atoms of silver at  $25^\circ$  (Abegg and Cox, Z phys Ch 1903, **46** 11)

1 l  $\text{H}_2\text{O}$  dissolves 0.029 g  $\text{Ag}_2\text{CrO}_4$  at  $25^\circ$  (Schafer, Z anorg 1905, **45** 310)

1 l  $\text{H}_2\text{O}$  dissolves 0.0256 g  $\text{Ag}_2\text{CrO}_4$  at  $18^\circ$ , 0.0341 g at  $27^\circ$ , 0.0534 g at  $50^\circ$  (Whitby Z anorg 1910, **67** 108)

Sol in hot  $\text{NH}_4\text{OH} + \text{Aq}$  of sp gr 0.94 (15.63%  $\text{NH}_3$ ), sl sol in cold  $\text{NH}_4\text{OH} + \text{Aq}$  of sp gr 0.91 (24.99%  $\text{NH}_3$ ) (Margosches, Z anorg 1904, **41** 73)

Solubility of  $\text{Ag}_2\text{CrO}_4$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$

Mols $\text{NH}_4\text{OH}$ per l	Mols $\times 10^3$ $\text{Ag}_2\text{CrO}_4$ per l
0.01	2.004
0.02	4.169
0.04	8.595
0.08	17.58

(Sherrill and Russ, J Am Chem Soc 1907, **29** 1662)

Sl sol in very conc  $\text{K}_2\text{CrO}_4 + \text{Aq}$  Practically insol in  $\text{AgNO}_3 + \text{Aq}$  (Margosches)

Solubility of  $\text{Ag}_2\text{CrO}_4$  in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$

Mols $\text{HNO}_3$ per l	Milhat per l		Solid Phase
	Cr	Ag	
0.01	3.157	6.315	$\text{Ag}_2\text{CrO}_4$
0.015	3.730		"
0.02	4.177	8.356	"
0.025	4.567		"
0.03	5.200		"
0.04	5.803	11.62	"
0.05	6.380		"
0.06	6.833		"
0.07	7.333		"
0.075	7.477	14.85	" + $\text{Ag}_2\text{CrO}_4$
0.08	7.260	15.45	"
0.10	5.647	19.01	"
0.13	4.293	23.89	"
0.14	3.948	25.63	"

(Sherrill and Russ, J Am Chem Soc 1907, **29** 1663)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, **20** 829)

1 l 65% alcohol dissolves 0.0129 g  $\text{Ag}_2\text{CrO}_4$  at ord temp (Guerini, Dissert 1912)

Insol in  $\text{H}_2\text{O}$  containing acetic acid in presence of large excess of  $\text{AgNO}_3$  (Gooch and Weed, Am J Sci 1908, (4) **26** 85)

Practically insol in glacial acetic acid but somewhat sol in dil acetic acid It behaves in a similar manner toward propionic, lactic and other organic acids The red modification is more sol than the greenish-black (Margosches, Z anorg 1906, **51** 233)

**Silver dichromate,  $\text{Ag}_2\text{Cr}_2\text{O}_7$**

Sl sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  (Warington)

Decomp by boiling with  $\text{H}_2\text{O}$  into  $\text{CrO}_3$  and  $\text{Ag}_2\text{CrO}_4$  (Jager and Kruss, B **22** 2050)

Decomp by cold  $\text{H}_2\text{O}$  (Autenrieth, B 1902, **35** 2061)

1 pt is sol in 12,000 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Mayer, B 1903, **36** 1741)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 7.3 \times 10^{-3}$  atoms Ag per l Decomp by  $\text{HNO}_3 + \text{Aq}$  (less than 0.06 N) with separation of  $\text{Ag}_2\text{CrO}_4$  (Sherrill and Russ, J Am Chem Soc 1907, **29** 1674)

Solubility of  $\text{Ag}_2\text{CrO}_7$  in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$

Mols $\text{HNO}_3$ per l	Milhat per l		Solid Phase
	Cr	Ag	
0	32.20	5.390	$\text{Ag}_2\text{CrO}_4 + \text{Ag}_2\text{CrO}_7$
0.01	25.06	6.131	"
0.02	20.21	7.148	"
0.04	13.59	9.529	"
0.06	11.10	11.10	$\text{Ag}_2\text{CrO}_7$
0.08	11.10	11.10	"
0.08 + 0.1 $\text{AgNO}_3$	6.624		"

(Sherrill and Russ, J Am Chem Soc 1907, **29** 1664)

**Silver uranyl chromate,  $2\text{Ag}_2\text{CrO}_4, \text{UO}_2\text{CrO}_4$**   
Ppt (Forminek, A **257** 110)

**Silver chromate ammonia,  $\text{Ag}_2\text{CrO}_4, 4\text{NH}_3$**

Decomp by  $\text{H}_2\text{O}$  Sol in warm conc  $\text{NH}_4\text{OH} + \text{Aq}$  (Mitscherlich, Pogg **12** 141)

**Silver dichromate mercuric cyanide,  $\text{Ag}_2\text{Cr}_2\text{O}_7, \text{Hg}(\text{CN})_2$**

Sol in cold  $\text{H}_2\text{O}$  very sol in hot  $\text{H}_2\text{O}$  without decomp (Kruss, Z anorg 1895, **8** 456)

$\text{Ag}_2\text{Cr}_2\text{O}_7, 2\text{Hg}(\text{CN})_2$  Scarcely sol in cold more readily in hot  $\text{H}_2\text{O}$  Sol in hot  $\text{HNO}_3 + \text{Aq}$ , putting on cooling (Durby, Chem Soc **1** 24)

**Sodium chromate, basic,  $\text{Na}_4\text{CrO}_5 + 13\text{H}_2\text{O}$**

Sol without decomp in  $\text{H}_2\text{O}$

Sat solution at  $30^\circ$  contains 41.3%

$\text{Na}_2\text{CrO}_5$  (Schreinemakers, Z phys Ch 1906, **55** 93)

Deliquescent  
Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	0°	10°	20°
% $\text{Na}_2\text{CrO}_5$	33.87	35.58	38.05
$t^\circ$	27°	35°	37°
% $\text{Na}_2\text{CrO}_5$	40.09	44.09	45.13

(Mylius and Funk, Gm -K **3** I, 1379)

$\text{Na}_2\text{CrO}_5 + \text{Aq}$  sat at  $18^\circ$  contains 37.50%  $\text{Na}_2\text{CrO}_5$ , and has sp gr = 1.446 (Mylius and Funk, B 1900, **33** 3688)

**Sodium chromate,  $\text{Na}_2\text{CrO}_4$**

100 ccm of solution sat at  $18^\circ$  contain 54 g  $\text{Na}_2\text{CrO}_4$  (Kohlrusch, B A B 1897 90)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	% $\text{Na}_2\text{CrO}_4$
70	55.15
80	55.53
100	55.74

(Mylius and Funk, Gm -K **3** I, 1379)

$\text{Na}_2\text{CrO}_4 + \text{Aq}$  sat at  $18^\circ$  contains 40.10%  $\text{Na}_2\text{CrO}_4$ , and has sp gr = 1.432 (Mylius and Funk, B 1900, **33** 3686)

See also +4, 6, and  $10\text{H}_2\text{O}$

Sp gr of  $\text{Na}_2\text{CrO}_4 + \text{Aq}$  at  $t^\circ/4^\circ$

$t^\circ$	17.4°	17.1°	20.7°
% $\text{Na}_2\text{CrO}_4$	5.76	10.62	14.81
Sp gr	1.0576	1.1125	1.1644

(Slotte, W Ann 1881, **14** 18)

$+4\text{H}_2\text{O}$  Sat solution at  $30^\circ$  contains 46.62%  $\text{Na}_2\text{CrO}_4$  (Schreinemakers, Z phys Ch 1906, **55** 93)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t$	% $\text{Na}_2\text{CrO}_4$	$t$	% $\text{Na}_2\text{CrO}_4$
25.6	46.08	49.5	50.93
31.5	47.05	54.5	52.28
36	47.98	59.5	53.39
40	48.97	65	55.2
45	50.20		

(Mylius and Funk Gm -K **3** I, 1379)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t$	% $\text{Na}_2\text{CrO}_4$	Mols $\text{H}_2\text{O}$ to 1 mol anhydrous salt	Mols anhydrous salt to 100 mols $\text{H}_2\text{O}$
28.9	46.47	10.37	9.64
29.7	46.54	10.34	9.67
31.2	47.08	10.12	9.88

(Salkowski B 1901, **34** 1948)

$+6\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	% $\text{Na}_2\text{CrO}_4$	Mols $\text{H}_2\text{O}$ to 1 mol anhydrous salt	Mols anhydrous salt to 100 mols $\text{H}_2\text{O}$
17.7	43.65	11.60	8.62
19.2	44.12	11.40	8.77
21.2	44.64	11.16	8.96
23.2	45.27	10.88	9.19
24.7	45.75	10.77	9.37
26.6	46.28	10.45	9.57

(Salkowski, B 1901, **34** 1948)

$+10\text{H}_2\text{O}$  Deliquescent (Kopp, A 4 99) Easily sol in  $\text{H}_2\text{O}$  Melts in cryst  $\text{H}_2\text{O}$  at  $23^\circ$  (Berthelot)

Sp gr of solution sat at  $18^\circ$  = 1.409, and contains 38.1%  $\text{Na}_2\text{CrO}_4$  (Mylius and Funk B 1897, **30** 1718)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	% $\text{Na}_2\text{CrO}_4$
0	24.04
10	33.41
18.5	41.65
19.5	44.78
21	47.40

(Mylius and Funk, Gm -K **3** I, 1379)

Sp gr of solution at  $15^\circ$  containing 40.1%  $\text{Na}_2\text{CrO}_4$  = 1.432 (Mylius, B 1900, **33** 3688)

Sl sol in alcohol (Mosci)

100 g absolute methyl alcohol dissolv 0.345 g  $\text{Na}_2\text{CrO}_4$  at  $25^\circ$  (de Bruyn, Z phy Ch **10** 783)

Insol in acetone (Naumann B 1904, **34** 4329)

**Sodium dichromate,  $\text{Na}_2\text{Cr}_2\text{O}_7$**

More sol in  $\text{H}_2\text{O}$  than  $\text{Na}_2\text{CrO}_4$

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t$	% $\text{Na}_2\text{Cr}_2\text{O}_7$
93	51.19
98°	51.2

(Mylius and Funk Gm -K **3** I 1380)

Sp gr of aqueous solution containing

1	5	10	15	20	25%
1.007	1.035	1.071	1.105	1.141	1.171

30 35 40 45 50%,  $\text{Na}_2\text{Cr}_2\text{O}_7$

1.208	1.24	1.280	1.313	1.34

(Stenley C N **54** 194)

Sp gr of sat solution containing 63.92%  $\text{Na}_2\text{Cr}_2\text{O}_7$  at  $18^\circ$  = 1.745 (Mylius and Funk B 1900, **33** 3688)

Sl sol in liquid  $\text{NH}_3$  (Franklin Am Ch J 1898, **20** 829)

Sol in acetone (Naumann, B 1904, 37 4328)

+2H<sub>2</sub>O Deliquescent

100 pts H<sub>2</sub>O dissolve at—

0° 15° 30° 80° 100° 139°  
107 2 109 2 116 6 142 8 162 8 209 7 pts salt

(Stanley, C N 54 194)

Solubility in H<sub>2</sub>O at t°

t	% Na <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub>
0	61 98
17	63 82
34 5	67 36
52	71 76
72	76 90
81	79 80

(Mylius and Funk, Gm-K 3 I, 1380)

100 g H<sub>2</sub>O at 30° dissolve 197 6 g Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, or sat solution at 30° contains 66 4% Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> (Schrenemakers, Z phys Ch 1906, 55 97)

100 ccm of a solution of sodium dichromate in alcohol contain 5 133 g Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> + 2H<sub>2</sub>O at 19 4° The solution decomp rapidly (Reinitzer, Zeit angew Ch 1913, 26 456)

The composition of the hydrates formed by Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> at different dilutions is calculated from determinations of the lowering of the fr = pt produced by Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> and of the conductivity and sp gr of Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> + 4q (Jones, Am ch J 1905, 34 317)

#### Sodium trichromate, NaCr<sub>3</sub>O<sub>10</sub>

Deliquescent Very sol in H<sub>2</sub>O (Stanley, C N 54 194)

+H<sub>2</sub>O Sat solution at 30° contains 80% Na<sub>2</sub>Cr<sub>3</sub>O<sub>10</sub> (Schrenemakers, Z phys Ch 1906, 55 94)

Solubility in H<sub>2</sub>O at t°

t° 0° 15° 55° 99°  
% Na<sub>2</sub>Cr<sub>3</sub>O<sub>10</sub> 50 03 80 44 52 68 85 78

(Mylius and Funk, Gm-K 3 I, 1380)

Sp gr of sat solution containing 80 6% Na<sub>2</sub>Cr<sub>3</sub>O<sub>10</sub> at 18° = 2 059 (Mylius and Funk B 1900, 33 3688)

#### Sodium ultrachromate, Na<sub>2</sub>Cr<sub>4</sub>O<sub>13</sub> + 4H<sub>2</sub>O

Solubility in H<sub>2</sub>O at t°

t° 0° 16° 22°  
% Na<sub>2</sub>Cr<sub>4</sub>O<sub>13</sub> 72 19 74 19 76 01

(Mylius and Funk, Gm-K 3 I, 1380)

Deliquescent

Sat solution at 18° contains 74 6% Na<sub>2</sub>Cr<sub>4</sub>O<sub>13</sub> and has sp gr = 1 926 (Mylius and Funk, B 1900, 33 3688)

#### Sodium uranyl chromate, Na<sub>2</sub>CrO<sub>4</sub>

2(UO<sub>2</sub>)CrO<sub>4</sub> + 10H<sub>2</sub>O

Easily sol in H<sub>2</sub>O (Formánek, A 257 108)

100 pts of the solution in H<sub>2</sub>O contain 52 52 pts of the anhydrous salt at 20° (Rumbach, B 1904, 37 482)

#### Sodium chromate silicate, Na<sub>2</sub>O, Cr<sub>2</sub>O<sub>3</sub>, 2SiO<sub>2</sub> + 14H<sub>2</sub>O

Not decomp by HCl + 1q (Singer, Disser 1910)

2Na<sub>2</sub>O, 3Cr<sub>2</sub>O<sub>3</sub>, 6SiO<sub>2</sub> Not decomp by boiling conc acids except HF (Weyberg C B Miner, 1908 519)

5Na<sub>2</sub>O, 2Cr<sub>2</sub>O<sub>3</sub>, 11SiO<sub>2</sub> (Weyberg)

3Na<sub>2</sub>O, 2Cr<sub>2</sub>O<sub>3</sub>, 9SiO<sub>2</sub> (Weyberg)

#### Strontium chromate, SrCrO<sub>4</sub>

Somewhat sol in H<sub>2</sub>O Sol in 840 pts H<sub>2</sub>O (Meschevskij, Z anal 21 399), sol in 831 8 pts H<sub>2</sub>O at 15° (Fresenius, Z anal 29 419)

100 cc H<sub>2</sub>O dissolve 0 4651% at 10° 1% at 20°, 2 417% at 50°, 3% at 100° (Reichard, Ch Z 1903, 27 877)

Easily sol in HCl, HNO<sub>3</sub>, or H<sub>2</sub>CrO<sub>4</sub> + 1q

Sol in 512 pts 0 5% NH<sub>4</sub>Cl + 1q at 15°

Sol in 63 7 pts 1% HC H<sub>3</sub>O + 1q at 15°

Sol in 348 8 pts solution containing 0 75% NH<sub>4</sub>C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, 4 drops HC H<sub>3</sub>O, and 6 drops (NH<sub>4</sub>)<sub>2</sub>CrO<sub>4</sub> + 1q (Fresenius)

100 ccm NH<sub>4</sub>Cl + 1q sat at bpt dissolve 1 g SrCrO<sub>4</sub> (Dumesnil, A ch 1900 7) 20 125)

50 ccm alcohol (29%) dissolve 0 0066 g SrCrO<sub>4</sub>

50 ccm alcohol (53%) dissolve 0 001 g SrCrO<sub>4</sub> (Fresenius, Z anal 30 672)

#### Strontium dichromate, SrCr<sub>2</sub>O<sub>7</sub>

Easily sol in H<sub>2</sub>O

#### Strontium trichromate, SrCr<sub>3</sub>O<sub>10</sub> + 3H<sub>2</sub>O

Very deliquescent, and sol in H<sub>2</sub>O (Preis and Ravmann, B 13 340)

#### Strontium chromate mercuric hydrogen chloride, SrCrO<sub>4</sub>, 2HgCl<sub>2</sub>, HCl

According to Stromholm 1:1 SrCl<sub>2</sub>:SrCrO<sub>4</sub> 4HgCl<sub>2</sub> + H<sub>2</sub>O

Recryst from H<sub>2</sub>O (Imbert and Belugon Bull Soc 1897 (3) 17 471)

2SrCrO<sub>4</sub>, 6HgCl<sub>2</sub>, HCl (Imbert and Belugon)

#### Thallos chromate, TlCrO<sub>4</sub>

100 pts H<sub>2</sub>O dissolve 0 05 pt at 60° (Rupp and Zimmer, Z anorg 1902 33 157)

Ppt Insol in cold moderately conc HC H<sub>3</sub>O + 1q or in very dil HNO<sub>3</sub> + 1q and very sl sol on boiling therewith Dil NH<sub>4</sub>OH, and Na<sub>2</sub>CO<sub>3</sub> + 1q have the same action Attacked by very dil HCl + 1q Sol in hot conc HCl + 1q Decomp by dil H<sub>2</sub>SO<sub>4</sub> + 1q (Carstanjen)



1 l KOH+Aq (112 g per l) dissolves about 3.5 g  $\text{Ti}_2\text{CrO}_4$  on boiling, which separates out on cooling

Boiling conc KOH+Aq (31% KOH) dissolves 15 g  $\text{Ti}_2\text{CrO}_4$  per litre (Lepierre and Lachaud, C R 113 196)

#### Thalious dichromate, $\text{Ti}_2\text{Cr}_2\text{O}_7$

Insol in  $\text{H}_2\text{O}$ , etc Has the same properties as  $\text{Ti}_2\text{CrO}_4$

#### Thalious trichromate, $\text{Ti}_2\text{Cr}_3\text{O}_{10}$

Sol in 2814 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and 438.7 pts at  $100^\circ$  (Crookes)

#### Thallic chromate

Ppt

#### Thorium chromate, basic, $\text{Th}(\text{OH})_2\text{CrO}_4$

Ppt, unstable in solution (Palmer, Am Ch J 1895, 17 278)

#### Thorium chromate, $\text{Th}(\text{CrO}_4)_2 \cdot \text{H}_2\text{O}$

Ppt Sol in HCl and  $\text{NH}_4\text{Cl}$ +Aq 1 pt is sol in 284 pts  $\text{H}_2\text{O}$  at  $22^\circ$  (Palmer, Am Ch J 1895, 17 375 and 278)

+ $3\text{H}_2\text{O}$  Ppt (Haber, M 1897, 18 689)  
+ $8\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Chydenius, Pogg 119 54)

#### Tin (stannous) chromate

Ppt Sol in dil acids (Berzelius)

#### Tin (stannic) chromate

Ppt (Leykauf, J p 19 127)

#### Uranyl chromate, basic, $\text{UO}_3 \cdot 2(\text{UO})_2\text{CrO}_4 \cdot 8\text{H}_2\text{O}$

Ppt (Orloff, Ch Z 1907, 31 375)

$\text{UO}_3 \cdot (\text{UO})_2\text{CrO}_4 \cdot 6\text{H}_2\text{O}$  (Orloff)

#### Uranyl chromate, $(\text{UO})_2\text{Cr}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$

1 pt is sol in 133 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , slowly sol in alcohol to give a solution which is decomp on boiling (Orloff, Ch Z 1907, 31 375)

+ $11\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Formáněk, A 257 108)

#### Yttrium chromate

Deliquescent Easily sol in  $\text{H}_2\text{O}$  (Bailin)

#### Zinc chromate, basic, $4\text{ZnO} \cdot \text{Cr}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$

(Groger, Z anorg 1911, 70 135)

+ $5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in hot  $\text{H}_2\text{CrO}_4$ +Aq, slowly sol in  $\text{NH}_4\text{OH}$ +Aq (Malaguti and Sarzeau, A ch (3) 9 431)

$3\text{ZnO} \cdot \text{Cr}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  (Groger)  
 $2\text{ZnO} \cdot \text{Cr}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (Briggs, Z anorg 1907, 56 254)

+ $1\frac{1}{2}\text{H}_2\text{O}$  Ppt Insol in  $\text{H}_2\text{O}$  Sol in hot  $\text{H}_2\text{CrO}_4$ +Aq (Prussen and Phillipona, A 149 92)

+ $2\text{H}_2\text{O}$  Ppt Not wholly insol in  $\text{H}_2\text{O}$  (Prussen and Phillipona)

$3\text{ZnO} \cdot 2\text{CrO}_3 \cdot \text{H}_2\text{O}$  (Gröger)

#### Zinc chromate, $\text{ZnCrO}_4$

Insol in  $\text{H}_2\text{O}$ , very sol in acids, decomposed by boiling with  $\text{H}_2\text{O}$  (Schulze, Z anorg 1895, 10 154)

Insol in liquid  $\text{NH}_3$  (Franklin, Am J 1898, 20 830)

Insol in acetone (Naumann, B 1894, 37 4329)

+ $\text{H}_2\text{O}$  (Groger, Z anorg 1911, 70 1)

#### Zinc dichromate, $\text{ZnCr}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$

Hygroscopic

Very sol in  $\text{H}_2\text{O}$  and sl decomp by boiling (Schulze, Z anorg 1895, 10 153)

#### Zinc trichromate, $\text{ZnCr}_3\text{O}_{10} \cdot 3\text{H}_2\text{O}$

Deliquescent, very sol in  $\text{H}_2\text{O}$  (Gröger, Z anorg 1910, 66 10)

#### Zinc chromate ammonia, $\text{ZnCrO}_4 \cdot \text{NH}_3 \cdot \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Groger, Z anorg 1908, 58 417)

$\text{ZnCrO}_4 \cdot 4\text{NH}_3 \cdot 5\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH}$ +Aq Insol in alcohol and ether (Malaguti and Sarzeau, A ch (3) 9 431)

+ $3\text{H}_2\text{O}$  Efflorescent Decomp by  $\text{H}_2\text{O}$  Easily sol in dil acids and  $\text{NH}_4\text{OH}$ +Aq (Bieler, A 151 223)

$2\text{ZnO} \cdot 3\text{CrO}_3 \cdot 10\text{NH}_3 \cdot 10\text{H}_2\text{O}$  P (Malaguti and Sarzeau)

#### Zinc dichromate mercuric cyanide, $\text{ZnCr}_2\text{O}_7 \cdot 2\text{Hg}(\text{CN})_2 \cdot 7\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Stable in aqueous solution at  $100^\circ$  (Kriess, Z anorg 1895, 3 460)

#### Perchromic acid

See Perchromic acid

#### Chromicomolybdic acid, $(\text{CrO}_3)_2 \cdot 12\text{MoO}_3 \cdot 28\text{H}_2\text{O}$

Slowly sol in  $\text{H}_2\text{O}$  (Hull, J Am Chem Soc 1907, 29 708)

#### Ammonium chromicomolybdate, $3(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \cdot 12\text{MoO}_3 \cdot 20\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Stuart, J p 61 457, H 1, J Am Chem Soc 1907, 29 695)

+ $26\text{H}_2\text{O}$  (Muckwald, Dissert, 1895)

#### Ammonium barium chromicomolybdate, $(\text{NH}_4)_2\text{O} \cdot 22\text{BaO} \cdot \text{Cr}_2\text{O}_3 \cdot 12\text{MoO}_3 \cdot 20\text{H}_2\text{O}$

(Hall, J Am Chem Soc 1907, 29 707)

**Barium chromicomolybdate**,  $4\text{BaO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 15\text{H}_2\text{O}$ ,  $4\text{BaO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 18\text{H}_2\text{O}$ ,  $5\text{BaO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 16\text{H}_2\text{O}$

Ppts (Hall, J Am Chem Soc 1907, **29** 705)

**Lead chromicomolybdate**,  $4\text{PbO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 22\text{H}_2\text{O}$ , and  $+24\text{H}_2\text{O}$

Ppts (Hall, J Am Chem Soc 1907, **29** 706)

**Mercurous chromicomolybdate**,  $8\text{Hg}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 16\text{H}_2\text{O}$

Ppt (Hall, J Am Chem Soc 1907, **29** 707)

**Potassium chromicomolybdate**,  $\text{K}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $3\text{MoO}_3$

Sol in  $\text{HCl} + \text{Aq}$  with evolution of  $\text{Cl}$  (Bradbury, Z anorg 1894, **7** 46)

$3\text{K}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 20\text{H}_2\text{O}$  Sol in  $38.51$  pts  $\text{H}_2\text{O}$  at  $17^\circ$  (Struve, Hall)  $+24\text{H}_2\text{O}$  (Hall)

$4\text{K}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 15\text{H}_2\text{O}$  (Hall, J Am Chem Soc 1907, **29** 709)

$7\text{K}_2\text{O}$ ,  $2\text{Cr}_2\text{O}_3$ ,  $24\text{MoO}_3 + 32\text{H}_2\text{O}$  (Hall)

**Silver chromicomolybdate**,  $5\text{Ag}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 17\text{H}_2\text{O}$

Ppt (Hall)

**Sodium chromicomolybdate**,  $3\text{Na}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 21\text{H}_2\text{O}$

Efflorescent Easily sol in  $\text{H}_2\text{O}$  (Struve)

**Chromic sulphuric acid**

See Sulphochromic acid

**Chromicyanhydric acid**,

$\text{H}_3\text{Cr}(\text{CN})_6(?)$

Insol in  $\text{H}_2\text{O}$  (Kaiser, A Suppl **3** 163)

**Ammonium chromicyanide**,  $(\text{NH}_4)_3\text{Cr}(\text{CN})_6$

Easily sol in  $\text{H}_2\text{O}$  (Kaiser, A Suppl **3** 163)

**Cupric chromicyanide**,  $\text{Cu}_2[\text{Cr}(\text{CN})_6]$

Ppt Insol in dil or conc acids, except on heating Insol in  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$  (Kaiser)

**Lead chromicyanide, basic**,  $3\text{Pb}(\text{CN})_2$ ,  $2\text{Cr}(\text{CN})_3$ ,  $\text{Pb}(\text{OH})$

Ppt Sol in  $\text{HNO}_3$ ,  $\text{NaOH} + \text{Aq}$ , or  $\text{Pb}$  salts  $+ \text{Aq}$  (Kaiser)

**Potassium chromicyanide**,  $\text{K}_3\text{Cr}(\text{CN})_6$

Very sol in  $\text{H}_2\text{O}$

$100$  pts cold  $\text{H}_2\text{O}$  dissolve  $30.9$  pts salt Insol in absolute alcohol, but somewhat sol in dil alcohol

Sol in conc  $\text{H}_2\text{SO}_4$  without decomp (Kaiser, A Suppl **3** 170)

**Silver chromicyanide**,  $\text{Ag}_3\text{Cr}(\text{CN})_6$

Insol in all solvents, excepting  $\text{KCN} + \text{Aq}$  (Kaiser)

Sol in large excess of  $\text{HCl} + \text{Aq}$  Sl sol in cold, easily sol in hot conc  $\text{HNO}_3$  Very sol in conc  $\text{H}_2\text{SO}_4$  Insol in hot or cold acetic acid (Cruser, Dissert 1896)

**Chromisulphocyanhydric acid**

$\text{H}_3\text{Cr}(\text{SCN})_6$

Known only in aqueous solution

**Ammonium chromisulphocyanide**,

$(\text{NH}_4)_3\text{Cr}(\text{SCN})_6 + 4\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Rossler, A **141** 185)

**Barium chromisulphocyanide**,  $\text{Ba}_3[\text{Cr}(\text{SCN})_6]_2 + 16\text{H}_2\text{O}$

Deliquescent, and sol in  $\text{H}_2\text{O}$  (R)

**Lead chromisulphocyanide**,  $\text{Pb}_3[\text{Cr}(\text{SCN})_6]$ ,  $4\text{PbO}_2\text{H}_2 + 8\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , but decomp thereby into— $\text{Pb}_2[\text{Cr}(\text{SCN})_6]_2$ ,  $4\text{PbO}_2\text{H}_2 + 5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$

**Potassium chromisulphocyanide**,  $\text{K}_3\text{Cr}(\text{SCN})_6 + 4\text{H}_2\text{O}$

Sol in  $0.72$  pt  $\text{H}_2\text{O}$  and  $0.94$  pt alcohol

**Silver chromisulphocyanide**,  $\text{Ag}_3\text{Cr}(\text{SCN})_6$

Insol in  $\text{H}_2\text{O}$  or conc  $\text{HNO}_3 + \text{Aq}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in  $\text{KCN} + \text{Aq}$

**Sodium chromisulphocyanide**,  $\text{Na}_3\text{Cr}(\text{SCN})_6 + 7\text{H}_2\text{O}$

Deliquescent, sol in  $\text{H}_2\text{O}$

**Chromium**,

*Two modifications*—(a) Not attacked by  $\text{H}_2\text{O}$  Easily sol in cold  $\text{HCl} + \text{Aq}$  Sl sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Deville) Easily sol in a hot mixture of  $1$  pt  $\text{H}_2\text{SO}_4$  and  $20$  pts  $\text{H}_2\text{O}$  (Regnault, A ch **62** 357) Easily sol in warm conc  $\text{H}_2\text{SO}_4$  (Gmelin) Very slowly sol in hot  $\text{HNO}_3 + \text{Aq}$  (Vauquelin) Insol in dil or conc  $\text{HNO}_3 + \text{Aq}$  (Deville) Very slowly (Richter), not at all (Berzelius) sol in hot aqua regia Easily sol in  $\text{HF} + \text{Aq}$  (β) Insol in all acids, even aqua regia (Fremy), probably contains  $\text{Si}$

Pure  $\text{Cr}$  is sol in conc  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and dil  $\text{HNO}_3$ , sol in  $\text{HgCl}_2 + \text{Aq}$

Insol in fuming  $\text{HNO}_3$  and aqua regia (Moissan, C R **1894** 119, 187)

$\text{Cr}$  prepared by aluminothermic method is sol in haloid acids to form chromic and chromous salts, even in absence of au (Döring, J pr 1902, (2) **66** 65, 1906, (2) **73** 393)

Aluminothermic  $\text{Cr}$  is active in contact

with HCl, HBr, HI, HF,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{C}_2\text{O}_4$ , i.e., sol in cold conc or warm dil acids. Is inactive in contact with conc  $\text{HNO}_3$ ,  $\text{H}_2\text{Cr}_2\text{O}_4$ ,  $\text{HClO}_3$ ,  $\text{HClO}_4$ ,  $\text{H}_3\text{PO}_4$ , KOH, citric, formic, acetic and tartaric acids. Cause attributed to a different electric state (Hittorff, Z phys Ch 1898, 25 729)

### Chromium ammonia compounds

See—

**Bromotetramine chromium compounds,**  
 $\text{BrCr}(\text{NH}_3)_4\text{X}_2$

**Bromopurpleochromium compounds,**  
 $\text{BrCr}(\text{NH}_3)_5\text{X}_2$

**Chlorotetramine chromium compounds,**  
 $\text{ClCr}(\text{NH}_3)_4\text{X}_2$

**Chloropurpleochromium compounds,**  
 $\text{ClCr}(\text{NH}_3)_5\text{X}_2$

**Diamine chromium sulphocyanides,**  
 $\text{Cr}(\text{NH}_3)_2(\text{SCN})_4\text{M}$

**Erythrochromium compounds,**  
 $(\text{HO})\text{Cr}_2(\text{NH}_3)_{10}\text{X}_2$

**Iodopurpleochromium compounds,**  
 $\text{ICr}(\text{NH}_3)_5\text{X}_2$

**Iodotetramine chromium compounds,**  
 $\text{ICr}(\text{NH}_3)_4\text{X}_2$

**Luteochromium compounds,**  $\text{Cr}(\text{NH}_3)_6\text{X}_3$

**Rhodochromium compounds,**  
 $(\text{HO})\text{Cr}_2(\text{NH}_3)_{10}\text{X}_5$

**Rhodosechromium compounds,**  
 $(\text{HO})_3\text{Cr}_2(\text{NH}_3)_6\text{X}_3$

**Roseochromium compounds,**  
 $\text{Cr}(\text{NH}_3)_5(\text{OH})_2\text{X}_4$

**Xanthochromium compounds,**  
 $(\text{HO})_2\text{Cr}(\text{NH}_3)_5\text{X}_2$

### Chromium arsenide, $\text{CrAs}$

Insol in mineral acids (Dieckmann, Z anorg 1914, 86 294)

$\text{Cr}_2\text{As}_3$  Insol in mineral acids (Dieckmann)

### Chromium azoimide, $\text{CrN}_3$

Pptd by addition of alcohol and ether  
Insol in  $\text{H}_2\text{O}$  (Curtius, J pr 1900, (2) 61 410)

### Chromium boride, $\text{CrB}$

Insol in HCl, dil  $\text{H}_2\text{SO}_4$ , HF, HF +  $\text{HNO}_3$   
Sl sol in  $\text{HNO}_3$  and in aqua regia (Wedekind, B 1907, 40 299)

Sol in cold dil or conc HCl, HF, and  $\text{H}_2\text{SO}_4$  (Jassonneix, C R 1906, 143 1151)

$\text{Cr}_3\text{B}_2$  Sol in conc or dil HF, HCl,  $\text{H}_2\text{SO}_4$ , insol in  $\text{HNO}_3$  or alkalis + Aq (Jassonneix)

### Chromous bromide, $\text{CrBr}_2$

Sol in  $\text{H}_2\text{O}$  Not deliquescent in dry air (Moissan, C R 92 1051)

### Chromic bromide, $\text{CrBr}_3$

*Anhydrous* Insol in  $\text{H}_2\text{O}$ , but dissolves at once in presence of the least trace of  $\text{CrBr}_2$  (Bauk, A 111 382)

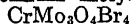
+  $6\text{H}_2\text{O}$  Deliquescent Very sol in  $\text{H}_2\text{O}$   
 $\text{H}_2\text{O}$  dissolves more than 2 pts crystals at ord temp Very sol in alcohol Insol in ether (Recoura, C R 110 1029)

*Blue modification* Insol in alcohol (Recoura, C R 110 1193)

Very hygroscopic Easily sol in alcohol and acetone Insol in ether (Werne A 1902, 322 343)

+  $8\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Varenne, C R 93 727)

### Chromium molybdenyl bromide,



Apparently wholly insol in dil acids  
Sol in hot conc HCl + Aq with decomp  
Insol in  $\text{M}_2\text{CrO}_4$  + Aq (Atterberg)

+  $2\text{H}_2\text{O}$  Apparently wholly insol in dil acids

Sol in hot conc HCl + Aq with decomp  
Insol in  $\text{M}_2\text{CrO}_4$  + Aq (Atterberg)

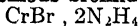
### Chromic rubidium bromide, $\text{CrBr}_3$ , 2R Br + $\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with decomp (Werner A 1902, 322 345)

### Chromic bromide ammonia

See Bromotetramine chromium bromide

### Chromous bromide hydrazine,



Insol in  $\text{H}_2\text{O}$  Sol in acids Insol in alcohol, ether and similar solvents (Traube, B 1913, 46 1507)

### Chromium carbide, $\text{Cr}_4\text{C}$

(Moissan C R 1894, 119 187)

$\text{Cr}_4\text{C}_2$  Does not decomp  $\text{H}_2\text{O}$  at ordinary temp or at  $100^\circ$ , insol in conc HCl, HI,  $\text{HNO}_3$ , and aqua regia sol in dil HCl (slowly), insol in fused KOH sol in fused  $\text{KNO}_3$  (Moissan, Bull Soc 1894 (3) 117 1016)

### Chromium iron carbide, $3\text{Fe}_3\text{C} \cdot 2\text{Cr}_4\text{C}$

Decomp by  $\text{H}_2\text{O}$ , sol in gaseous hydrocarbons, insol in  $\text{HNO}_3$  and aqua regia (Williams, C R 1898, 127 484)

### Chromium tungsten carbide, $\text{CW}$ , $3\text{Cr}_4\text{C}$

Not attacked by acids

Slowly attacked by fused KOH or alkali carbonates Rapidly decomp by fused alkali nitrates or  $\text{KClO}_3$  (Moissan, C R 1903, 137 294)

### Chromous chloride, $\text{CrCl}_2$

Deliquescent Very sol in  $\text{H}_2\text{O}$  with evolution of much heat (Moberg, J pr 29 1)

Practically insol in ether Moderately sol in absolute alcohol, methyl alcohol, and acetaldehyde (Rohland, Z anorg 1899, 21 39)

+1½H<sub>2</sub>O (Moissan, A ch (5) 25 40)  
+2H<sub>2</sub>O (Knight and Rich, Chem Soc 1911, 99 89)  
+3H<sub>2</sub>O (Knight and Rich)

**Chromic hydrogen chloride, 3CrCl<sub>3</sub>, 2HCl + 13H<sub>2</sub>O**

Decomp by H<sub>2</sub>O (Recoura, C R 100 1227)

Sl sol in liquid NH<sub>3</sub> (Gore, Am Ch J 1898, 20 827)

**Chromic chloride, CrCl<sub>3</sub>**

*Anhydrous*—*Peach-blossom-colored modification* Insol in pure H<sub>2</sub>O (Pelgrot), but by long continued boiling of the finely divided salt with H<sub>2</sub>O, traces are dissolved with decomp Not decomp by boiling conc H<sub>2</sub>SO<sub>4</sub>, or other acids, even aqua regia

Easily sol with evolution of heat in H<sub>2</sub>O containing only 1/40,000 pt CrCl<sub>3</sub> (Pelgrot, J pr 36 150) Also sol in presence of traces of SnCl<sub>2</sub> (5 mg SnCl<sub>2</sub> cause 1 g CrCl<sub>3</sub> to dissolve), FeCl<sub>3</sub>, Cu<sub>2</sub>Cl<sub>2</sub>, Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, and other reducing substances, chlorides without reducing properties have no effect (Pelouze, A ch (3) 14 251) TiCl<sub>3</sub> and SO<sub>2</sub> have similar solvent action (Ebelmen, A ch (3) 20 390), also Zn+dil acids (Moberg)

Insol in dil alkalis+Ag, very slowly decomp by boiling conc alkalis or alkali carbonates+Ag (Fellenberg, Pogg 50 76)

Difficulty sol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in CS (Arcowski, Z anorg 1894, 6 257)

Insol in acetone (Eidmann, C C 1899 II, 1014)

Practically insol in absolute ethyl alcohol, methyl alcohol, acetaldehyde and ether (Rohland, Z anorg 1899, 21 39)

*Yellow* Sl sol in benzonitrile (Naumann, B 1914, 47 1369)

*Violet modification* Very sol in H<sub>2</sub>O to form a green solution (Moberg, J pr 44 325)

The violet mod is almost insol in H<sub>2</sub>O but if 1/20,000 pt chromous chloride is present, it is readily sol (Rohland, Z anorg 1899, 21 39)

+4H<sub>2</sub>O Sl deliquescent Very sol in H<sub>2</sub>O, alcohol and ethyl acetate (Godeffroy, Bull Soc (2) 43 229)

+6H<sub>2</sub>O Deliquescent Sol in H<sub>2</sub>O, but probably decomp to CrOCl<sub>2</sub>

Practically insol in ether Moderately sol in absolute ethyl alcohol, methyl alcohol and acetaldehyde (Rohland, Z anorg 1899, 21 39)

"Monochlorochromic chloride" is sol in ether and fuming HCl(1 1) (Bjerrum, B 1906, 39 1599)

### Green modification

Solubility in H<sub>2</sub>O at 25°

25 g green CrCl<sub>3</sub>+6H<sub>2</sub>O and 10 g H<sub>2</sub>O

Time	Total Solubility in %	Composition of the sat solution	
		% violet salt	% green salt
¼ hr	58 36	8 30	91 70
½ hr		12 57	87 43
4 hrs	63 27	24 80	75 20
1 day	68 50	37 64	62 36
2 days		40 90	59 10
3 "	68 95	42 78	57 22
11 "		42 84	57 16
13 "		42 39	57 61
19 "	68 58	42 62	57 38

(Ohe, Z anorg 1906, 51 55)

Solubility of green CrCl<sub>3</sub>+6H<sub>2</sub>O in H<sub>2</sub>O at 32°

10 g CrCl<sub>3</sub>+6H<sub>2</sub>O and 4 g H<sub>2</sub>O

Time	Total solubility in %	Composition of the dissolved substance		Solid phase
		% violet salt	% green salt	
7'	63 69	12 87	87 13	Almost all dissolved
45'	66 24	21 43	78 57	
2h 5'	69 53	34 53	65 47	
48h	69 33	45 27	54 73	
* 11 dys	70 81	45 27	54 73	

\* First 8 days at 35°

(Ohe, Z anorg 1907, 53 276)

Solubility of green CrCl<sub>3</sub>+6H<sub>2</sub>O in H<sub>2</sub>O at 35°

10 g CrCl<sub>3</sub>+6H<sub>2</sub>O and 3 3 g H<sub>2</sub>O

Time	Total solubility in %	Composition of the dissolved substance	
		% violet salt	% green salt
8'	65 85	16 47	83 53
38'	66 74	25 02	74 98
1h	66 21	25 45	74 55
2h 10'	68 90	31 47	68 53
4h	70 79	36 28	63 72
23h	71 34	42 95	57 05
72h	70 79	42 88	57 12

(Ohe, l c)

If a solution saturated with the green hexahydrate below 32° is cooled, the decahydrate separates out, if the solution is saturated above 32°, both the decahydrate and hexahydrate separate out on cooling (Ohe, l c)

*Violet modification*Solubility in H<sub>2</sub>O at 25°25 g violet CrCl<sub>3</sub> + 6H<sub>2</sub>O and 10 ccm of a 35% solution of green CrCl<sub>3</sub> + 6H<sub>2</sub>O

Time	Total Solubility in %	Composition of the sat solution	
		% violet salt	% green salt
1 1/6 hr	65 49	84 05	15 95
5 "		84 47	15 53
29 "		78 16	21 84
2 dys	70 47	73 19	26 81
4 "		68 71	31 29
5 "		60 66	39 34
5 dys, 6 hrs	76 38	60 36	39 64
6 dys		65 10	34 90
8 "		65 80	34 20
10 "	73 26	58 08	41 92
12 "		41 40	58 60

(Olie, Z anorg 1906, 51 57)

Solubility in H<sub>2</sub>O at 25°25 g violet CrCl<sub>3</sub> + 6H<sub>2</sub>O and 10 g H<sub>2</sub>O

Time	Total Solubility in %	Composition of the sat solution	
		% violet salt	% green salt
1/6 hr	61 99	98 47	1 53
4 1/2 hrs		96 70	3 30
1 dy		91 54	8 46
2 "	63 88	83 37	16 63
4 "		69 11	30 89
5 "		62 20	37 80
7 "	70 68	62 72	37 28
8 "		54 63	45 37
12 "		46 39	53 61
13 "	72 11	47 66	52 34
26 "		48 55	51 45

(Olie, l c)

+6 1/2 H<sub>2</sub>O *Green modification* 100 pts H<sub>2</sub>O dissolve 130 pts salt at 15° Sol in alcohol (Recoura, C R 102 518)

*Grayish-blue modification* Very sol in H<sub>2</sub>O (Recoura, C R 102 548)

+10H<sub>2</sub>O Very deliquescent, melts in crystal H<sub>2</sub>O at 6-7° Very sol in H<sub>2</sub>O, alcohol, and ethyl acetate (Godeffroy)

Easily sol in H<sub>2</sub>O, can be recryst from H<sub>2</sub>O Sol in alcohol and ether (Werner, B 1906, 39 1827)

*Green modification*Solubility of green CrCl<sub>3</sub> + 10H<sub>2</sub>O in H<sub>2</sub>O at 29°142 g CrCl<sub>3</sub> + 10H<sub>2</sub>O and 25 g H<sub>2</sub>O

Time	Total solubility in %	Composition of the dissolved substance		Solid phase
		% violet salt	% green salt	
7'	61 35	8 71	91 29	CrCl <sub>3</sub> + 10H <sub>2</sub> O
20'	62 46	9 90	90 10	"
1 <sup>h</sup> 55'	65 04	25 05	74 95	"
4 <sup>h</sup> 30'	67 41	32 90	67 10	CrCl <sub>3</sub> + 6H <sub>2</sub> O
24 <sup>h</sup>	69 44	42 93	57 07	all dissolved
28 <sup>h</sup>		31 78	68 22	CrCl <sub>3</sub> + 10H <sub>2</sub> O
29 <sup>h</sup>	67 59	33 65	66 36	CrCl <sub>3</sub> + 6H <sub>2</sub> O
48 <sup>h</sup>	69 42	42 17	57 83	"
72 <sup>h</sup>	68 69	43 80	56 20	"

(Olie, Z anorg 1907, 53 275)

The composition of the hydrates formed by CrCl<sub>3</sub> at different dilutions is calculated from determinations of the lowering of t<sub>f</sub> and of the conductivity and sp gr of CrCl<sub>3</sub> + Aq (Jon, Am Ch J 1905, 34 310)

**Chromic glucinum chloride**, CrCl<sub>3</sub>, Gl + H<sub>2</sub>O

Sol in H<sub>2</sub>O with decomp (Neumann, 244 329)

**Chromic lithium chloride**, CrCl<sub>3</sub>, 2LiCl - 4H<sub>2</sub>O

Very hygroscopic

Sol in ice water but solution soon decomposes

Easily sol in alcohol (Werner, B 1901, 34 1603)

[Cr(OH<sub>2</sub>)Cl<sub>2</sub>]I + 4H<sub>2</sub>O

Very hygroscopic Sol in ice cold H<sub>2</sub>O and in alcohol (Werner, B 1901, 34 160)

**Chromic magnesium chloride**, CrCl<sub>3</sub>, MgCl<sub>2</sub> + H<sub>2</sub>O

Decomp by H<sub>2</sub>O (Neumann)

**Chromic phosphoric chloride**, CrCl<sub>3</sub>, PCl<sub>5</sub>

Decomp by H<sub>2</sub>O (Gronlund)

**Chromium platinum chloride**

See chloroplatinate, chromium

**Chromic potassium chloride**, CrCl<sub>3</sub>, KCl

Decomp by H<sub>2</sub>O

CrCl<sub>3</sub>, 2KCl + H<sub>2</sub>O (Neumann, A 24 329)

CrCl<sub>3</sub>, 3KCl Easily sol in H<sub>2</sub>O with decomp (Fremy, A ch (3) 12 361)

**Chromic rubidium chloride**,  $\text{CrCl}_3 \cdot 2\text{RbCl} + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Neumann, A 244 329)

Slowly sol in cold, rapidly sol in hot  $\text{H}_2\text{O}$  with decomp (Werner, B 1901, 34 1603)  
 $\text{CrCl}_3 \cdot 3\text{RbCl} + 8\text{H}_2\text{O}$  Unstable Decomp by alcohol (Werner, B 1906, 39 1830)

**Chromic sodium chloride**,  $\text{CrCl}_3 \cdot \text{NaCl}$

Sol in  $\text{H}_2\text{O}$  (Berzelius)

$\text{CrCl}_3 \cdot 3\text{NaCl}$  Sol in  $\text{H}_2\text{O}$  (Berzelius)

**Chromic thallium chloride**,  $\text{CrCl}_3 \cdot 3\text{TlCl}$

Sol with decomp in  $\text{H}_2\text{O}$  (Neumann, A 244 329)

**Chromic chloride ammonia**

See Chlorotetramine chromium chloride

**Chromous chloride hydrazine**,  $\text{CrCl}_3 \cdot 2\text{N}_2\text{H}_4$

Insol in  $\text{H}_2\text{O}$  Sol in acids Insol in alcohol, ether and similar solvents (Traube, B 1913, 46 1506)

**Chromic chloride ferric oxide**

$\text{Fe}_2\text{O}_3$  is easily sol in dil, difficultly sol in conc  $\text{CrCl}_3 + \text{Aq}$  (Béchamp A, ch (3) 57 311)

**Chromous fluoride**,  $\text{CrF}_2$

Sl sol in  $\text{H}_2\text{O}$ , hot  $\text{H}_2\text{SO}_4$  or dil  $\text{HNO}_3$   
 Sol in boiling  $\text{HCl}$  Insol in alcohol (Poulenc, C R 1893, 116 254)

**Chromic fluoride**,  $\text{CrF}_3$

Perfectly sol in  $\text{H}_2\text{O}$  (Berzelius)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 827)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

+  $3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Werner and Costachescu, B 1908, 41 4243)

+  $3\frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Poulenc, C R 1893, 116 255)

+  $6\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Werner and Costachescu, B 1908, 41 4242)

+  $9\text{H}_2\text{O}$  Violet modification Very sl sol in  $\text{H}_2\text{O}$  Insol in alcohol Sol in  $\text{HCl}$  and  $\text{KOH} + \text{Aq}$  (Poulenc, Gazz ch it 20 582)

**Chromium hexafluoride**,  $\text{CrF}_6$

Decomp by  $\text{H}_2\text{O}$  with evolution of heat (Berzelius)

Correct composition is  $\text{CrO}_2\text{F}_2$  (Oliveri, Gazz ch it 16 218)

**Chromic cobaltous fluoride**,  $\text{CrF}_3 \cdot \text{CoF}_2 + 7\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Petersen, J pr (2) 40 60)

**Chromic cupric fluoride**,  $\text{CrCuF}_5 + 5\text{H}_2\text{O}$

Can be cryst from  $\text{HF} + \text{Aq}$  (Higley, J Am Chem Soc 1904, 26 630)

**Chromic nickel fluoride**,  $\text{CrF}_3 \cdot \text{NiF}_2 + 7\text{H}_2\text{O}$

Somewhat more sol in  $\text{H}_2\text{O}$  than  $\text{CrF}_3$ ,  $\text{CoF}_2 + 7\text{H}_2\text{O}$  (Petersen, J pr (2) 40 61)

**Chromic potassium fluoride**,  $\text{CrF}_3 \cdot 3\text{KF}$

Nearly insol in  $\text{H}_2\text{O}$  (Christensen, J pr (2) 35 161)

$\text{CrF}_3 \cdot 2\text{KF} + \text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$  Sol in conc  $\text{HCl} + \text{Aq}$  (Christensen)

**Chromic sodium fluoride**,  $\text{CrF}_3 \cdot 2\text{NaF} + \text{H}_2\text{O}$

(Wagner, B 19 896)

**Chromic thalious fluoride**,  $2\text{CrF}_3 \cdot 3\text{TlF}$

Sol in hot  $\text{H}_2\text{O}$ , less sol in cold Sl sol in  $\text{HF}$  (Ephraim, Z anorg 1909, 61 242)

**Chromic zinc fluoride**,  $\text{CrF}_3 \cdot \text{ZnF}_2 + 7\text{H}_2\text{O}$

Can be cryst from  $\text{HF} + \text{Aq}$  (Higley, J Am Chem Soc 1904, 26 630)

Colloidal solution is perfectly clear (Biltz, B 1902, 35 4433)

**Chromous hydroxide**,  $\text{CrO}_2\text{H}$

Decomp by  $\text{H}_2\text{O}$ , especially if hot (Pellet, A ch (3) 12 539)

Slowly sol in cold conc acids, even aqua regia, almost insol in dil acids (Moberg, J pr 43 119)

**Chromic hydroxide**,  $\text{Cr}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ , probably  $\text{Cr}_2\text{O}_3\text{H}_6$

Insol in  $\text{H}_2\text{O}$  Easily sol in acids Easily sol in cold  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ , much less sol in cold  $\text{NH}_4\text{OH} + \text{Aq}$ , the presence of  $\text{NH}_4\text{Cl}$  has no influence upon solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  (Fresenius) Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  if it has been thoroughly washed

Insol in  $\text{KCN} + \text{Aq}$ , but sl sol in  $\text{KCN} + \text{HCN} + \text{Aq}$  (Rodgers, 1834)

Gradually sol in dil  $\text{FeCl}_3 + \text{Aq}$ , after three months, 2 mols  $\text{Cr}_2\text{O}_3\text{H}_6$  are dissolved by 1 mol  $\text{FeCl}_3$  without pptn of  $\text{FeO}_2\text{H}_6$  (Béchamp, A ch (3) 57 296)

Alsl sol in  $\text{CrCl}_3 + \text{Aq}$ , in four months,  $1\frac{1}{2}$  mols  $\text{Cr}_2\text{O}_3\text{H}_6$  are dissolved by 1 mol  $\text{CrCl}_3$  (Béchamp)

Sol in  $\text{Cr}(\text{NO}_3)_3 + \text{Aq}$ , and clear solution formed as long as 3 mols  $\text{HNO}_3$  are present for 8 mols  $\text{Cr}_2\text{O}_3$  (Ordway, Sill Am J (2) 27 197)

Chromic hydroxide, pptd by alkalis is easily sol in excess of the reagent, after being dried in a vacuum, however, it is insol in alkalis (Herz, Z anorg 1901, 28 344)

Freshly pptd it is sol in aq alkali, but it is readily changed into a modification which is insol (Herz, Z anorg 1902, 31 352)

The solubility of chromic hydroxide in an

aqueous solution of red chromic chloride is not directly proportional to the concentration of the latter—a basic chloride is probably formed (Fischer, Z anorg 1904, 40 43)

Not pptd in presence of Na citrate (Spiller)

Insol in amylamine+Aq, not pptd in presence of alkali tartrates, sugar, etc

$\text{Cr}_2\text{O}_3\text{H}_2 + 4\text{H}_2\text{O}$  Difficultly sol in acids

$\text{Cr}_2\text{O}_3\text{H}_2 + \text{H}_2\text{O}$  Extremely hygroscopic

Exists in a soluble modification, obtained by dialysis, solution can be diluted with pure  $\text{H}_2\text{O}$ , but gelatinizes with traces of salts (Graham, Roy Soc Trans 1861 183)

$\text{Cr}_2\text{O}_3(\text{OH})$  Insol in boiling dil HCl+Aq

$\text{Cr}_2\text{O}(\text{OH})_4$  (Guignet's green) Scarcely sol in boiling HCl+Aq (Salvetat, C R 48 295)

Guignet gave formula as  $2\text{Cr}_2\text{O}_3 + 3\text{H}_2\text{O}$

### Chromochromic hydroxide, $\text{Cr}_2\text{O}_4, \text{H}_2\text{O} (?)$

Slightly attacked by acids (Peligot, A ch (3) 12 539)

### Chromous iodide, $\text{CrI}$

Easily sol in  $\text{H}_2\text{O}$  (Moissan, A ch (5) 25 401)

### Chromic iodide, $\text{CrI}_3 (?)$

Insol in cold, sol in hot  $\text{H}_2\text{O}$ , but no separation occurs on cooling (Berlin)

+9H<sub>2</sub>O Hygroscopic Sol in alcohol and acetone Insol in  $\text{CHCl}_3$  (Higley, J Am Chem Soc 1904, 26 628)

### Chromous iodide hydrazine, $\text{CrI} \cdot 2\text{N}_2\text{H}_4$ (Traube, B 1913, 46 1507)

### Chromium nitride, $\text{CrN}$

Insol in dil acids and alkalis, conc  $\text{HNO}_3$ , HCl or HF+Aq, even on heating. Slowly sol in hot aqua regia or cold  $\text{H}_2\text{SO}_4$ . Sol in cold solutions of alkali hypochlorites (Ufer, A 112 281)

Insol in HCl,  $\text{HNO}_3$  and aqua regia (Férée, Bull Soc 1901 (3) 25 618)

Unacted upon by acids at ordinary temperatures (Smits, Chem Soc 1897, 72 (2) 33)

$\text{Cr}_2\text{N}_2$  Slowly attacked by conc  $\text{HNO}_3$ , and by  $\text{HNO}_3 + \text{HCl}$ . All other reagents act without action (Henderson and Gaultly, J Soc Chem Ind 1908, 27 357)

$\text{CrN}_3$  See Chromium azonide

### Chromous oxide, $\text{CrO}$

Insol in  $\text{HNO}_3$  and dil  $\text{H}_2\text{SO}_4 + \text{Aq}$   
Sol in HCl (Férée, Bull Soc 1901, (3) 25 619)

### Chromic oxide, $\text{Cr}_2\text{O}_3$

When ignited is nearly insol in acids, but dissolves in  $\text{H}_2\text{SO}_4$  by long boiling. Insol in liquid HCl (Gore)

Insol in acetone (Fidmann, C C 1 19 II, 1014)

Solubility in (calcium succinate+sugar)+Aq

1 l solution containing 418.6 g sugar and 34.3 g CaO dissolves 1.07 g  $\text{Cr}_2\text{O}_3$ , 1 l solution containing 296.5 g sugar and 24.2 g CaO dissolves 0.56 g  $\text{Cr}_2\text{O}_3$ , 1 l solution containing 174.4 g sugar and 14.1 g CaO dissolves 0.20 g  $\text{Cr}_2\text{O}_3$  (Bodenbender, J B 1 15 600)

See also Chromic hydroxide

+ $\text{H}_2\text{O}$  The compound to which Bunsen gave the formula  $\text{Cr}_2\text{O}_3$ . Insol in acids, but easily attacked by  $\text{HNO}_3$  (Férée, Bull Soc 1901, (3) 25 620)

### Chromochromic oxide, $\text{Cr}_2\text{O}_4 = \text{CrO}, \text{Cr}_2\text{O}_3$

Known only in form of hydroxide, which is

+3H<sub>2</sub>O Stable in dry air. Decomposes in moist air (Bauge, C R 1898, 127 552)

$\text{Cr}_2\text{O}_5$ , or  $\text{Cr}_2\text{O}_6 (?)$  Insol in acids (in aqua regia (Bunsen, Pogg 91 622)

Not obtainable (Geuther, A 118 66)

Formula is  $\text{CrO}_3 + \text{H}_2\text{O}$  (Férée)

### Chromium trioxide, $\text{CrO}_3$

Deliquescent, and very sol in  $\text{H}_2\text{O}$  to form solution of  $\text{H}_2\text{CrO}_4$  or  $\text{H}_2\text{Cr}_2\text{O}_7$

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	$0^\circ$	$15^\circ$	$50^\circ$	$100^\circ$
% $\text{CrO}_3$	62.08	62.38	64.55	66.39

(Mylius and Funk, Gm K 3 1 1332)

Sat  $\text{CrO}_3 + \text{Aq}$  contains at

$0^\circ$	$20^\circ$	$60^\circ$
61.54	62.52	65.12% $\text{CrO}_3$

(Koppel und Blumenthal Z anorg 1907 33 228)

The system  $\text{CrO}_3 - \text{H}_2\text{O}$  has been studied at temp from  $0^\circ$  to  $-74^\circ$ . In the limit of concentration investigated from 0—71%  $\text{CrO}_3$ , no hydrate of  $\text{CrO}_3$  crystal from the aq solution (Kremann, M 1911, 32 62)

Sat  $\text{CrO}_3 + \text{Aq}$  contains at

$82^\circ$	$100^\circ$	$115^\circ$
66	67.4	68.4% $\text{CrO}_3$

(Kremann, M 1911, 32 620)

Solubility in H<sub>2</sub>O at°

t°	% by wt CrO <sub>3</sub>	Solid phase
-0 9°	3 6	Ice
-1 9	7 8	"
-3 7	11 5	"
-4 8	14 1	"
-10 95	24 9	"
-11 7	25 2	"
-18 75	33 5	"
-25 25	39 2	"
-43 5	49 1	"
-60	53 3	"
-20	61 7	CrO <sub>3</sub>
0	62 24	"
+24 8	62 88	"
40	63 50	"
65	64 83	"
90	68 5	"
122	70 7	"
193-196	100	"

Buchner and Prins, Z phys Ch 1912, **81**  
114)

Sp gr of CrO<sub>3</sub>+Aq at t°

t°	Sp gr	% CrO <sub>3</sub>
16 0	1 0606	8 25
18 0	1 0679	8 79
14 5	1 0694	8 79
19 5	1 0957	12 34
19 0	1 1569	19 33
20 9	1 20269	31 83
20 1	1 20264	31 83
12 0	1 20714	31 83
35 0	1 20940	32 59
18 6	1 21914	32 59
15 2	1 22106	32 59
9 7	1 22384	32 59
22 0	1 3441	37 77
19 2	1 3448	37 82
22 0	1 34416	37 82
	1 7028	62 23

(Zettnow Pogg **143** 474)

Sp gr of CrO<sub>3</sub>+Aq (H CrO<sub>3</sub>+Aq) M =  
according to Mendeleeff at 15°, Z = α  
according to Zettnow, calculated by Ger-  
lach (Z and **27** 360)

CrO <sub>3</sub>	M	Z	CrO <sub>3</sub>	M	Z
5	1 036	1 037	35	1 324	1 312
10	1 076	1 076	40	1 383	1 373
15	1 119	1 118	45	1 445	1 440
20	1 166	1 162	50	1 510	1 512
25	1 215	1 208	55	1 579	1 587
30	1 268	1 258	60		1 656

B-pt of CrO<sub>3</sub>+Aq at ord pressure

B pt	G CrO <sub>3</sub> in 100 g of the solution
102°	10 81
104	24 08
107	36 47
110 5	45 15
116	54 56
120	61 54
127	71 24 sat solution

(Koppel and Blumenthal, Z anorg 1907, **53**  
254)

Sol in H<sub>2</sub>SO<sub>4</sub>, the solubility is least when  
the acid contains 66% H<sub>2</sub>SO<sub>4</sub> (Schrotter),  
84.5% H<sub>2</sub>SO<sub>4</sub> (Bolley)

Verv sol in H<sub>2</sub>SO<sub>4</sub> of 1.85 sp gr Sl sol  
in cold KHSO<sub>4</sub>+Aq (Fritzsche)

The statement that CrO<sub>3</sub> is insol in acids  
is incorrect 2.85 g (ignited) are sol in HNO<sub>3</sub>,  
to the extent of 2.58 g 0.81 g (ignited) are  
sol in HNO<sub>3</sub> to the extent of 0.77 g (Jovit-  
schitsch, M 1909, **30** 48)

Practically insol in POCl<sub>3</sub> (Walden, Z  
anorg 1910, **68** 312)

Sl sol in liquid NH<sub>3</sub> (Franklin, Am Ch  
J 1898, **20** 827)

Sol in alcohol with decomp

Sol in anhydrous ether

Sol in acetic anhydride (Fry, J Am  
Chem Soc 1911, **33** 700)

Sol in acetone (Ne

Sol in benzonitrile (Franklin, Am Ch  
J 1898, **20** 827)

Sol in methyl acetate (Naumann, B  
1909, **42** 3790)

Difficultly sol in ethyl acetate (Nau-  
mann, B 1910, **43** 314)

**Chromium oxide**, Cr<sub>2</sub>O<sub>3</sub>=2Cr O<sub>3</sub> CrO<sub>3</sub>

Cr<sub>2</sub>O<sub>3</sub>=3Cr<sub>2</sub>O<sub>3</sub>, 2CrO<sub>3</sub>

CrO = Cr<sub>2</sub>O<sub>3</sub>, CrO<sub>3</sub>

Cr<sub>2</sub>O<sub>3</sub>=Cr<sub>2</sub>O<sub>3</sub>, 3CrO<sub>3</sub>

Cr<sub>2</sub>O<sub>3</sub>=Cr<sub>2</sub>O<sub>3</sub>, 4CrO<sub>3</sub>

See **Chromate, chromium**

**Chromium peroxide**, Cr<sub>2</sub>O<sub>7</sub>(<sup>2</sup>)

More sol in ether than in H<sub>2</sub>O Ether  
solution is somewhat more stable than aque-  
ous solution (Aschoff, J pr **81** 401)

Formula is Cr<sub>2</sub>O<sub>7</sub> H<sub>2</sub>O (Mossan C R  
**97** 96)

**Chromium peroxide ammonia**, CrO<sub>3</sub>, 3NH<sub>3</sub>

Sol in H<sub>2</sub>O with partial decomp

Sl sol in NH<sub>4</sub>OH+Aq

Sol with decomp in 20% acetic acid  
(Hofmann, B 1905 **38** 3060)

**Chromium tetroxide potassium cyanide**,

CrO<sub>4</sub>, 3KCN

Sol in H<sub>2</sub>O Insol in other ordinary  
solvents (Wiede, B 1899, **32**, 381)



**Chromic oxychloride**

From  $\text{Cr}_2\text{O}_3$  Sol in  $\text{H}_2\text{O}$  as long as 1 mol  $\text{CrCl}_3$  is present for  $2\frac{1}{2}$  mols  $\text{Cr}_2\text{O}_3\text{H}_6$  (Ordway, *Sill Am J* (2) **27** 197)

$\text{Cr}_2\text{O}_3, 2\text{CrCl}_3$  Sol in  $\text{H}_2\text{O}$  (Kletzensky, *Zeit Ch* **1866** 277)

$\text{Cr}_2\text{O}_3, \text{CrCl}_3 = \text{CrOCl}$  *Anhydrous* Only partly sol in  $\text{H}_2\text{O}$

+  $3\text{H}_2\text{O}$  Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Peligot)

$\text{Cr}_2\text{O}_3, 4\text{CrCl}_3 + 6\text{H}_2\text{O} = \text{Cr}_2\text{OCl}_4 + 2\text{H}_2\text{O}$  (Peligot, *J pr* **37** 38)

+  $9\text{H}_2\text{O} = \text{Cr}_2\text{OCl}_4 + 3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Moberg),  $= \text{Cr}_2(\text{OH})_2\text{Cl}_4 + 2\text{H}_2\text{O}$  (Schiff, *A* **124** 157)

$\text{Cr}_2\text{O}_3, 7\text{CrCl}_3 = \text{Cr}_2\text{OCl}_7$  Very sol in  $\text{H}_2\text{O}$  with decomp (Besson and Fourmier, *C R* 1909, **148** 1194)

$\text{Cr}_2\text{O}_3, 8\text{CrCl}_3 + 24\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Moberg),  $= \text{Cr}_2(\text{OH})\text{Cl}_5 + 4\text{H}_2\text{O}$  (Schiff, *l c*)

$(\text{CrO}_3)_2\text{Cl}_2$  (Pascal, *C R* 1909, **148** 1464)

$\text{Cr}_2\text{O}_3\text{Cl}_4$  Insol in  $\text{H}_2\text{O}$  (Pascal, *C R* 1909, **148** 1464)

From  $\text{CrO}_3$

See Chromyl chloride

**Chromic oxychloride potassium chloride,  $\text{CrOCl}_3, 2\text{KCl}$** 

Decomp in the air

Sol in conc  $\text{HCl}$  without decomp (Weinland, *B* 1906, **39** 4043)

**Chromic oxychloride rubidium chloride,  $\text{CrOCl}_3, 2\text{RbCl}$** 

Decomp in the air

Sol in conc  $\text{HCl}$  without decomp (Weinland, *B* 1906, **39** 4045)

**Chromium oxyfluoride,  $\text{CrO}_2\text{F}_2$** 

See Chromyl fluoride

**Chromium phosphide,  $\text{CrP}$** 

Insol in acids, but a trace dissolves in aqua regia Insol in  $\text{HF} + \text{Aq}$  (Berzelius)

Not attacked by acids or by aqua regia (Granger, *C N* 1898, **77** 228)

Insol in all acids except a mixture of  $\text{HNO}_3$  and  $\text{HF}$  (Maronneau, *C R* 1900, **130** 658)

Insol in mineral acids (Dieckmann, *Z anorg* 1914, **86** 295)

Insol in aqua regia (Granger, *C R* 1897, **124**, 191)

$\text{CrP}_3$  Insol in mineral acids (Dieckmann *Z anorg* 1914, **86** 295)

**Chromous selenide,  $\text{CrSe}$** 

(Moissan, *C R* **90** 817)

**Chromic selenide,  $\text{Cr}_2\text{Se}_3$** 

Insol in  $\text{H}_2\text{O}$  (Moissan, *C R* **90** 817)

**Chromic potassium selenide,  $\text{K}_2\text{Cr}_2\text{Se}_4$** 

Insol in  $\text{HCl}$  Easily sol in conc  $\text{HN}$  (Milbauer, *Z anorg* 1904, **42** 451)

**Chromium silicide,  $\text{Cr}_2\text{Si}$** 

Sol in fused  $\text{KNO}_3$ , insol in cold  $\text{HCl}$  d aqua regia

Insol in  $\text{HF} + \text{Aq}$  (Moissan, *C R* **18**, **121** 625)

$\text{CrSi}_2$  Sol in  $\text{HF}$  Insol in  $\text{HCl}$  d aqua regia (Chalmot, *Am Ch J* 1897, **69**)

$\text{Cr}_2\text{Si}_2$  Insol in dil  $\text{HCl}$ , sol in wa n conc  $\text{HCl}$  and in  $\text{HF}$ , insol in  $\text{HNO}_3$  d  $\text{H}_2\text{SO}_4$  (Lebeau, *C R* 1903, **136** 1330)

$\text{Cr}_3\text{Si}$  Sol in  $\text{HF}$ , insol in other aci, sol in fused  $\text{KOH}$  and fused alkali nitra s and carbonates (Zettel, *C R* 1898, **1**, 834)

**Chromous sulphide,  $\text{CrS}$** 

Insol in  $\text{H}_2\text{O}$  or  $\text{K}_2\text{S} + \text{Aq}$  (Peligot) Easily sol in acids (Moissan, *C R* **81** 7)

Sol in cold conc acids

Sol in molten alkalis (Mourlot, *C* 1895, **121** 944)

Min *Daubreite*

**Chromic sulphide,  $\text{Cr}_2\text{S}_3$** 

Insol in  $\text{H}_2\text{O}$  or alkali sulphides +  $\text{Aq}$  l attacked by  $\text{HCl} + \text{Aq}$  (W Muller, *Po* **127** 404)

$\text{HNO}_3 + \text{Aq}$  decomposes or not accordi g to method of preparation Easily decomp by aqua regia

Insol in caustic alkalis +  $\text{Aq}$

Insol in  $\text{K S} + \text{Aq}$  (Berzelius)

**Chromochromic sulphide,  $\text{Cr}_3\text{S}_4 = \text{CrS}, \text{Cr}_2\text{S}_3$** 

Insol in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or dil  $\text{H}_2\text{SO}_4 + \text{A}$  Easily sol in  $\text{HNO}_3 + \text{Aq}$  (Grogg, *W A* **81** (2) 531)

**Chromic zinc sulphide,  $\text{Cr}_2\text{ZnS}_4$** 

(Grogg *W A B* 1880, **81** 334)

**Chromicyanhydric acid****Cadmium chromicyanide,  $(\text{Cd})_2(\text{Cr}(\text{CN})_6)_2$** 

Readily sol in excess of  $\text{KCN}$  and  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp by conc  $\text{HCl}$ ,  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$  Slowly decomp by co, rapidly by hot dil  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4$

Quickly dissolved by aqua regia Decon by boiling with  $\text{Na}_2\text{O}_2$ , by  $\text{NaOH} + \text{Aq}$  a l by  $\text{Na}_2\text{CO}_3 + \text{Aq}$  Slowly decomp by boili g acetic acid (Cruser and Miller, *J A Chem Soc* 1906, **28** 1136)

**Cobaltous chromicyanide,  $\text{Co}_2[\text{Cr}(\text{CN})_6]$** 

Sol in cold, readily sol in hot conc  $\text{H}$  l or  $\text{H}_2\text{SO}_4$  Sl sol even in boiling cor

**HNO<sub>3</sub>** Slowly sol in cold dil H<sub>2</sub>SO<sub>4</sub>, HCl or HNO<sub>3</sub>. Readily sol in boiling dil HCl or H<sub>2</sub>SO<sub>4</sub>. Decomp but not entirely dissolved by aqua regia. Readily sol in an excess of KCN. Decomp by NH<sub>4</sub>OH, NaOH or Na<sub>2</sub>CO<sub>3</sub>+Aq. Decomp by boiling with Na<sub>2</sub>O<sub>2</sub>. Insol in cold or boiling acetic acid (Cruser and Miller)

**Cuprous chromicyanide, Cu<sub>2</sub>Cr(CN)<sub>6</sub>**

Sol in KCN, cold conc or boiling dil HNO<sub>3</sub>+Aq. Slowly sol in cold conc H<sub>2</sub>SO<sub>4</sub>, still more slowly sol in dil H<sub>2</sub>SO<sub>4</sub> but rapidly sol in hot dil and conc H<sub>2</sub>SO<sub>4</sub>. Readily decomp by aqua regia. Decomp by dil or conc HCl, slowly going into solution in the cold, but quickly on boiling (Cruser and Miller)

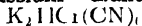
**Cupric chromicyanide, Cu<sub>2</sub>[Cr(CN)<sub>6</sub>]<sub>2</sub>**

Slowly sol in cold dil HCl, HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub> on boiling the first two readily dissolve it, but the H<sub>2</sub>SO<sub>4</sub> dissolves it only slowly. Sol in aqua regia or cold conc H<sub>2</sub>SO<sub>4</sub>. Readily sol in cold or hot conc HCl. Decomp by cold, dissolved by boiling HNO<sub>3</sub>. Decomp by boiling Na<sub>2</sub>O<sub>2</sub>+Aq. Decomp by NH<sub>4</sub>OH, NaOH or Na<sub>2</sub>CO<sub>3</sub>+Aq. Readily sol in an excess of KCN+Aq. Insol in cold acetic acid (Cruser and Miller)

**Nickel chromicyanide, Ni<sub>3</sub>[Cr(CN)<sub>6</sub>]<sub>2</sub>**

Slowly sol in cold, readily sol in hot dil HCl, HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub>. Slowly sol in cold, readily sol in hot conc H<sub>2</sub>SO<sub>4</sub>, HCl or HNO<sub>3</sub>. Slowly decomp by cold, rapidly by boiling aqua regia. Readily sol in excess of KCN. Sol in NH<sub>4</sub>OH+Aq. Decomp by NaOH, Na<sub>2</sub>CO<sub>3</sub>+Aq or Na<sub>2</sub>O<sub>2</sub>+Aq. Insol in cold dil sol in boiling acetic acid (Cruser and Miller)

**Potassium thallous chromicyanide,**



(Fischer and Benzian, Ch Z 1902, 26 50)

**Thallous chromicyanide, Hg<sub>2</sub>Cl(CN)<sub>4</sub>**

Easily sol in H<sub>2</sub>O (Fischer and Benzian, Ch Z 1902, 26 50)

**Zinc chromicyanide, Zn<sub>3</sub>[Cr(CN)<sub>6</sub>]<sub>2</sub>**

Insol in H<sub>2</sub>O. Sol in excess of NH<sub>4</sub>OH, NaOH and KCN+Aq. Decomp by Na<sub>2</sub>CO<sub>3</sub>+Aq. Sol in cold dil HCl. Slowly sol in dil H<sub>2</sub>SO<sub>4</sub> and in dil HNO<sub>3</sub>. By boiling with dil acids a clear solution is quickly obtained (Cruser, Dissert 1906)

**Chromisulphocyanhydric acid**

**Cæsium chromisulphocyanide,**



Less sol in H<sub>2</sub>O than K salt (Osann, Dissert 1907)

**Lithium chromisulphocyanide,**



Extremely deliquescent (Osann)

**Rubidium chromisulphocyanide,**



Appreciably less sol in H<sub>2</sub>O and alcohol than the K salt (Osann)

**Chromocyanidic acid, H<sub>2</sub>Cr(CN)<sub>6</sub>**

Decomp rapidly on air. Sol in H<sub>2</sub>O (Moissan, A ch (6) 4 144)

**Potassium chromocyanide, K<sub>4</sub>Cr(CN)<sub>6</sub>**

Very sol in H<sub>2</sub>O, 100 pts H<sub>2</sub>O dissolve 32.33 pts at 20°. Much more sol in hot H<sub>2</sub>O. Insol in alcohol, ether, benzene, or chloroform (Moissan, A ch (6) 4 136)

Above salt was K<sub>3</sub>Cr(CN)<sub>6</sub> (Christensen) +3H<sub>2</sub>O (Christensen, J pr (2) 31 166)

**Chromiodic acid, CrO<sub>3</sub>, HIO<sub>3</sub>+2H<sub>2</sub>O**

Deliquescent (Berg, C R 104 1514)

**Ammonium chromiodate, CrO<sub>3</sub>, NH<sub>4</sub>IO<sub>3</sub>+H<sub>2</sub>O**

Moderately sol in H<sub>2</sub>O (Berg)

**Lithium chromiodate, CrO<sub>3</sub>, LiIO<sub>3</sub>+H<sub>2</sub>O**

Very sol in H<sub>2</sub>O (Berg)

**Magnesium chromiodate**

Sol in H<sub>2</sub>O (Berg)

**Potassium chromiodate, CrO<sub>3</sub>, KIO<sub>3</sub>**

Sol in H<sub>2</sub>O (Berg)

+H<sub>2</sub>O=KCrIH<sub>2</sub>O<sub>7</sub>. Sl decomp by H<sub>2</sub>O (Blomstrand, J pr (2) 40 331)

**Silver chromiodate, CrO<sub>3</sub>, AgIO<sub>3</sub>**

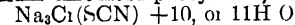
Sl attacked by cold, rapidly decomp by hot H<sub>2</sub>O (Berg, C R 111 42)

**Sodium chromiodate, CrO<sub>3</sub>, NaIO<sub>3</sub>+H<sub>2</sub>O**

Very sol in H<sub>2</sub>O (Berg)

**Chromosulphocyanhydric acid**

**Sodium chromosulphocyanide,**



Unstable

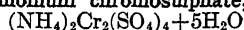
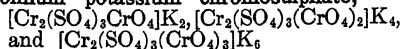
Decomp by H<sub>2</sub>O (Koppel, Z anorg 1905, 45 360)

**Chromosulphuric acid, H<sub>2</sub>Cr(SO<sub>4</sub>)<sub>4</sub>**

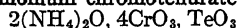
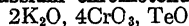
Sol in H<sub>2</sub>O in all proportions, but solution is easily decomp on standing or boiling (Recoura, Bull Soc (3) 9 586)

H<sub>4</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>6</sub> As above

H<sub>6</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>8</sub> As above

**Ammonium chromosulphate,**Sol in  $\text{H}_2\text{O}$  after a few minutes (Recoura)**Chromium potassium chromosulphate,**Sol in  $\text{H}_2\text{O}$  (Recoura, Bull Soc 1897, (3) 17 934)**Potassium chromosulphate,  $\text{K}_2\text{Cr}_2(\text{SO}_4)_4 + 4\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  in a few minutes (Recoura, Bull Soc (3) 9 590)**Sodium chromosulphate,  $\text{Na}_2\text{Cr}_2(\text{SO}_4)_4 + 10\text{H}_2\text{O}$** 

As K salt (Recoura)

**Chromotelluric acid****Ammonium chromotellurate,**Sol in  $\text{H}_2\text{O}$  (Berg, C R 1911, 152 1588)**Potassium chromotellurate,**Sl sol in cold  $\text{H}_2\text{O}$  without decomp  
Sol in boiling  $\text{H}_2\text{O}$  (Berg, Bull Soc 1911, (4) 9 583)**Chromous acid,  $\text{H}_2\text{Cr}_2\text{O}_4 = \text{Cr}_2\text{O}_3, \text{H}_2\text{O}$** 

Chromic hydroxide shows slightly acid properties, and salts corresponding to the above acid are known

**Aluminum ferrous magnesium chromite (chrome iron ore),  $(\text{Fe}, \text{Mg})\text{O}, (\text{Cr}, \text{Al})\text{O}_3$** Insol in  $\text{H}_2\text{O}$  or acids, even a mixture of  $\text{H}_2\text{SO}_4$  and  $\text{HF}$  (Ebelmen)**Barium chromite,  $\text{BaCr}_2\text{O}_4$** Insol in  $\text{H}_2\text{O}$  (Gaber Bull Soc (2) 27 436)**Barium tetrachromite,  $\text{BaO} \cdot 4\text{Cr}_2\text{O}_3$** Undecomposed by steam at red heat insol in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , sol in fused  $\text{KOH} + \text{KNO}_3$  decomp in the air (Dufau C R 1896, 122 1120)**Cadmium chromite,  $\text{CdCr}_2\text{O}_4$** 

Not attacked by acids (Viard C R 109 142)

**Calcium chromite,  $\text{CaCr}_2\text{O}_4$** Insol in  $\text{H}_2\text{O}$  (Gaber, Bull Soc (2) 27 436)Insol in  $\text{HCl}$ ,  $\text{HF}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , sol in gaseous  $\text{HCl}$  and  $\text{HF}$  at red heat, sol in fused  $\text{KOH}$ ,  $\text{KNO}_3$ ,  $\text{KClO}_3$ ,  $\text{K}_2\text{CO}_3$  (Dufau, C R 1895, 121 690) $2\text{CaO}, \text{Cr}_2\text{O}_3$  Insol in  $\text{H}_2\text{O}$ ,  $\text{KOH}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ , slowly decomp by  $\text{H}_2\text{CO}_3$  or  $\text{M}_2\text{CO}_3 + \text{Aq}$ , insol in sugar solution (Pelouze, A ch (3) 33 9) $4\text{CaO}, \text{Cr}_2\text{O}_3$  Attacked by  $\text{H}_2\text{O}$  (Morris, C R 1894, 119 188)**Cobaltous chromite,  $\text{CoCr}_2\text{O}_4$** 

(Elliot, Dissert, Gottingen, 1862)

**Cuprous chromite,  $\text{Cu}_2\text{O}, \text{Cr}_2\text{O}_3$** Insol in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1.4) (Wohler Z phys Ch 1908, 62 445)**Cupric chromite basic,  $5\text{CuO}, 4\text{Cr}_2\text{O}_3$**   
(Wohler, Z phys Ch 1908, 62 445)**Cupric chromite,  $\text{CuCr}_2\text{O}_4$** Not attacked by  $\text{HNO}_3 + \text{Aq}$  (Persoz, A ch (3) 25 283)Not attacked by conc  $\text{HCl}$   
Insol in dil acids (Wohler, Z phys Ch 1908, 62 446) $\text{CuO}, 3\text{Cr}_2\text{O}_3$  (Rosenfeld, B 1879, 1 958)**Glucinum chromite,  $\text{GlCr}_2\text{O}_4$** Insol in  $\text{H}_2\text{O}$  (Mallard, C R 105 1260)**Iron (ferrous) chromite (chrome iron ore)**

See Chromite, aluminum ferrous magnesian

**Iron (ferroferric) chromite,  $\text{FeO}, \text{Fe}_2\text{O}_3, \text{Cr}_2\text{O}_3$** Not attacked by  $\text{HCl} + \text{Aq}$  (Ebelmen)**Iron (ferrous) magnesium chromite**Insol in  $\text{HCl} + \text{Aq}$  Slightly attacked by  $\text{H}_2\text{SO}_4$ **Lead chromite,  $\text{PbCr}_2\text{O}_4$** Ppt Insol in  $\text{KOH} + \text{Aq}$  (Chance C R 43 927)**Lithium chromite,  $\text{Li}_2\text{Cr}_2\text{O}_4$** 

Very sl sol in acids (Weyberg, C R 1906 II 1659)

**Magnesium chromite,  $\text{MgO} \cdot 2\text{Cr}_2\text{O}_3$** Insol in  $\text{H}_2\text{O}$  (Nichols Sil Am J 47 16) $\text{MgCr}_2\text{O}_4$  Insol in acids or alkalis, except boiling  $\text{H}_2\text{SO}_4$  (Schweitzer, J pr 3 259)

Could not be obtained (Viard, Bull Soc (3) 5 934)

Easily attacked by boiling  $\text{H}_2\text{SO}_4 + \text{Aq}$   
Less easily by  $\text{HCl}$  or  $\text{HF} + \text{Aq}$  not attacked by boiling  $\text{HNO}_3$  (Dufau, C R 1896, 123 886) $2\text{MgO}, \text{Cr}_2\text{O}_3$  Insol in  $\text{H}_2\text{O}$  or acid (Nichols) $5\text{MgO}, 4\text{Cr}_2\text{O}_3$  Insol in acids (Viard C R 112 1003) $3\text{MgO}, 2\text{Cr}_2\text{O}_3$  As above (V)

**Manganese chromite,  $\text{MnCr}_2\text{O}_4$** 

Entirely insol in acids (Fbelmen, A ch (3) 33 44)

**Zinc chromite,  $\text{ZnCr}_2\text{O}_4$** 

Insol in acids and alkalis (Viard, C R 109 142)

+xH<sub>2</sub>O (Chancel, C R 43 927)  
3ZnO, 2Cr<sub>2</sub>O<sub>3</sub> As above (Viard, C R 112 1003)

6ZnO, 5Cr<sub>2</sub>O<sub>3</sub> As above (V)  
8ZnO, 3Cr<sub>2</sub>O<sub>3</sub> (Groger M 1904, 25, 520)

**Chromovanadic acid**

**Ammonium chromovanadate**,  $2(\text{NH}_4)_2\text{O}$ ,  
2CrO<sub>3</sub>, V<sub>2</sub>O<sub>5</sub>+7H<sub>2</sub>O

Sol in H<sub>2</sub>O (Ditte, C R 102 1105)

**Chromyl amide,  $\text{CrO}_2(\text{NH}_2)$** 

Sol in H<sub>2</sub>O (Ohly, C N 1899, 80 134)

**Chromyl subchloride,  $(\text{CrO}_2)_2\text{Cl}_2$** 

Deliquescent, sol in H<sub>2</sub>O with decomp, insol in dry ether (Pascal, C R 1909, 148, 1463)

**Chromyl chloride (chlorochromic acid)  $\text{CrO}_2\text{Cl}$** 

Decomp by H<sub>2</sub>O with evolution of much heat Sol in glacial acetic acid without decomposition

Sol in CCl<sub>4</sub>, C<sub>6</sub>H<sub>6</sub> (mol wt det.) (Oddo, Gazz ch it 1899, 29 (2) 318, Chem Soc 1900, 78 (2) 75)

**Trichromyl chloride,  $\text{Cr}_3\text{O}_7\text{Cl}_2$** 

Deliquescent Sol in H<sub>2</sub>O with gradual decomposition Sol in conc HCl+aq (Thorpe, Chem Soc (2) 8 31)

Scarcely sol in CS<sub>2</sub>  
Sol in alcohol and ether (Rawson, C N 1889 59 155)

**Chromyl chlorides**

From Cr<sub>2</sub>O<sub>3</sub>

See Chromium oxychlorides

**Chromyl chloride nitrogen trioxide,**

$\text{Cr}_2\text{Cl}_2\text{O}_7$ , 2N<sub>2</sub>O

Sol in H<sub>2</sub>O with decomp (Thomson, C R 1899, 129 528)

**Chromyl fluoride,  $\text{CrOF}$** 

Decomp by H<sub>2</sub>O with evolution of heat (Olive, Gazz ch it 16 218)

**Clay**

See Silicate, aluminum, Al<sub>2</sub>O<sub>3</sub>, SiO<sub>2</sub>+2H<sub>2</sub>O

**Cobalt, Co**

Not attacked by H<sub>2</sub>O

Sol in dil HCl, or H<sub>2</sub>SO<sub>4</sub>, or HNO<sub>3</sub>+aq  
Conc hot H<sub>2</sub>SO<sub>4</sub>, and HNO<sub>3</sub> decomp with evolution of SO<sub>2</sub> or NO gas

Exists also in passive state See Iron (Nickles, J pr 61 186)

Sol in conc KOH+aq when in finely divided state (Winkler, J pr 91 211)

Sol in NH<sub>4</sub>OH+aq in presence of air (Hodgkinson and Bellairs, C N 1895, 71 73)

**Cobalt ammonia compounds**

See—

Anhydrooxycobaltamine compounds,

$[\text{Co}(\text{NH}_3)_6]_2 \left[ \begin{array}{c} \text{Cl} \\ \text{O}(\text{OH}) \end{array} \right] X_4$

Bromotetramine cobaltic compounds,

$\text{BrCo}(\text{NH}_3)_4X_2$

Bromopurpureocobaltic compounds,

$\text{Br}_2\text{Co}(\text{NH}_3)_6X_2$

Carbonatotetramine cobaltic compounds,

$(\text{CO}_3)_2\text{Co}(\text{NH}_3)_4X$

Chlorotetramine cobaltic compounds,

$\text{ClCo}(\text{NH}_3)_4X$

Chloropurpureocobaltic compounds,

$\text{Cl}_2\text{Co}(\text{NH}_3)_6X$

Croceocobaltic compounds,

$\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2X$

Decamine cobaltic sulphite,

$\text{Co}_2(\text{NH}_3)_{10}(\text{SO}_3)_3$

Diamine cobaltic nitrites,

$\text{Co}(\text{NH}_3)_2(\text{NO}_2)_4M$

Dichrocoaltic compounds,  $\text{Co}(\text{NH}_3)_3X_3$

Flavocobaltic compounds,

$(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4X$

Fuscoaltic compounds,

$(\text{OH})\text{Co}(\text{NH}_3)_4X_2$

Iodotetramine cobaltic compounds,

$\text{ICo}(\text{NH}_3)_4X_2$

Luteocobaltic compounds,  $\text{Co}(\text{NH}_3)_6X_3$

Melanocobaltic compounds,

$[\text{Co}(\text{NH}_3)_3\text{Cl}]_2, \text{NH}_4\text{Cl}$

Nitratotetramine cobaltic compounds,

$(\text{NO}_3)_2\text{Co}(\text{NH}_3)_4X_2$

Nitratopurpureocobaltic compounds,

$(\text{NO}_3)_3\text{Co}(\text{NH}_3)_6X$

Nitritocobaltic compounds,

$(\text{NO})_2\text{Co}(\text{NH}_3)_6X$

Octamine cobaltic compounds,

$\text{Co}(\text{NH}_3)_8X_6$

(= Tetramine cobaltic compounds,

$\text{Co}(\text{NH}_3)_4X_3$

Oxycobaltamine compounds,

$\text{Co}(\text{NH}_3)_{10}(\text{OOH})X_4$

Praseocobaltic compounds,  $\text{Co}(\text{NH}_3)_4X_3$

Purpureocobaltic compounds,

$\text{Co}(\text{NH}_3)_6X_3$

Roseocobaltic compounds,

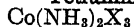
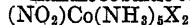
$\text{Co}(\text{NH}_3)_5(\text{OH})_2X_3$

Sulphatotetramine cobaltic compounds,

$(\text{SO}_4)_2\text{Co}(\text{NH}_3)_4X$

Sulphatopurpureocobaltic compounds,

$(\text{SO}_4)_3\text{Co}(\text{NH}_3)_6X$

**"Tetramine cobaltic" compounds,****Xanthocobaltic compounds****Cobalt arsenide, CoAs**

As  $\text{Co}_3\text{As}_2$  (Ducelliez, C R 1908, 147 425)

$\text{CoAs}_2$  As  $\text{Co}_3\text{As}_2$  (Ducelliez, C R 1908, 147 425)

$\text{Co}_2\text{As}_3$  As  $\text{Co}_3\text{As}_2$  (Ducelliez, C R 1908, 147 425)

$\text{Co}_3\text{As}_2$  Very sl attacked by hot conc HCl, less by  $\text{H}_2\text{SO}_4$ . Easily sol in  $\text{HNO}_3$  and aqua regia. Sl attacked by fused alkalis and alkali carbonates (Ducelliez, C R 1908, 147 425)

$\text{CoAs}_2$  Min *Skutterudite* Sol in  $\text{HNO}_3$  + Aq, with separation of  $\text{As}_2\text{O}_3$

**Cobalt arsenide sulphide,  $\text{CoAs}_2$ ,  $\text{CoS}_2$** 

Min *Cobaltite* Sol in  $\text{HNO}_3$  + Aq, with separation of S and  $\text{As}_2\text{O}_3$

*Glauco-dote* Completely sol in  $\text{HNO}_3$  + Aq

**Cobalt azomide, basic,  $\text{Co}(\text{OH})\text{N}_3$** 

Insol in  $\text{H}_2\text{O}$

Sol in  $\text{HN}_3$  + Aq (Curtius, J pr 1898, (2) 58 300)

**Cobalt potassium azomide,  $\text{KN}_3$ ,  $\text{Co}(\text{N}_3)_2$** 

Sol in  $\text{H}_2\text{O}$ , Aq solution decomp on boiling (Curtius, J pr 1898, (2) 58 301)

**Cobalt boride,  $\text{Co}_2\text{B}$** 

Attacked by  $\text{HNO}_3$  (Jassonneix, C R 1907, 145 240)

CoB Decomp by moist air and by alkali nitrates, chlorates, hydroxides and carbonates, decomp by steam at red heat and by acids (Moissan, C R 1896, 122 425)

Not attacked by HCl, rapidly attacked by  $\text{HNO}_3$ . Not attacked by dil but decomp by conc  $\text{H}_2\text{SO}_4$ . Rapidly attacked by aqua regia (Moissan, A ch 1896, (7) 9 272)

$\text{CoB}_2$  (Jassonneix, C R 1907, 145 241)

**Cobaltous bromide,  $\text{CoBr}_2$** 

Deliquescent Sol in  $\text{H}_2\text{O}$ , alcohol, and ether

Sat  $\text{CoBr}_2$  + Aq contains at

59° 75° 97°  
66.7 66.8 68.1%  $\text{CoBr}_2$

(Etard, A ch 1894, (7) 2 542)

Nearly insol in  $\text{AsBr}_3$  (Walden, Z anorg 1902, 29 374)

Sol in  $\text{SO}_2\text{Cl}(\text{OH})$  (Walden)

Sol in quinine (Beckmann and Gabel, Z anorg 1906, 51 236)

1g  $\text{CoBr}_2$  is sol in 9.74g methyl acetate at 18°. Sp gr 1.8°/4° of sat solution = 1.013 (Naumann, B 1909, 42 3792)

Difficultly sol in ethyl acetate (Naumann, B 1910, 43 314)

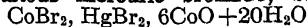
Sol in acetone (Eidmann, C C 189, II 1014, Naumann, B 1904, 37 4328)

Mol weight determined in pyridine (Werner, Z anorg 1897, 15 24)

+2, and 6 $\text{H}_2\text{O}$  (Hartley, Chem Soc ( ) 12 214)

**Cobaltous hydrazine bromide hydrazine,  $2\text{CoBr}_2$ ,  $4\text{N}_2\text{H}_4\text{HBr}$ ,  $\text{N}_2\text{H}_4(?)$** 

Sol in  $\text{H}_2\text{O}$  with decomp (Ferratini, C 1912 1613)

**Cobaltous mercuric bromide, basic,**

(Mailhe, A ch 1902, (7) 27 369)

**Cobalt stannic bromide**

See Bromostannate, cobalt

**Cobaltous bromide ammonia,  $\text{CoBr}_2$ ,  $6\text{NH}_3$** 

Sol in  $\text{H}_2\text{O}$  with residue of cobalt hydroxide (Rammelsberg, Pogg 55 245)

**Cobaltous bromide hydrazine,  $\text{CoBr}_2$ ,  $2\text{N}_2\text{H}_4$** 

Decomp by boiling with  $\text{H}_2\text{O}$  (Franze, Z anorg 1908, 60 270)

**Cobalt carbonyl,  $\text{Co}(\text{CO})_4$** 

Insol in  $\text{H}_2\text{O}$ . More or less sol in  $\text{CS}_2$  ether, alcohol and  $\text{Ni}(\text{CO})_4$ . Relative stable with non-oxidizing acids. Quick decomp by oxidizing acids (Mond, Hir and Cowap, C N 1908, 98 165)

**Cobaltous chloride,  $\text{CoCl}$** 

Deliquescent Sol in  $\text{H}_2\text{O}$  with evolution of heat 100 pts  $\text{H}_2\text{O}$  dissolve 4.5 pts  $\text{CoCl}$  at 0° (Engel, A ch (6) 17 355)

100 pts sat  $\text{CoCl}$  + Aq at 1° contain pt  $\text{CoCl}$

t	100 CoCl	t	100 CoCl	t	100 CoCl
-22	24.7	25	31.4	56	48.4
-4	28.0	34	37.5	78	48.5
+7	31.2	41	39.8	94	50.5
11	31.3	45	41.7	96	51.2
12	32.5	49	46.7	112	52.5

(Etard, C R 113 699)

Sp gr of  $\text{CoCl}$  + Aq containing

5 10 12 20 25%  $\text{CoCl}$   
1.0496 1.0997 1.1579 1.2245 1.3002

Sat solution, 1.3613

(Franz, J pr (2) 5 284)

Sp gr of  $\text{CoCl}$  + Aq containing in 1000 g  $\text{H}_2\text{O}$ , g  $\text{CoCl}$  + 6 $\text{H}_2\text{O}$

119 g (= 1/2 mol) 238 357 476 594  
1.055 1.101 1.141 1.177 1.200

833 952 1071 1190  
1.238 1.264 1.287 1.309

Containing g  $\text{CoCl}_2$  (anhydrous)—  
 65 g (=  $\frac{1}{2}$  mol) 130 195 260 325 390  
 1 058 1 112 1 164 1 213 1 260 1 304  
 (Gerlach, Z anal 28 466)

Sp gr of  $\text{CoCl}_2 + \text{Aq}$  at room temp containing  
 7 97 14 858 22 27%  $\text{CoCl}_2$   
 1 0807 1 1613 1 2645  
 (Wagner, W Ann 1883, 18 267)

Sp gr of  $\text{CoCl}_2 + \text{Aq}$  at  $20^\circ$  containing M  
 g mols of salt per liter

M 0 01 0 025 0 05 0 075  
 Sp gr 1 001159 1 003052 1 006065 1 009190

M 0 10 0 25 0 50 0 75  
 Sp gr 1 012386 1 03049 1 05492 1 09118

M 1 0 1 5 2 0  
 Sp gr 1 11847 1 17502 1 23637  
 (Jones and Pearce, Am Ch J 1907, 38 711)

Sp gr of  $\text{CoCl}_2 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{CoCl}_2 + \text{Aq}$	Sp gr
1—normal	1 0571
$\frac{1}{2}$ —	1 0286
$\frac{1}{4}$ —	1 0144
$\frac{1}{8}$ —	1 0058

(Wagner, Z phys Ch 1890, 5 37)

Solubility in  $\text{HCl} + \text{Aq}$  at  $0^\circ$   $\frac{\text{CoCl}_2}{2} = \frac{1}{2}$  mols  
 $\text{CoCl}_2$  in mgs in 10 ccm of solution  
 $\text{HCl} = \text{mols}$   $\text{HCl}$  in mgs in ditto  $\text{H}_2\text{O}$   
 $= \text{g}$   $\text{H}_2\text{O}$

$\frac{\text{CoCl}_2}{2}$	HCl	$\text{CoCl}_2 + \text{HCl}$	Sp gr	H O
62 4	0	62 4	1 343	9 36
58 525	3 7	62 2	1 328	9 34
50 8	11 45	62 25	1 299	9 27
37 25	25 2	62 45	1 248	9 13
12 85	55 0	67 85	1 167	
4 75	74 75	79 50	1 150	8 46
12 0	104 5	116 5	1 229	7 5
25 0	139 0	164 0	1 323	

(Engel, A ch (6) 17 355)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

Sol in alcohol

Sat solution in alcohol (0 792 sp gr) contains 23 66 %  $\text{CoCl}_2$  and has sp gr = 1 0107 (Winkler, J pr 91 209)

Very sol in ether

100 pts absolute ether dissolve only 0 021 g  $\text{CoCl}_2$  (Bodtker, Z phys Ch 1897, 22 511)

100 g formic acid (95% c) dissolve 6 2 g  $\text{CoCl}_2$  at  $20^\circ$  (Aschan, Ch Z 1913, 37 1117)

1g  $\text{CoCl}_2$  is sol in 271g methyl acetate at  $18^\circ$  Sp gr  $18^\circ/4^\circ$  of sat solution = 0 938 (Naumann, B 1909, 42 3791)

Difficultly sol in ethyl acetate (Naumann, B 1910, 43 314)

100 pts acetone dissolve 8 62 pts anhydrous  $\text{CoCl}_2$  (Krug and McElroy, J Anal Ch 6 184)

0 08 pts sol in 100 pts ethyl acetate at  $14^\circ$   
 0 26 " " " 100 " " 79°  
 9 11 " " " 100 " acetone " 0°  
 9 28 " " " 100 " " " 22 5°

(Laszczyński, B 1894, 27, 2286)

Sol in acetone (Eidmann, C C 1899, II 1014)

1 g  $\text{CoCl}_2$  is sol in 36 4 g acetone at  $18^\circ$  Sp gr of sat solution  $18^\circ/4^\circ = 0 825$  (Naumann, B 1904, 37 4334)

100 g acetonitrile dissolve 4 08 g  $\text{CoCl}_2$  at  $18^\circ$  (Naumann and Scher, B 1914, 97 249)

Sol in quinoline (Beckmann and Gabel, Z anorg 1906, 51 236)

Solubility in pyridine at  $t^\circ$

$t^\circ$	G $\text{CoCl}_2$ sol in 100 g pyridine	Solid phase
-50 3	0 4200	$\text{CoCl}_2 \cdot 6\text{C}_5\text{H}_5\text{N}$
-45 0	0 4204	
-30 0	0 4221	
-19 6	0 4227	
-10 0	0 4329	
0	0 4326	
+23 0	0 572	$\text{CoCl}_2 \cdot 4\text{C}_5\text{H}_5\text{N}$
25 0	0 578	
34 6	0 755	
37 6	0 760	
44 6	0 959	
47 2	1 029	
51 0	1 172	$\text{CoCl}_2 \cdot 2\text{C}_5\text{H}_5\text{N}$
55 0	1 206	
60 0	1 342	
64 2	1 483	
68 0	1 597	
74 8	2 079	
78 2	2 350	$\text{CoCl}_2$
79 8	2 488	
88 0	3 397	
96 5	7 817	
98 8	8 862	
106 0	14 340	
110 0	16 500	

(Pearce and Moore, Am Ch J 1913 50 226)

Mol weight determined in piperidine, and pyridine (Werner Z anorg 1897, 15 18 and 23)

Sol in urethane (Castoro, Z anorg 1899, 20 61)  
 $+ \text{H}_2\text{O}$

+2H<sub>2</sub>O Very deliquescent (Bersch, J B 1867 291)  
17 16 pts sol in 100 pts acetone at 0°  
17 06 " " 100 " " 25°

(Laszczyński, B 1894, 27 2287)

+4H<sub>2</sub>O Deliquescent (Bersch)

+6H<sub>2</sub>O Not deliquescent Easily sol in H<sub>2</sub>O

Solubility of CoCl<sub>2</sub>+6H<sub>2</sub>O in ethyl alcohol +Aq at 11.5° under addition of increasing amounts of CoCl<sub>2</sub>

P = Percent of alcohol by volume

G = Grams of CoCl<sub>2</sub> added

C<sub>c</sub> = Grams of CoCl<sub>2</sub> in 5 cc of the solution

C<sub>w</sub> = Grams of water in 5 cc of the solution, calculated from

(1) the water content of the alcohol

(2) the water of crystallization which had gone into solution

(3) the water held mechanically in CoCl<sub>2</sub>+6H<sub>2</sub>O

P	G	C <sub>w</sub>	C <sub>c</sub>
91 3	0 0	1 375	1 168
98 3	0 0	1 134	1 214
98 3	0 0	1 068	1 181
99 3	0 0	1 045	1 199
"	0 194	0 899	1 204
"	0 400	0 829	1 325
"	0 612	0 764	1 459
"	0 813	0 688	1 568
"	1 022	0 634	1 713
"	1 240	0 553	1 831
"	1 446	0 483	1 943
"	0 650	0 500	2 186

(Bodtker, Z phys Ch 1897, 22 508)

Easily soluble in absolute ethyl alcohol 100 pts absolute alcohol dissolve at room temperature 56 20 pts CoCl<sub>2</sub> Water precipitates CoCl<sub>2</sub>+6H<sub>2</sub>O from a solution of CoCl<sub>2</sub> in absolute alcohol (Bodtker)

100 pts absolute ether dissolve 0 291g CoCl<sub>2</sub>+6H<sub>2</sub>O (Bodtker, Z phys Ch 1897, 22 511)

Anhydrous ethylene glycol dissolves 10 6% CoCl<sub>2</sub>+6H<sub>2</sub>O at 16 4° (de Coninck, Chem Soc 1904, 86, (2) 741)

**Cobaltous hydrazine chloride,**  
CoCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>HCl+2½H<sub>2</sub>O

Sol in H<sub>2</sub>O (Ferradini, C A 1912 1613)

**Cobaltous iodine chloride,** CoCl, 2ICl<sub>3</sub>+8H<sub>2</sub>O

Decomp by H<sub>2</sub>O CCl<sub>4</sub> separates ICl<sub>3</sub> (Weinland and Schlegel milch, Z anorg 1902 30 157)

**Cobalt lithium chloride,** CoCl, LiCl+5H<sub>2</sub>O

Very deliquescent Sol in H<sub>2</sub>O with decomp Sol in LiCl+Aq without decomp Sol in alcohol without decomp (Chassavant, A ch (6) 30 27)

**Cobaltous mercuric chloride basic,** CoCl<sub>2</sub>, HgCl<sub>2</sub>, 6CoO+20H<sub>2</sub>O

(Mailhe, A ch 1902, (7) 27 369)

**Cobaltous mercuric chloride,** CoCl<sub>2</sub>, HgCl<sub>2</sub>  
Very deliquescent (v Bonsdorff)

**Cobaltous thallic chloride,** 2TlCl<sub>3</sub>, CoCl +8H<sub>2</sub>O

Hydroscopic, can be cryst from H<sub>2</sub>O (Gewecke, A 1909, 366 222)

**Cobaltous tin (stannic) chloride,** CoCl<sub>2</sub>, SnCl<sub>4</sub>+6H<sub>2</sub>O

See Chlorostannate, cobaltous

**Cobaltous chloride ammonia,** CoCl<sub>2</sub>, 2NH<sub>3</sub>

Decomp by H<sub>2</sub>O (F Rose)

CoCl<sub>2</sub>, 4NH<sub>3</sub> Decomp by H<sub>2</sub>O (H Rose)

CoCl<sub>2</sub>, 6NH<sub>3</sub> Decomp by H<sub>2</sub>O Sol in dil NH<sub>4</sub>OH+Aq with ease, but difficultly in conc NH<sub>4</sub>OH+Aq Insol in absolute alcohol (Fremy)

**Cobaltous chloride hydrazine,** CoCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>

Insol in cold H<sub>2</sub>O

Slowly decomp by cold, rapidly by hot H<sub>2</sub>O

Easily sol in dil acids and NH<sub>4</sub>OH+Aq (Franzen, Z anorg 1908, 60 270)

**Cobaltous chloride hydroxylamine,**  
CoCl<sub>2</sub>, 2NH<sub>2</sub>OH

Decomp in the air, sol in H<sub>2</sub>O (Feldt, B 1894, 27 403)

**Cobaltic chloride hydroxylamine,**  
CoCl<sub>3</sub>, 6NH<sub>2</sub>OH

Insol in alcohol

Sol in acidified H<sub>2</sub>O without decomp sol in conc H<sub>2</sub>SO<sub>4</sub> without decomp (Feldt B 1894 27 404)

**Cobaltous fluoride,** CoF

Sl sol in H<sub>2</sub>O insol in alcohol and ether, slowly attacked by cold HCl H<sub>2</sub>SO<sub>4</sub> or HNO<sub>3</sub>+Aq (Poulenc C R 114 1129)

Insol in liquid NH<sub>3</sub> (Gore Am Ch J 1898, 29 527)

+2H<sub>2</sub>O Sol in a little H<sub>2</sub>O without decomp Decomp into oxyfluoride by boiling with much H<sub>2</sub>O Sol in HCl+Aq (Berzelius)

+4H<sub>2</sub>O Two modifications

Solubility of α mod at 15° = 2 2328 g/g  
β " " = 2 203 g/g

(Costichescu Ann Sci Univ Jassy, 1912 7, 1, 10)

**Cobaltic fluoride,** CoF<sub>3</sub>

Sol in conc H<sub>2</sub>SO<sub>4</sub> (Bubrien, Chem Soc 1905, 88, (2) 393)

**Cobaltous hydrogen fluoride**,  $\text{CoF}_2$ ,  $5\text{HF} + 6\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  and dil acids  
Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp (Bohm, Z anorg 1905, 43 330)

**Cobalt columbium fluoride**

See Fluocolumbate, cobalt

**Cobaltous iron (ferric) fluoride**,

$\text{CoF}_2$ ,  $\text{FeF}_3 + 7\text{H}_2\text{O}$

Sol in dil  $\text{HF} + \text{Aq}$  (Weinland, Z anorg 1899, 22 269)

**Cobaltous manganic fluoride**,  $2\text{CoF}$ ,  $\text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$

(Christensen, J pr (2) 34 41)

**Cobalt molybdenyl fluoride**

See Fluoxymolybdate, cobalt

**Cobaltous potassium fluoride**,  $\text{CoF}_2$ ,  $\text{KF}$

Sl sol in  $\text{H}_2\text{O}$ , less in ethyl or methyl alcohol, insol in amyl alcohol or benzene  
Decomp by hot  $\text{H}_2\text{SO}_4$  (Poulenc, C R 114 747)

$+ \text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Wagner, B 19 896)

$\text{CoF}$ ,  $2\text{KF}$

**Cobaltous sodium fluoride**,  $\text{CoF}_2$ ,  $\text{NaF} + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Wagner, B 19 896)

**Cobaltous stannic fluoride**

See Fluostannate, cobaltous

**Cobalt vanadium fluoride**

See Fluovanadate, cobalt

**Cobaltous hydroxide**,  $\text{Co}_2\text{O}_3\text{H}_2$

Insol in  $\text{H}_2\text{O}$  Sol in acids Insol in  $\text{KOH} + \text{Aq}$  Sol in ammonium sulphate, chloride, nitrate, or succinate +  $\text{Aq}$  (Brett)

Sol in warm acetic acid, insol in  $\text{NH}_4\text{OH} + \text{Aq}$  and cold  $\text{NH}_4\text{Cl} + \text{Aq}$ , but sol in warm  $\text{NH}_4\text{Cl} + \text{Aq}$  (de Schulten, C R 109 266)

Insol in  $\text{H}_2\text{O}$  and dil  $\text{KOH} + \text{Aq}$ , somewhat sol in conc  $\text{KOH} + \text{Aq}$  easily sol in  $\text{NH}_4$  salts +  $\text{Aq}$  (Fresenius)

Easily sol in  $\text{KCN} + \text{Aq}$  (Rodgers, 1834)

Sol in conc  $\text{K}_2\text{CO}_3 + \text{Aq}$  (Gmelin)

Not pptd by  $\text{KOH} + \text{Aq}$  in presence of  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$  or  $\text{NH}_4$  citrate (Spiller)

Sol in large amt in boiling  $\text{NH}_4\text{SCN} + \text{Aq}$  (Grossmann, Z anorg 1908, 58 269)

Insol in methyl, or amyl amine +  $\text{Aq}$  (Wurtz)

Many non-volatile organic substances prevent its pptn

**Cobaltic hydroxide**,  $3\text{Co}_2\text{O}_3$ ,  $2\text{H}_2\text{O}$

(Mills, Phil Mag (4) 35 257)

$\text{Co}_2\text{O}_3$ ,  $2\text{H}_2\text{O}$  Decomp by  $\text{HCl} + \text{Aq}$ ,

gives brown solutions with cold  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , which soon decomp (Wernicke Pogg 141 120)

$\text{Co}_2\text{O}_3\text{H}_2 = \text{Co}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$  Sol in warm  $\text{HCl}$ ,  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4$ , with decomp (Proust)  
Sol in cold  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ , but decomp on standing or warming (Winkelblech)

Sol in racemic, tartaric oxalic or citric acid as cobaltous salt

Sol in conc acetic acid without immediate decomp (Remele) Solution is not decomp by boiling Sol in warm sat  $(\text{NH}_4)_2\text{C}_2\text{O}_4 + \text{Aq}$  with decomp

Not attacked by cold or hot  $\text{NH}_4\text{OH} + \text{Aq}$   
Insol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$

Sol when freshly pptd in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (Geuther, A 123 157)

**Cobaltocobaltic hydroxide**,  $\text{Co}_2\text{O}_4$ ,  $3\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in oxalic acid, solution decomp by heat Sol in  $\text{HCl} + \text{Aq}$  with evolution of  $\text{Cl}$  (Gibbs and Genth, Sil Am J (2) 23 257)

$\text{Co}_2\text{O}_4 \cdot 7\text{H}_2\text{O}$  Sol in weak acids, especially  $\text{HC}_2\text{H}_3\text{O}_2$  without decomp (Fremy)

$\text{Co}_2\text{O}_7$ ,  $6\text{H}_2\text{O}$  Min Heterogeneous Sol in dil  $\text{HCl} + \text{Aq}$  with evolution of  $\text{Cl}$

**Cobaltous iodide**,  $\text{CoI}$

Deliquescent, and very sol in  $\text{H}_2\text{O}$

100 pts sat  $\text{CoI} + \text{Aq}$  at  $t^\circ$  contain  
pts  $\text{CoI}$

t	Pts CoI	t	Pts CoI	t	Pts CoI
-22	52 4	14	61 6	60	79 2
-8	56 7	25	66 4	82	80 7
-2	58 7	34	73 0	111	80 9
+9	61 4	46	79 0	156	83 1

(Etard C R 113 699)

Sol in  $\text{SO}(\text{OCH}_3)$  (Walden Z anorg 1902, 29 388)

Sol in  $\text{SOCl}_2$  (Walden Z anorg 1900 25 216)

Sol in  $\text{POCl}_3$  (Walden Z anorg 1900 25 212)

Sol in  $\text{S Cl}_2$  (Walden Z anorg 1900 25 217)

Nearly insol in  $\text{AsBr}_3$  (Walden Z anorg 1902, 29 374)

Sol in  $\text{AsCl}_3$  (Walden Z anorg 1900 25 214)

Easily sol in alcohol  
Sol in acetone (Fidmann C C 1899 II 1014) (Naumann, B 1904 37 4528)

Sol in quinoline (Beckmann and Gabel Z anorg 1906, 51 236)

Sol in methylacetate (Naumann B 1900 42, 3790)

$+ 2\text{H}_2\text{O}$   
 $+ 4\text{H}_2\text{O}$  Very deliquescent (Etard)



+6H<sub>2</sub>O (Hartley, Chem Soc (2) 12 214)  
 +9H<sub>2</sub>O Very hygroscopic (Bolschakoff, C C 1898, II 660)

**Cobaltous lead iodide**, 2 CoI<sub>2</sub>, PbI<sub>2</sub>+3H<sub>2</sub>O  
 Decomp by H<sub>2</sub>O (Mosnier, A ch 1897, (7) 12 412)

**Cobaltous mercuric iodide**, CoI<sub>2</sub>, HgI + 6H<sub>2</sub>O

Partially decomp by H<sub>2</sub>O  
 Sol in alcohol and acetone (Dobroserdoff, C C 1901, II 332)

CoI<sub>2</sub>, 2HgI<sub>2</sub>+6H<sub>2</sub>O Decomp by H<sub>2</sub>O, sol in alcohol and acetone (Dobroserdoff, C C 1901, II 332)

**Cobaltous iodide ammonia**, CoI<sub>2</sub>, 4NH<sub>3</sub>

Decomp by H<sub>2</sub>O Sol in NH<sub>4</sub>OH+ Aq (Rammelsberg, Pogg 48 155)

CoI<sub>2</sub>, 6NH<sub>3</sub> Insol in NH<sub>4</sub>OH+ Aq (Rammelsberg)

**Cobaltous iodide hydrazine**, CoI<sub>2</sub>, 2N H<sub>4</sub>

Sl sol in H<sub>2</sub>O Easily sol in acids (Franzen, Z anorg 1911, 70 147)

**Cobaltic octamine compounds**

See Octamine cobaltic compounds

**Cobaltous oxide**, CoO

Insol in H<sub>2</sub>O Easily sol in dil or conc HCl or HNO<sub>3</sub>+Aq Slowly sol in cold, but easily in hot dil H<sub>2</sub>SO<sub>4</sub>+Aq, acetic, or tartaric acid +Aq Insol in NH<sub>4</sub>OH+ Aq Sol in hot NH<sub>4</sub>Cl+ Aq, KOH, or NaOH+ Aq (Rose)

Insol in NH<sub>4</sub>Cl or NH<sub>4</sub>NO<sub>3</sub>+Aq (Brett, 1834)

Insol in K<sub>2</sub>CO<sub>3</sub>+Aq Sol in boiling Co and Ni nitrates +Aq, with pptn of the oxides (Persoz)

Easily sol in dil acids, even tartaric, acetic, and oxalic acids Not attacked by NH<sub>4</sub>OH+ Aq Sol in 13% NH<sub>4</sub>Cl+ Aq with evolution of NH<sub>3</sub>, also in NH<sub>4</sub>SCN+ Aq Sol in warm conc NaOH, and KOH+ Aq (Zimmerman, A 232 324)

Solubility in (calcium sucrose + sugar) + Aq  
 1 l solution containing 418.6 g sugar and 34.3 g CaO dissolves 1.56 g CoO 1 l solution containing 296.5 g sugar and 24.2 g CaO dissolves 0.29 g CoO (Bodenbender, J B 1865 600)

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 827)

See also Cobaltous hydroxide

**Cobaltic oxide**, Co<sub>2</sub>O<sub>3</sub>

Decomp by most acids, even in the cold, with formation of cobaltous salts Sol in acetic acid without immediate decomp

See also Cobaltic hydroxide

**Cobaltocobaltic oxide**, Co<sub>3</sub>O<sub>4</sub>=CoO, Co<sub>2</sub>O<sub>3</sub>

Insol in boiling conc HCl, HNO<sub>3</sub>, or aqua regia Sol by long standing with H<sub>2</sub>SO<sub>4</sub> (Gibbs and Genth, Sill Am J (2) 23 257)

See also Cobaltocobaltic hydroxide

Co<sub>3</sub>O<sub>4</sub>=2CoO, Co<sub>2</sub>O<sub>3</sub>

Co<sub>3</sub>O<sub>4</sub>=4CoO, Co<sub>2</sub>O<sub>3</sub> Not attacked by boiling dil HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub>+Aq (Beetz)

Co<sub>3</sub>O<sub>4</sub>=6CoO, Co<sub>2</sub>O<sub>3</sub>+20H<sub>2</sub>O Sol in dil acids, with residue of Co<sub>2</sub>O<sub>3</sub>, which dissolves on warming (Gentele, J pr 69 131 +8H<sub>2</sub>O As above (Gentele))

**Cobaltous oxychloride**, CoCl<sub>2</sub> 3CoO+ 3½H<sub>2</sub>O

Ppt Very sl sol in H<sub>2</sub>O (Habeimann M 5 432)

**Cobaltous oxychloride hydroxylamine**, CoOCl, 2NH<sub>2</sub>OH

Insol in H<sub>2</sub>O, unstable, insol in alcohol (Feldt, B 1894, 27 404)

**Cobaltous oxyfluoride**, CoO, CoF +H<sub>2</sub>O

Ppt (Berzelius Pogg 1 26)

**Cobaltous oxyiodide**, CoO, CoI<sub>2</sub>

Insol in H<sub>2</sub>O (Rammelsberg)

**Cobaltous oxysulphide**, CoO, CoS

Cold HCl+ Aq dissolves out CoO, hot HCl+ Aq decomp with evolution of H<sub>2</sub>S (Arfvedson, Pogg 1 64)

**Cobalt phosphide**, Co P

Sol in conc HNO<sub>3</sub> Slowly attacked by HCl and H<sub>2</sub>SO<sub>4</sub> (Munroe, C R 1900 130 658)

Sol in HNO<sub>3</sub>, aqua regia and in fused alkalis (Gauger, Bull Soc 1896, (3) 15 1089)

Co P<sub>3</sub> Insol in HNO<sub>3</sub> and aqua regia stable in the air even when heated (Gauger, Bull Soc 1896, (3) 15 1087)

Co<sub>2</sub>P<sub>2</sub> Insol in conc HCl+ Aq Sol in HNO<sub>3</sub>+ Aq (Rose Pogg 24 332)

**Cobalt subselelide**, Co Se

Sol in bromine water

Only sl attacked by boiling fuming HCl (Fonzes-Diacon, C R 1900 131 704)

**Cobalt monoselelide**, CoSe

(Little, A 112 211)

**Cobalt diselelide** CoSe<sub>2</sub>

Sol in Br<sub>2</sub>+Aq

Only sl attacked by boiling fuming HCl (Fonzes-Diacon, C R 1900, 131 705)

**Cobalt sesquiselemdie,  $\text{Co}_2\text{Se}_3$** Sol in  $\text{Br}_2 + \text{Aq}$ Only sl attacked by boiling fuming  $\text{HCl}$  (Fonzes-Diacon, C R 1900, 131 704)**Cobalt selenide,  $\text{Co}_3\text{Se}_4$** Sol in  $\text{Br}_2 + \text{Aq}$ Only sl attacked by boiling fuming  $\text{HCl}$  (Fonzes-Diacon, C R 190, 131 704)**Cobalt silicide,  $\text{Co}_2\text{Si}$** Sol in  $\text{HF}$  and aqua regia Insol in cold  $\text{H}_2\text{O}$  Decomp by steam at red heat Sol in fused alkali carbonates (Vigouroux, C R 1895, 121 687) $\text{CoSi}$  Insol in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  Sol in aqua regia and  $\text{HCl}$ , and in fused  $\text{KOH}$  (Lebeau, C R 1901, 132 557)Not attacked by dil or conc  $\text{HNO}_3$ , or conc  $\text{H}_2\text{SO}_4$  Sol in aqua regia and in conc  $\text{HCl}$ Not attacked by dil alkali hydroxides +  $\text{Aq}$ , attacked by fused alkali (Lebau, Bull Soc 1901, (3), 25 540) $\text{CoSi}_2$  Sl sol in hot conc  $\text{HCl}$  and hot conc alkali +  $\text{Aq}$  Sol in  $\text{HF}$ , insol in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  (Lebeau, C R 1902, 135 476)**Cobaltous sulphide,  $\text{CoS}$** *Anhydrous* Easily sol in acids, even  $\text{HCl}$ , but only slowly in the latter case (Hjortdahl, C R 65 75)Not attacked by cold dil  $\text{HCl} + \text{Aq}$  (Ebelmen, A ch (3) 25 94)*Min Seypoorte*+  $\text{zH}_2\text{O}$  1 l  $\text{H}_2\text{O}$  dissolve 41.62 + 10<sup>-6</sup> moles  $\text{CoS}$  at 18° (Weigel, Z phys Ch 1907, 58 294)

Sol in conc mineral acids, very sl sol in cold dil acids, scarcely sol in acetic acid (Wackemoder)

Sol when still moist in  $\text{SO} + \text{Aq}$  (Berthier)Easily sol in  $\text{HNO}_3$ , but only very sl sol in  $\text{HCl} + \text{Aq}$  Not pptd from very dil acid solutions by  $\text{H}_2\text{S}$ Insol in  $\text{H}_2\text{O}$ , alkalis and alkali carbonates, or sulphides +  $\text{Aq}$  (Fresenius)Insol in  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett)When pptd by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ , shows a brown colour in presence of 200,000 pts  $\text{H}_2\text{O}$  (Pfaff)Tartaric acid, etc does not hinder the pptn by  $(\text{NH}_4)_2\text{S} + \text{Aq}$  (Rose)Sol in potassium thiocarbonate +  $\text{Aq}$  (Rosenblatt, Z anal 26 15)Sol in  $\text{N}_2\text{S}_x$  or  $\text{K}_2\text{S}_x + \text{Aq}$  (de Koninck, Zeit angew Ch 1891 202)**Cobaltic sulphide,  $\text{Co}_2\text{S}_3$** Partially decomp by  $\text{HCl} + \text{Aq}$ , sol in  $\text{HNO}_3 + \text{Aq}$  with decompositionSl attacked by  $\text{HCl} + \text{Aq}$ , and slowly even by aqua regia (Schneider, J pr (2) 9 209)*Min Cobalt pyrite*+  $\text{zH}_2\text{O}$  Insol in  $\text{KCN} + \text{Aq}$  (Fleek J pr 97 303) More sol in  $\text{HCl} + \text{Aq}$  than  $\text{CoS}$  (Dingler, Berz, J B 10 130)**Cobaltocobaltic sulphide,  $\text{Co}_3\text{S}_4$** *Min Lammite* Sol in warm  $\text{HNO}_3 + \text{Aq}$ , with residue of  $\text{S}$ **Cobalt disulphide,  $\text{CoS}_2$** Not attacked by alkalis or acids except  $\text{HNO}_3$  and aqua regia (Setterberg Pogg 7 40)**Cobalt sulphide,  $\text{Co}_2\text{S}_3$** Easily sol in hot  $\text{HCl}$  with evolution of  $\text{H}_2\text{S}$  (and  $\text{H}^?$ ) (Proust)**Cobalt potassium sulphide,  $\text{K Co}_{11}\text{S}_{10}$** Slowly sol in cold  $\text{HCl}$  and aqua regia Quickly sol in warm aqua regiaSol in  $\text{HF}$  and  $\text{H}_2\text{SO}_4$  only on warming Insol in  $(\text{NH}_4)_2\text{S}$ , organic acids, alkalis,12%  $\text{HCl} + \text{Aq}$  and  $\text{KCN} + \text{Aq}$  (Milbauer, Z anorg 1904, 42 447)**Cobalt telluride,  $\text{CoTe}$** 

(Fabre, C R 105 673)

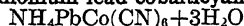
**Cobalt decamine sulphurous acid**

See Decamine cobaltisulphurous acid

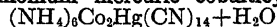
**Cobaltic acid****Potassium cobaltate,  $\text{K Co}_9\text{O}_{16} + 2\text{H}_2\text{O}$ , or  $3\text{H}_2\text{O}$** Insol in  $\text{H}_2\text{O}$  (Pebal, A 100 262), but decomp by long boiling Sol in conc acids  $\text{K}_2\text{O}$ ,  $\text{rCoO}_2$  Sol in  $\text{H}_2\text{O}$  (Winkler, J pr 91 351)

Does not exist (Donath W A B 102, 2b 71)

**Cobaltcyanhydric acid,  $\text{H Co}(\text{CN})_6 + 1/2\text{H}_2\text{O}$** Deliquescent Very sol in  $\text{H}_2\text{O}$  and only sl decomp on boilingSol in  $\text{HCl} + \text{Aq}$  without decomp even on boiling Sl sol in conc more sol in dil  $\text{HNO}_3 + \text{Aq}$  Not decomp by boiling conc  $\text{HNO}_3 + \text{Aq}$  or aqua regia Insol in conc sl sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Sol in alcohol Insol in ether (Zwenger A 162 157)**Ammonium cobalticyanide,  $(\text{NH})_4\text{Co}(\text{CN})_6 + 1/2\text{H}_2\text{O}$** Very sol in  $\text{H}_2\text{O}$ , sl sol in alcohol**Ammonium barium cobalticyanide,  $\text{NH}_4\text{BaCo}(\text{CN})_6 + \text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  (Weselsky)**Ammonium calcium cobalticyanide,  $\text{NH}_4\text{CaCo}(\text{CN})_6 + 10\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$

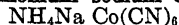
**Ammonium lead cobalticyanide,**

Sol in 831 pts  $\text{H}_2\text{O}$  at  $18^\circ$ , and sl sol in 93% alcohol (Schuler)

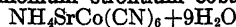
**Ammonium mercuric cobalticyanide,**

Sol in  $\text{H}_2\text{O}$  with decomp

Insol in alcohol (Soenderop, Dissert 1899)

**Ammonium sodium cobalticyanide,**

Only sl sol in  $\text{H}_2\text{O}$  (Weselsky, B 2 598)

**Ammonium strontium cobalticyanide,**

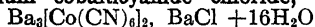
Sol in  $\text{H}_2\text{O}$  (W)

**Barium cobalticyanide, basic,  $\text{Ba}_3[\text{Co}(\text{CN})_6]_2$ ,  $\text{BaO}_2\text{H}$** 

Not very stable Cannot be recryst without partial decomp (W)

**Barium cobalticyanide,  $\text{Ba}_3[\text{Co}(\text{CN})_6] + 10\text{H}_2\text{O}$** 

Sl efflorescent Very sol in  $\text{H}_2\text{O}$  Insol in alcohol

**Barium cobalticyanide chloride,**

Sol in  $\text{H}_2\text{O}$  without decomp (W)

**Barium lithium cobalticyanide,  $\text{BaLiCo}(\text{CN})_6 + 15\text{H}_2\text{O}$** 

The most sol of the double cobalticyanides (Weselsky)

**Barium potassium cobalticyanide,**

Sol in  $\text{H}_2\text{O}$  (W)

**Bismuth cobalticyanide  $\text{BiCo}(\text{CN})_6$** 

Ppt (Mathews J Am Chem Soc 1900, 22 275)

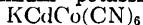
+  $5\text{H}_2\text{O}$  Moderately stable with dil min acids, more stable with conc acids than Cd or Zn comp

Decomp by  $\text{NH}_3$  and alkalis (Fischer and Cuntze, Ch Z 1902, 26 872)

**Cadmium cobalticyanide,  $\text{Cd}[\text{Co}(\text{CN})_6] + 7\frac{1}{2}\text{H}_2\text{O}$** 

Attacked by strong min acids only when hot Behaves as Zn salt, toward conc  $\text{H}_2\text{SO}_4$  and dil and conc  $\text{HCl}$

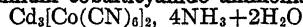
Insol in  $\text{K}_2\text{Co}(\text{CN})_6 + \text{Aq}$  Sol in  $\text{NH}_4\text{OH}$  and  $\text{NH}_4\text{Cl} + \text{Aq}$  (Fischer and Cuntze, Ch Z 1902, 26 573)

**Cadmium potassium cobalticyanide,**

Not attacked by  $\text{H}_2\text{O}$  (Fischer and Cuntze, Ch Z 1902, 26, 873)

**Cadmium sodium cobalticyanide,**

(Fischer and Cuntze, Ch Z 1902, 26 873)

**Cadmium cobalticyanide ammonia,**

(Fischer and Cuntze, Ch Z 1902, 26 873)

$\text{Cd}_3[\text{Co}(\text{CN})_6]_2, 5\text{NH}_3 + 3\text{H}_2\text{O}$  (Fischer and Cuntze, Ch Z 1902, 26 873)

$\text{Cd}_3[\text{Co}(\text{CN})_6]_2, 7\text{NH}_3$  (Fischer and Cuntze, Ch Z 1902, 26 873)

$\text{Cd}_3[\text{Co}(\text{CN})_6]_2, 9\text{NH}_3 + 2\text{H}_2\text{O}$  (Fischer and Cuntze, Ch Z 1902, 26 873)

**Calcium potassium cobalticyanide,**

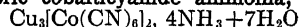
Sol in  $\text{H}_2\text{O}$  (W)

**Cobaltous cobalticyanide,  $\text{Co}_3[\text{Co}(\text{CN})_6]_2 + 14\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  and acids Sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp by  $\text{KOH} + \text{Aq}$

**Cupric cobalticyanide,  $\text{Cu}_3[\text{Co}(\text{CN})_6]_2 + 7\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  and acids Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Cupric cobalticyanide ammonia,**

Sol in  $\text{H}_2\text{O}$  (Zwenger)

**Lead cobalticyanide, basic,  $\text{Pb}_3[\text{Co}(\text{CN})_6]_2, 3\text{PbO}_2\text{H}_2 + 11\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  or alcohol, somewhat sol in hot  $\text{Pb}(\text{C}_2\text{H}_3\text{O}) + \text{Aq}$  (Schuler)

**Lead cobalticyanide,  $\text{Pb}_4[\text{Co}(\text{CN})_6] + 4\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  Insol in alcohol

(Zwenger)  
+  $7\text{H}_2\text{O}$  Sol in 177 pts  $\text{H}_2\text{O}$  at  $18^\circ$ , and 163 pts at  $19^\circ$  Insol in absolute alcohol Sl sol in 93% alcohol (Schuler, W A B 79 302)

**Lead potassium cobalticyanide,  $\text{PbKCo}(\text{CN})_6 + 3\text{H}_2\text{O}$** 

Sol in 674 pts  $\text{H}_2\text{O}$  at  $18^\circ$  and much more easily in hot  $\text{H}_2\text{O}$  Insol in absolute, sl sol in 93% alcohol (Schuler)

**Lead cobalticyanide nitrate,  $\text{Pb}_4[\text{Co}(\text{CN})_6]_2, \text{Pb}(\text{NO}_3)_2 + 12\text{H}_2\text{O}$** 

Sol in 1691 pts  $\text{H}_2\text{O}$  at  $18^\circ$ , 1679 pts at  $19^\circ$ , and much less hot  $\text{H}_2\text{O}$

Nearly insol in 93% alcohol (Schuler)

**Mercurous cobalticyanide,  $\text{Hg}_2\text{Co}(\text{CN})_6$** 

Ppt Decomp by  $\text{HCl}$  Not attacked by cold, but by hot conc  $\text{H}_2\text{SO}_4$  Not attacked by  $\text{HNO}_3$ , acetic or oxalic acid Decomp by alkalis +  $\text{Aq}$  (Miller and Mathews, J Am Chem Soc 1900 22 64)

**Mercuric cobaltcyanide,  $\text{Hg}_2[\text{Co}(\text{CN})_6]_2$** 

Sl sol in  $\text{H}_2\text{O}$ , decomp by boiling  
 Insol in alcohol and ether Not attacked  
 by  $\text{HCl}$  (Soenderop, Dissert, 1899)

**Mercuric potassium cobaltcyanide,  
 $\text{K}_6\text{HgCo}_2(\text{CN})_{14}$** 

Sol in  $\text{H}_2\text{O}$  with decomp Insol in al-  
 cohol Sl sol in ether (Soenderop, Dissert,  
 1899)

$\text{K}_6\text{Hg}_3\text{Co}_4(\text{CN})_{24}$  (Soenderop, Dissert  
 1899)

**Mercuric sodium cobaltcyanide,  
 $\text{Na}_6\text{Hg}_3\text{Co}_4(\text{CN})_{24} + 4\text{H}_2\text{O}$** 

Extremely deliquescent (Soenderop,  
 Dissert, 1899)

**Nickel cobaltcyanide,  $\text{Ni}_3[\text{Co}(\text{CN})_6]_2 + 12\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  and acids Not attacked by  
 boiling  $\text{HCl} + \text{Aq}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
 Decomp by  $\text{KOH} + \text{Aq}$

**Nickel cobaltcyanide ammonia,  
 $\text{Ni}_3[\text{Co}(\text{CN})_6]_2 \cdot 4\text{NH}_3 + 7\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$

**Potassium cobaltcyanide,  $\text{K}_3\text{Co}(\text{CN})_6$**   
Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol**Potassium strontium cobaltcyanide,  
 $\text{K}_2\text{SrCo}(\text{CN})_6 + 9\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$  (Weselsky)**Potassium thallium cobaltcyanide,  
 $\text{K}_3\text{Tl}[\text{Co}(\text{CN})_6]$** 

More sol in  $\text{H}_2\text{O}$  than corresponding  
 K salt (Fischer und Benzin Ch Z 1902,  
 26 49)

**Potassium zinc cobaltcyanide,  
 $\text{K}_2\text{ZnCo}(\text{CN})_6 + 3\text{H}_2\text{O}$**   
(Fischer und Cuntze, Ch Z 1902, 26 873)**Potassium cobaltcyanide mercuric chloride,  
 $2\text{K}_3\text{Co}(\text{CN})_6 + 3\text{HgCl}_2$**   
(Soenderop Dissert 1899)**Potassium cobaltcyanide mercuric iodide,  
 $4\text{K}_3\text{Co}(\text{CN})_6 + \text{HgI}_2$** 

Sol in  $\text{H}_2\text{O}$  with subsequent decomp  
 Sol in alcohol and ether with decomp  
 (Soenderop Dissert, 1899)

**Silver cobaltcyanide,  $\text{Ag}_3\text{Co}(\text{CN})_6$** 

Insol in  $\text{H}_2\text{O}$  and acids Sol in  $\text{NH}_4\text{OH} +$   
 $\text{Aq}$

**Silver cobaltcyanide ammonia,  $\text{Ag}_3\text{Co}(\text{CN})_6 \cdot$   
 $\text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$**   
Insol in  $\text{H}_2\text{O}$  (Zwenger)**Sodium cobaltcyanide,  $\text{Na}_3\text{Co}(\text{CN})_6 + 2\text{H}_2\text{O}$**   
Easily sol in  $\text{H}_2\text{O}$ , insol in alcohol**Sodium zinc cobaltcyanide,  $\text{NaZnCo}(\text{CN})_6$   
 $+ \text{H}_2\text{O}$**   
(Fischer und Cuntze, Ch Z 1902, 26 873)**Strontium cobaltcyanide,  $\text{Sr}_3[\text{Co}(\text{CN})_6]_2 + 10\text{H}_2\text{O}$**   
Very sol in  $\text{H}_2\text{O}$  (Weselsky)**Thallium cobaltcyanide,  $\text{Tl}_3\text{Co}(\text{CN})_6$** 

100 pts  $\text{H}_2\text{O}$  dissolve 3.6 pts at  $0^\circ$ , 5.86 pts  
 at  $9.5^\circ$ , 10.04 pts at  $19.5^\circ$  (Fronmuller, B  
 11 91)

**Yttrium cobaltcyanide,  $\text{YCo}(\text{CN})_6 + 2\text{H}_2\text{O}$**   
Nearly insol in  $\text{H}_2\text{O}$  (Cleve)**Zinc cobaltcyanide,  $\text{Zn}_3[\text{Co}(\text{CN})_6]_2 + 12\text{H}_2\text{O}$**   
Sol in  $\text{HCl} + \text{Aq}$  and salt is pptd by dilu-  
 tion with  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{SO}_4$  Insol  
 in  $\text{K}_4\text{Co}(\text{CN})_6 + \text{Aq}$  Sol in  $\text{NH}_4\text{OH}$  and  
 $\text{NH}_4\text{Cl} + \text{Aq}$  (Fischer und Cuntze, Ch Z  
 1902, 26 873)**Zinc cobaltcyanide ammonia,  
 $\text{Zn}_3[\text{Co}(\text{CN})_6]_2 \cdot 5\text{NH}_3$**   
Decomp by  $\text{H}_2\text{O}$  and acids (Fischer und  
 Cuntze, Ch Z 1902, 26 873)  
 $\text{Zn}_3[\text{Co}(\text{CN})_6]_2 \cdot 6\text{NH}_3$  (Fischer und  
 Cuntze)  
 $+ 3\text{H}_2\text{O}$  (Fischer und Cuntze)  
 $\text{Zn}_3[\text{Co}(\text{CN})_6]_2 \cdot 10\text{NH}_3 + 9\text{H}_2\text{O}$  Decomp  
 by  $\text{H}_2\text{O}$  (Fischer und Cuntze)**Cobaltumolybdic acid****Ammonium barium cobaltous cobaltumolyb-  
date,  $\frac{1}{2}(\text{NH}_4)_2\text{O}, 1\frac{1}{2}\text{BaO}, \text{CoO}, \text{CoO},$   
 $10\text{MoO}_3 + 15\frac{1}{2}\text{H}_2\text{O}$**   
Difficultly sol in  $\text{H}_2\text{O}$  (Friedheim and  
 Keller B 1906 39 4306)**Ammonium cobaltous cobaltumolybdate,  
 $2(\text{NH}_4)_2\text{O}, \text{CoO}, \text{CoO}, 10\text{MoO}_3 + 12\text{H}_2\text{O}$**   
Much more sol in  $\text{H}_2\text{O}$  than  $3(\text{NH}_4)_2\text{O}$   
 $\text{CoO}, \text{CoO}_2, 12\text{MoO}_3 + 20\text{H}_2\text{O}$  Sp gr of  
 cold sat solution = 1.096 (Friedheim and  
 Keller)  
 $3(\text{NH}_4)_2\text{O}, \text{CoO}, \text{CoO}, 12\text{MoO}_3 + 20\text{H}_2\text{O}$   
 100 cc cold sat aqueous solution contain  
 3 g of the salt Sp gr of the solution = 1.0234  
 Sol in conc  $\text{HCl}$   
 Decomp by conc  $\text{H}_2\text{SO}_4$ , by  $\text{KOH} + \text{Aq}$   
 and by  $\text{NaOH} + \text{Aq}$  (Friedheim and Keller)**Barium cobaltous cobaltumolybdate,  
 $3\text{BaO}, \text{CoO}, \text{CoO}_2, 9\text{MoO}_3 + 25\text{H}_2\text{O}$**   
Sl sol in  $\text{H}_2\text{O}$  (Friedheim and Keller)

**Cobaltous potassium cobaltmolybdate**,  
 $\text{CoO}, 3\text{K}_2\text{O}, \text{CoO}_2, 10\text{MoO}_3 + 10\text{H}_2\text{O}$   
 (Kurnakoff, Ch Z 1890, 14 113)

+11H<sub>2</sub>O Sol in conc HCl Decomp by  
 KOH+Aq and by NaOH+Aq (Friedheim  
 and Keller)

$3\text{K}_2\text{O}, \text{CoO}, \text{CoO}_2, 12\text{MoO}_3 + 15\text{H}_2\text{O}$  Sl  
 sol in H<sub>2</sub>O Sol in conc HCl Decomp by  
 KOH+Aq and by NaOH+Aq (Friedheim  
 and Keller)

+20H<sub>2</sub>O (Kurnakoff, Ch Z 1890, 14  
 113)

**Potassium cobaltmolybdate**,  
 $3\text{K}_2\text{O}, \text{CoO}_2, 9\text{MoO}_3 + 6\frac{1}{2}\text{H}_2\text{O}$

Ppt (Hall, J Am Chem Soc 1907, 29  
 703)

### Cobaltnitrocyanhydric acid

**Potassium cobaltnitrocyanide**,  
 $\text{K}_4\text{Co}_2(\text{CN})_8\text{NO}_2 + 3\text{H}_2\text{O}$

Very sol in H<sub>2</sub>O but quickly decomp  
 Insol in alcohol (Rosenheim and Kopp-  
 pel, Z anorg 1898, 17 68)

**Silver cobaltnitrocyanide**,  
 $\text{Co}_2\text{Ag}_6\text{NO}_2(\text{CN})_{10} + 6\text{H}_2\text{O}$ , and +21H<sub>2</sub>O  
 (Rosenheim and Koppel)

**Sodium cobaltnitrocyanide**,  
 $\text{Na}_6\text{Co}_4(\text{NO}_2)(\text{CN})_{10} + 11\text{H}_2\text{O}$

Very deliquescent Sol in H<sub>2</sub>O (Rosen-  
 heim and Koppel)

**Cobaltisulphurous acid**,  $\text{H}_6\text{Co}_2(\text{SO}_3)_6$

Not obtained in a solid state (Berglund,  
 Acta Lund 1872)

### Cobaltisulphites

The cobaltisulphites are insol or at least  
 very sl sol in H<sub>2</sub>O (Berglund, Acta Lund  
 1872 23)

**Ammonium cobaltous cobaltisulphite**,  
 $(\text{NH}_4)_2\text{SO}_3, 2\text{CoSO}_3, \text{Co}_2(\text{SO}_3)_3 + 14\text{H}_2\text{O} =$   
 $(\text{NH}_4)_4\text{Co}_2\text{Co}_2(\text{SO}_3)_7 + 14\text{H}_2\text{O}$

Scarcely sol in H<sub>2</sub>O, but decomp thereby  
 Easily sol in acids, when finely divided,  
 also in H<sub>2</sub>SO<sub>3</sub>+Aq (Berglund)

$2(\text{NH}_4)_2\text{SO}_3, \text{CoSO}_3, \text{Co}(\text{SO}_3)_3 + 8\text{H}_2\text{O} =$   
 $(\text{NH}_4)_4\text{CoCo}_2(\text{SO}_3)_6 + 8\text{H}_2\text{O}$  As above  
 (Berglund)

**Barium cobaltisulphite**  $3\text{BaSO}_3, \text{Co}(\text{SO}_3)_3 +$   
 $12\text{H}_2\text{O} = \text{Ba}_3\text{Co}_2(\text{SO}_3)_7 + 12\text{H}_2\text{O}$

Ppt Insol in H<sub>2</sub>O Not attacked by cold  
 acids even H<sub>2</sub>SO<sub>4</sub>, but is decomp by boiling  
 therewith (Berglund, Acta Lund 1872)

**Bismuth cobaltisulphite**,  $\text{Bi}_2\text{Co}_2(\text{SO}_3)_6$

Insol in H<sub>2</sub>O, dil HNO<sub>3</sub>, or HCl+Aq  
 (Berglund, Acta Lund 1872 31)

**Calcium cobaltisulphite**,  $\text{Ca}_3\text{Co}_2(\text{SO}_3)_6$   
 Ppt Insol in H<sub>2</sub>O or HCl+Aq (Berg-  
 lund, Acta Lund 1872 30)

**Cobaltous cobaltisulphite**,  $\text{Co}_3\text{Co}_2(\text{SO}_3)_6$   
 $3\text{CoSO}_3, \text{Co}_2(\text{SO}_3)_3$

Ppt (Berglund, B 7 470)

**Cobaltous potassium cobaltisulphite**,  
 $\text{CoK}_4\text{Co}_2(\text{SO}_3)_6$

Insol in H<sub>2</sub>O (Berglund)

**Silver cobaltisulphite**,  $\text{Co}_2(\text{SO}_3)_3, 3\text{Ag}_2\text{SO}_3$   
 Properties as the following comp (Berg-  
 lund)

**Silver cobaltous cobaltisulphite**,  $\text{CoSO}_3,$   
 $\text{Co}_2(\text{SO}_3)_3, 2\text{Ag}_2\text{SO}_3 + 9\text{H}_2\text{O}$

Insol in H<sub>2</sub>O Insol in HNO<sub>3</sub>+Aq De-  
 comp by HCl or H<sub>2</sub>S+Aq (Berglund)

**Sodium cobaltous cobaltisulphite**

Decomp by H<sub>2</sub>O, so that it has not been  
 obtained pure (Berglund, Acta Lund 1872  
 29)

**Cobaltoctamine sulphurous acid**

See Octamine cobaltisulphurous acid

**Cobaltocobalticyanhydric acid**,  
 $\text{H}_3\text{Co}_3(\text{CN})_{11}$

Unstable (Jackson and Comey, Am Ch  
 J 1897 19, 277)

**Barium cobaltocobalticyanide**,

$\text{BaHCo}_3(\text{CN})_{11} + 1\frac{1}{2}\text{H}_2\text{O}$

Somewhat sol in H<sub>2</sub>O when pure

The crude salt is insol even in hot H<sub>2</sub>O  
 (Jackson and Comey)

**Cupric cobaltocobalticyanide**,  $\text{Cu}_3\text{Co}_6(\text{CN})_{11}$   
 $+ 4\text{H}_2\text{O}$

Ppt (Jackson and Comey)

**Potassium hydrogen cobaltocobalticyanide**  
 $\text{K}_2\text{HCo}_3(\text{CN})_{11} + 2\text{H}_2\text{O}$

Sl sol in cold easily sol in hot H<sub>2</sub>O

Insol in alcohol (Jackson and Comey)

$\text{KH}_2\text{Co}_3(\text{CN})_{11} + \text{H}_2\text{O}$  Insol in cold c  
 hot H<sub>2</sub>O when impure

The pure salt is slowly sol in cold H<sub>2</sub>O  
 More sol in warm H<sub>2</sub>O (Jackson and  
 Comey)

**Silver cobaltocobalticyanide**,  $\text{Ag}_3\text{Co}_3(\text{CN})_{11}$   
 $+ \text{H}_2\text{O}$

Ppt (Jackson and Comey, B 1896, 24  
 1021)

**Zinc cobaltocobalticyanide**,  $\text{ZnHCo}_3(\text{CN})_{11}$   
 $+ 3\text{H}_2\text{O}$

Ppt (Jackson and Comey)

**Cobaltocyanhydric acid**,  $\text{H}_4\text{Co}(\text{CN})_6$   
Very unstable Sol in  $\text{H}_2\text{O}$  Insol in alcohol

**Cuprous potassium cobaltocyanide**,  
 $\text{K}_3\text{CuCo}(\text{CN})_6$   
(Straus, Z anorg 1895, 9 17)

**Potassium cobaltocyanide**,  $\text{K}_4\text{Co}(\text{CN})_6$   
Decomp on air Very deliquescent, and sol in  $\text{H}_2\text{O}$  Insol in alcohol and ether (Descamps, Zeit Ch 1868 952)

### Cobaltous acid

**Barium cobaltite**,  $\text{BaCoO}_3$   
Insol in  $\text{H}_2\text{O}$  or dil  $\text{HCl}$  Sol in  $\text{HCl} + \text{Aq}$  (Rousseau, C R 109 64)  
 $\text{BaCo}_2\text{O}_5$  As above (Rousseau)

**Cobaltous potassium cobaltite**,  $3\text{CoO}_2, \text{CoO}, \text{K}_2\text{O}$   
Rapidly hydrolysed by  $\text{H}_2\text{O}$   
Sol in conc  $\text{HCl}$  (Bellucci, Chem Soc 1907, 92, (2) 354)

**Magnesium cobaltite**,  $\text{MgCoO}_3$   
Insol in  $\text{H}_2\text{O}, \text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$   
Easily sol in  $\text{NH}_4\text{Cl} + \text{Aq}$ , from which it is pptd by  $\text{KOH} + \text{Aq}$  (Berzelius, Pogg 33 126)  
Sol in  $\text{HF}, \text{HCl}, \text{HNO}_3 + \text{H}_2\text{SO}_4$ , decomp and partially dissolved by  $\text{NH}_4\text{OH} + \text{Aq}$ , quite stable when heated (Dufau, C R 1896, 123 240)

**Potassium cobaltite**  
According to Bellucci and Dominici the compounds formerly described are more or less decomp by hydrolysis (C C 1907 I, 1530)

**Sodium cobaltite**  
Sol in  $\text{NaOH} + \text{Aq}$ , but pptd by diluting the solution

**Columbic acid (Niobic acid)**,  $3\text{Cb}_2\text{O}_5, 4\text{H}_2\text{O}$ , or  $3\text{Cb}_2\text{O}_5, 7\text{H}_2\text{O}$   
Easily sol in  $\text{HF}$ , very sl sol in  $\text{HCl} + \text{Aq}$ , but is sol in  $\text{H}_2\text{O}$  after being treated with  $\text{HCl} + \text{Aq}$  Sol in conc  $\text{H}_2\text{SO}_4$  Sol in  $\text{KOH} + \text{Aq}$  Insol in  $\text{NaOH} + \text{Aq}$ , but becomes sol in  $\text{H}_2\text{O}$  by being treated with  $\text{NaOH} + \text{Aq}$  Sol in boiling  $\text{Na}_2\text{CO}_3 + \text{Aq}$  (Rose, Pogg 113 109)  
Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 830)  
 $\text{Cb}_2\text{O}_5, 4\text{H}_2\text{O}$   
 $\text{Cb}_2\text{O}_5, 7\text{H}_2\text{O}$  (Santesson, Bull Soc (2) 24 52)

**Aluminum columbate**,  $\text{Al}_2\text{O}_3, 3\text{Cb}_2\text{O}_5 + 12\text{H}_2\text{O}$   
Ppt (E F Smith, J Am Chem Soc 1908, 30 1652)

**Barium columbate**,  $7\text{BaO}, 6\text{Cb}_2\text{O}_5 + 18\text{H}_2\text{O}$   
Ppt (Bedford, J Am Chem Soc 1905, 27 1218)

**Cadmium columbate**,  $\text{CdO}, \text{Cb}_2\text{O}_5$   
Sol in boiling conc  $\text{H}_2\text{SO}_4$ , insol in most acids, decomp by  $\text{H}_2\text{SO}_4$  at red heat (Larsson, Z anorg 1896, 12 199)  
 $+ 3\frac{1}{2}\text{H}_2\text{O}$  Ppt (E F Smith, J Am Chem Soc 1908, 30 1652)

**Cæsium columbate**,  $4\text{Cs}_2\text{O}, 3\text{Cb}_2\text{O}_5 + 14\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  (E F Smith, J Am Chem Soc 1908, 30 1654)  
 $7\text{Cs}_2\text{O}, 6\text{Cb}_2\text{O}_5 + 30\text{H}_2\text{O}$  Ppt (E F Smith, J Am Chem Soc 1908, 30 1655)

**Calcium columbate**,  $2\text{CaO}, \text{Cb}_2\text{O}_5$   
Insol in  $\text{H}_2\text{O}$  (Joly, C R 81 266)  
 $\text{CaO}, \text{Cb}_2\text{O}_5$  Sol in boiling conc  $\text{H}_2\text{SO}_4$ , insol in most acids, decomp by  $\text{H}_2\text{SO}_4$  at red heat (Larsson, Z anorg 1896, 12 198)

**Cobalt columbate**,  $\text{CoO}, \text{Cb}_2\text{O}_5$   
Sol in conc boiling  $\text{H}_2\text{SO}_4$ , insol in most acids, decomp by  $\text{H}_2\text{SO}_4$  at red heat (Larsson)

**Copper columbate**,  $\text{CuO}, \text{Cb}_2\text{O}_5$   
Sol in boiling conc  $\text{H}_2\text{SO}_4$ , insol in most acids, decomp by  $\text{H}_2\text{SO}_4$  at red heat (Larsson)  
 $+ 3\frac{1}{2}\text{H}_2\text{O}$  Ppt (E F Smith, J Am Chem Soc 1908, 30 1652)

**Iron (ferrous) columbate**,  $\text{Fe}(\text{CbO}_3)_2$   
Min *Columbite* Insol in acids

**Iron (ferrous) columbate tantalate**,  
 $x\text{Fe}(\text{TaO}_3)_2, y\text{Fe}(\text{CbO}_3)_2$   
Min *Tantalite* Not attacked by acids  
 $\text{Fe}(\text{CbO}_3)_2, 4\text{Fe}(\text{TaO}_3)_2$  Min *Taprobite*

**Lithium columbate**,  $7\text{Li}_2\text{O}, 6\text{Cb}_2\text{O}_5 + 26\text{H}_2\text{O}$   
Ppt (E F Smith, J Am Chem Soc 1908, 30 1655)

**Magnesium columbate**,  $\text{MgO}, \text{Cb}_2\text{O}_5$   
Sol in boiling conc  $\text{H}_2\text{SO}_4$ , insol in most acids, decomp by  $\text{H}_2\text{SO}_4$  at red heat (Larsson, Z anorg 1896, 12 196)  
 $+ 4\text{H}_2\text{O}$  Precipitate (Rummelsberg)  
 $+ 7\text{H}_2\text{O}$  Ppt (E F Smith, J Am Chem Soc 1908, 30 1651)  
 $4\text{MgO}, \text{Cb}_2\text{O}_5$  Insol in  $\text{H}_2\text{O}$  (Joly, C R 81 266)  
 $3\text{MgO}, \text{Cb}_2\text{O}_5$  As above

**Manganous columbate**  
Insol in  $\text{H}_2\text{O}$  (Joly, C R 81 266)  
 $3\text{MnO}, 5\text{Cb}_2\text{O}_5$  Sol in boiling conc  $\text{H}_2\text{SO}_4$ , insol in most acids, decomp by  $\text{H}_2\text{SO}_4$  at red heat (Larsson, Z anorg 1896, 12 201)

**Potassium columbate,  $\text{KCbO}_3$** 

Sol in  $\text{H}_2\text{O}$  (Joly, in Fremy's Encyc Ch)  
 $\text{K}_2\text{Cb}_4\text{O}_7 + 5\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Santesson)

$\text{K}_2\text{Cb}_5\text{O}_{16} + 5\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$   
 $\text{K}_4\text{Cb}_6\text{O}_{17} + 11\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Santesson, Bull Soc (2) 24 53)

$\text{K}_4\text{Cb}_8\text{O}_{22} + 11\text{H}_2\text{O}$  (Santesson)

$\text{K}_5\text{Cb}_9\text{O}_{13} + 13\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

$\text{K}_5\text{Cb}_9\text{O}_{10} + 16\text{H}_2\text{O}$  Efflorescent Sol in  $\text{H}_2\text{O}$  (Marignac, A ch (4) 8 20)

Very sol in  $\text{H}_2\text{O}$  (E F Smith, J Am Chem Soc 1908, 30 1652)

$\text{K}_{14}\text{Cb}_{12}\text{O}_{37} + 27\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Insol in alcohol (E F Smith)

$\text{K}_{16}\text{Cb}_{14}\text{O}_{48} + 32\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

**Potassium sodium columbate,  $3\text{K}_2\text{O}, \text{Na}_2\text{O}, 3\text{Cb}_2\text{O}_5 + 9\text{H}_2\text{O}$** 

Very slightly sol in  $\text{H}_2\text{O}$  Insol in alkalis (Marignac)

**Rubidium columbate,  $3\text{Rb}_2\text{O}, 4\text{Cb}_2\text{O}_5 + 9\frac{1}{2}\text{H}_2\text{O}$** 

(E F Smith, J Am Chem Soc 1908, 30 1655)

$4\text{Rb}_2\text{O} + 3\text{Cb}_2\text{O}_5 + 14\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (E F Smith)

**Silver columbate,  $\text{Ag}_2\text{O}, \text{Cb}_2\text{O}_5 + 2\text{H}_2\text{O}$** 

Ppt (E F Smith)

$7\text{Ag}_2\text{O}, 6\text{Cb}_2\text{O}_5 + 5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Bedford, J Am Chem Soc 1905, 27 1218)

**Sodium columbate,  $\text{NaCbO}_3 + 3\frac{1}{2}\text{H}_2\text{O}$** 

Completely sol in  $\text{H}_2\text{O}$  (Rose)

Ppt (E F Smith, J Am Chem Soc 1908, 30 1651)

$+ 2\frac{1}{2}\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$  Insol in  $\text{NaOH} + \text{Aq}$  (Santesson)

$2\text{Na}_2\text{O}, 3\text{Cb}_2\text{O}_5 + 9\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  or  $\text{NaOH} + \text{Aq}$  (Santesson)

$8\text{Na}_2\text{O}, 7\text{Cb}_2\text{O}_5$  1 pt is sol in 195–200 pts  $\text{H}_2\text{O}$  at 14–20°, in ether 75–80 pts or in 103 pts boiling water (Rose)

$7\text{Na}_2\text{O}, 6\text{Cb}_2\text{O}_5 + 32\text{H}_2\text{O}$  Very stable Sol in  $\text{H}_2\text{O}$  (Bedford, J Am Chem Soc 1905, 27 1217)

**Thorium columbate,  $5\text{Th}_2\text{O}_3, 16\text{Cb}_2\text{O}_5$** 

Sol in boiling conc  $\text{H}_2\text{SO}_4$ , insol in most acids, decomp by  $\text{HKSO}_4$  at red heat (Larsen, Z anorg 1896, 12 202)

**Yttrium columbate,  $\text{Y}_2\text{O}_3, \text{CbO}_3$** 

Insol in  $\text{H}_2\text{O}$  (Joly, C R 81 1261)

Sol in boiling conc  $\text{H}_2\text{SO}_4$ , insol in most acids, decomp by  $\text{HKSO}_4$  at red heat (Larsen)

**Zinc columbate,  $\text{ZnO}, \text{Cb}_2\text{O}_5$** 

Sol in boiling conc  $\text{H}_2\text{SO}_4$ , insol in most acids, decomp by  $\text{HKSO}_4$  at red heat (Larsen)

$7\text{ZnO}, 6\text{Cb}_2\text{O}_5 + 25\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Bedford, J Am Chem Soc 1905, 27 1218)

**Zirconium columbate,  $\text{ZrO}_2, 5\text{Cb}_2\text{O}_5$** 

Sol in boiling conc  $\text{H}_2\text{SO}_4$ , insol in most acids, decomp by  $\text{HKSO}_4$  at red heat (Larsen)

**Percolumbic acid**

See Percolumbic acid

**Columbium (Niobium),  $\text{Cb}$** 

Scarcely attacked by  $\text{HCl}$ ,  $\text{HNO}_3$ , or aqua regia Conc  $\text{H}_2\text{SO}_4$  dissolves easily on warming

Sol in fused oxidizing agents, sol in hot conc  $\text{H}_2\text{SO}_4$  and in  $\text{HF}$ , also in  $\text{HF} + \text{HNO}_3$ , insol in other acids (Moissan, C R 1901 133 24)

**Columbium pentabromide,  $\text{CbBr}_5$** 

(Rose, Pogg 104 422)

**Columbium carbide nitride,  $3\text{CbC}, 2\text{CbN}$** 

(Joly, Bull Soc (2) 25 506)

**Columbium trichloride,  $\text{CbCl}_3$** 

Not deliquescent, not attacked by  $\text{H}_2\text{O}$  but easily oxidised by  $\text{HNO}_3 + \text{Aq}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Roscoe, C N 37 25)

**Columbium pentachloride,  $\text{CbCl}_5$** 

Decomp by  $\text{H}_2\text{O}$  with separation of hydrate of  $\text{Cb}_2\text{O}_5$  Sol in cold  $\text{HCl} + \text{Aq}$  forming a solution which soon gelatinises, and separates out  $\text{CbO}_5$  by heat or dilution, with hot  $\text{HCl} + \text{Aq}$ , forms a cloudy solution which does not gelatinise Sol in  $\text{H}_2\text{SO}_4$  to form clear liquid which gelatinises on heating Sol in  $\text{KOH} + \text{Aq}$  Sol in alcohol with slight residue (Rose, Pogg 104 422)

**Columbium pentafluoride,  $\text{CbF}_5$** 

Very hygroscopic, sol in  $\text{H}_2\text{O}$  without separation of columbic acid (Ruff, B 1909 42 492)

**Columbium fluoride with MF**

See Fluocolumbate, M

**Columbium hydride,  $(\text{CbH})_2$** 

Insol in  $\text{HCl}$ ,  $\text{HNO}_3$ , and dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  even on boiling Sol in boiling conc  $\text{H}_2\text{SO}_4$  and in fused  $\text{KHSO}_4$  Sol in cold  $\text{HCl} + \text{Aq}$  if not too dilute Also attacked by  $\text{KOH} + \text{Aq}$  (Marignac N Arch Phys Nat 31 89)

Not attacked by boiling  $\text{H}_2\text{O}$ , or boiling  $\text{HCl}$

Oxidized by hot  $\text{H}_2\text{SO}_4$  Insol in boiling  $\text{HNO}_3$  (Muthmann, A 1907, 355 90)

**Columbium hydroxide  $\text{CbO}_3, \text{rH}_2\text{O}$** 

See Columbic acid

**Columbium nitride**

Not attacked by boiling nitric acid or aqua regia, but sol in a cold mixture of  $\text{HNO}_3$  and  $\text{HF}$  (Rose, Pogg 111 426)

$\text{Cb}_3\text{N}_5$  Not attacked by boiling  $\text{H}_2\text{O}$  or  $\text{HCl}$  Insol in conc  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4$

Decomp by fused  $\text{KOH}$  Not attacked by boiling with  $\text{KOH} + \text{Aq}$  (Muthmann, A 1907, 355 94)

**Columbium dioxide,  $\text{Cb}_2\text{O}_3$** 

Sol when still moist in boiling dil  $\text{HCl} + \text{Aq}$  Insol in hot  $\text{HNO}_3$ , less sol in aqua regia than in  $\text{HCl} + \text{Aq}$  Sol in conc  $\text{H}_2\text{SO}_4$  after long heating (Rose)

Insol in  $\text{H}_2\text{O}$ ,  $\text{KOH}$ , or conc acids, even when boiling (Delafontaine)

**Columbium trioxide,  $\text{Cb}_2\text{O}_3$** 

Insol in acids except  $\text{HF}$  (Smith, Z anorg 1894, 7 28)

**Columbium tetroxide,  $\text{Cb}_2\text{O}_4$** 

Not attacked by cold or hot  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or aqua regia Slightly attacked by boiling  $\text{KOH} + \text{Aq}$  (Delafontaine)

**Columbium pentoxide,  $\text{Cb}_2\text{O}_5$** 

When ignited insol in hot conc  $\text{H}_2\text{SO}_4$ . When it has not been ignited it forms a clear solution with  $\text{H}_2\text{SO}_4$ , which can be diluted without forming any precipitate (Rose, Pogg 112 549)

Sol in fused  $\text{KHSO}_4$ , which can be diluted with  $\text{H}_2\text{O}$  without causing pptn Insol in  $\text{HF}$

**Columbium oxybromide,  $\text{CbOBr}_3$** 

Decomp by  $\text{H}_2\text{O}$  into  $\text{Cb}_2\text{O}_3$  and  $\text{HBr}$  Sol in hot  $\text{H}_2\text{SO}_4$  and conc  $\text{HCl} + \text{Aq}$  (Rose, Pogg 104 442)

$3\text{H}_2\text{O}$ ,  $\text{Cb}_2\text{O}_4$ ,  $\text{HBr} (?)$  Easily sublimed (Smith, Z anorg 1894, 7 97)

**Columbium oxybromide rubidium bromide,  $\text{CbOBr}_3$ ,  $2\text{RbBr}$** 

Unstable in moist air Decomp by  $\text{H}_2\text{O}$  (Weinland, B 1905 39 3059)

**Columbium oxychloride,  $\text{CbOCl}_3$** 

Attracts  $\text{H}_2\text{O}$  from air without deliquescing and decomposed Decomp with  $\text{H}_2\text{O}$  with evolution of heat Insol in hot or cold  $\text{HCl} + \text{Aq}$  Sol by long contact with  $\text{H}_2\text{SO}_4$  to a cloudy liquid, which clears up on warming, but soon separates out  $\text{Cb}_2\text{O}_5$  Sol in cold  $\text{KOH} + \text{Aq}$  and hot  $\text{K}_2\text{CO}_3 + \text{Aq}$  (Rose)

Sol in alcohol, from which it is precipitated by ether (Blomstrand)

$3\text{H}_2\text{O}$ ,  $\text{Cb}_2\text{O}_4$ ,  $\text{HCl}$  Sublimate (Smith, Z anorg 1894, 7 97)

**Columbium oxychloride rubidium chloride,  $\text{CbOCl}_3$ ,  $2\text{RbCl}$** 

Decomp by  $\text{H}_2\text{O}$  (Weinland, B 1906, 39 3057)

**Columbium oxyfluoride,  $\text{CbOF}_3$** 

(Joly, C R 81 1266)

**Columbium oxyfluoride with MF**

See Fluoxycolumbate, and Fluoxyhypocolumbate, M

**Columbium oxysulphide,  $\text{Cb}_2\text{OS}_3$** 

Insol in boiling  $\text{HCl} + \text{Aq}$  Slowly decomp into  $\text{Cb}_2\text{O}_3$  by boiling with  $\text{HNO}_3$  or aqua regia Insol in boiling dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Converted into columbic sulphate, sol in  $\text{H}_2\text{O}$ , by boiling conc  $\text{H}_2\text{SO}_4$  Sl sol in hot  $\text{HF}$  Insol in boiling  $\text{K}_2\text{S} + \text{Aq}$  (Rose, Pogg 111 193)

**Copper, Cu**

Copper is not attacked by distilled  $\text{H}_2\text{O}$ , or by  $\text{NH}_4\text{NO}_3$ ,  $\text{KNO}_3$ , or  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ , or by a mixture of those salts in solution (Muir, cited by Carnelly, Chem Soc 30 1)

Distilled  $\text{H}_2\text{O}$  has slight action on Cu 100 cem  $\text{H}_2\text{O}$  dissolved from 2 sq dem Cu from 0.035 mg Cu in one hour up to 0.280 mg in 72 hours 100 cem  $\text{H}_2\text{O}$  dissolved 0.44 mg from 6 sq dem in 48 hours Presence of solder diminishes solubility about one-half At 90–100° the amount dissolved is about one-half that at ord temp (Carnelly, Chem Soc 30 1)

100 cem distilled  $\text{H}_2\text{O}$  dissolved only 1 mg Cu from 11.8 sq cm during a week while air free from  $\text{CO}_2$  was conducted through the solution When the air contained  $\text{CO}$  3 mg were dissolved (Wagner, Dingl 221 259)

100 l sea water dissolved 12.96 g Cu from 1 sq m (Calvert and Johnson, C N 11 171)

**Solubility in  $\text{H}_2\text{SO}_4$** 

Not attacked by dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Vogel, Schw J 32 301)

Action of  $\text{H}_2\text{SO}_4$  at ordinary temp is very slight even after a long time (Barruel J Pharm 20 13 [1834])

$\text{H}_2\text{SO}_4$  has no action below 130 Calvert and Johnson, Chem Soc 19 458

$\text{H}_2\text{SO}_4$  acts slightly even at 20° 16.3 g  $\text{H}_2\text{SO}_4$  (1.843 sp gr) dissolved the following amts from 3 g Cu having a surface of 65 sq cm at the given temp

Temp	Time	Cu dissolved
19°	14 days	About 6
60	120 min	2.5
80	30 "	1.5
100	30 "	3.1
124	30 "	22.7
130	30 "	32.6
137	30 "	35.0
150	30 "	69.2
170	10 "	51.62
195	2 "	22.2
220	1/2 "	70.2
270	few seconds	nearly 100



With dilute acid the action was much less violent, as is seen in the following table—

Tem	Time	Acid	Sp gr	% Cu dissolved
100°	30 min	H <sub>2</sub> SO <sub>4</sub>	1 843	2 380
100	30 "	2H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O	1 8295	0 585
100	30 "	H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O	1 780	0
100	30 "	H <sub>2</sub> SO <sub>4</sub> , 2H <sub>2</sub> O	1 620	0
130	30 "	H <sub>2</sub> SO <sub>4</sub>	1 843	32 6
130	30 "	H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O	1 780	1 18
130	30 "	H <sub>2</sub> SO <sub>4</sub> , 2H <sub>2</sub> O	1 620	0
165	15 "	H <sub>2</sub> SO <sub>4</sub>	1 843	70
165	30 "	H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O	1 780	16 5
165	30 "	H <sub>2</sub> SO <sub>4</sub> , 2H <sub>2</sub> O	1 620	2 7

(Pickering, Chem Soc 33 112)

Cu is very sl attacked by cold HCl+Aq of 1 12 sp gr, but somewhat more on warming. Even less sol in dil HCl+Aq (Lowe, Z anal 4 361)

Sol in warm conc HI+Aq (Rose)

Slowly attacked by H<sub>2</sub>SO<sub>4</sub>+Aq (Causse, Bull Soc (2) 45 3)

More or less sol in all dil mineral acids and also in organic acids, as acetic, tartaric, etc., when supply of air is afforded, but absolutely insol in the latter acids when air is wholly excluded. The importance of this fact in the use of Cu cooking utensils is manifest.

Easily attacked by ord HNO<sub>3</sub>+Aq

With very conc HNO<sub>3</sub>+Aq (sp gr 1 52) it becomes passive, as in the case of Fe

Pure dil HNO<sub>3</sub>+Aq of 1 07 sp gr or less does not attack Cu at 20°, but if NO<sub>2</sub> or KNO<sub>3</sub> is added the action begins at once. If HNO<sub>3</sub>+Aq is more conc the Cu is attacked. HNO<sub>3</sub>+Aq of 1 106 sp gr begins to act at -2°, and of 1 217 sp gr at -10°

HNO<sub>3</sub>+Aq of 1 512 sp gr attacks Cu violently at 20°, but action soon ceases on account of formation of a crust of Cu(NO<sub>3</sub>), insol in pure HNO<sub>3</sub> (Millon, A ch (3) 6 95)

Easily sol in 2N-HClO<sub>3</sub>+Aq at 50° (Hendrixson, J Am Chem Soc 1904, 26 756)

Not appreciably sol in anhydrous HF (Poulenc, A ch 1894, (7) 2 12)

When in contact with the air, Cu is soon oxidised by acids, alkalis (especially NH<sub>4</sub>OH+Aq), and many fatty bodies

Sol in (NH<sub>4</sub>) CO<sub>3</sub>+Aq (Traube, B 18 1887)

Slowly sol in NH<sub>4</sub>OH+Aq (Schonbein, B A B 1856 580)

Sol in KI+Aq when warm and conc (Rose)

When finely divided, Cu is easily sol in hot FeCl<sub>3</sub>+Aq

Action of dilute solutions of salts on solubility of Cu in H<sub>2</sub>O

100 ccm solution of the following salts dissolve the amts of Cu given below, from a surface of 1 sq decm in 48 hours

Salts	G salt dissolved in 100 ccm H <sub>2</sub> O	Mg Cu dissolved
H <sub>2</sub> O		0 11
KNO <sub>3</sub>	0 01 0 05 5 00	0 07 0 13 0 16
NaNO <sub>3</sub>	0 05 5 00	0 18 0 19
CaSO <sub>4</sub>	0 05	0 11
K <sub>2</sub> SO <sub>4</sub>	0 05 5 00	0 12 0 28
MgSO <sub>4</sub>	0 05 5 00	0 16 0 34
Na <sub>2</sub> CO <sub>3</sub>	0 01 0 05 5 00	0 05 0 11 2 80
K <sub>2</sub> CO <sub>3</sub>	0 05 5 00	0 14 2 35
NaCl	0 01 0 05 5 00	0 05 0 13 7 50
KCl	5 00	8 17
(NH <sub>4</sub> ) SO <sub>4</sub>	0 05 5 00	0 66 28 50
NH <sub>4</sub> NO <sub>3</sub>	0 01 0 05 5 00	0 17 0 66 60 00
NH <sub>4</sub> Cl	0 05 5 00	0 92 158 75

At 100° the action of KNO<sub>3</sub>, K<sub>2</sub>SO<sub>4</sub>, and NH<sub>4</sub>NO<sub>3</sub> is diminished while that of (NH<sub>4</sub>) SO<sub>4</sub>, Na<sub>2</sub>CO<sub>3</sub>, and NaCl is increased

Tables are also given for mixtures of the above salts (Cunlley Chem Soc 30 1)

Solubility of Cu in dilute salt solutions. 11 5 sq cm Cu were used, and the action continued one week, while air with or without CO<sub>2</sub> was passed through the solution continually

100 ccm solution of the following salts dissolved the given amts Cu

Salt	G salt dissolved in 100 ccm H <sub>2</sub> O	Mg Cu dissolved with out CO <sub>2</sub>	Mg Cu dissolved with CO <sub>2</sub>
NaCl	0 50	4	115
KCl	0 50	4	115
MgCl <sub>2</sub>	0 83	5	112
NH <sub>4</sub> Cl	1 00	904	138
K <sub>2</sub> SO <sub>4</sub>	1 00	0	4
KNO <sub>3</sub>	1 00	0	3
Na <sub>2</sub> CO <sub>3</sub>	1 00	0	
NaOH	0 923	0	
CaO <sub>2</sub> H <sub>2</sub>	sat	0	

(Wagner, Dingl 221 260)

Distilled H<sub>2</sub>O dissolved no Cu from 420 sq mm in 150 hours at ord temp

NH<sub>4</sub>NO<sub>3</sub>+Aq with less than 0.4 g per litre showed the same result

KNO<sub>3</sub>+Aq or (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq containing 0.1 to 0.2 g per litre dissolved no Cu

H<sub>2</sub>O containing carbonates+nitrates, carbonates+sulphates, or chlorides+nitrates also dissolved no Cu

NH<sub>4</sub>NO<sub>3</sub>+Aq containing 0.4 g per litre dissolved 3 mg per litre after 150 hours contact

From a surface of 2100 sq m of Cu, H<sub>2</sub>O charged with CO<sub>2</sub> at ord pressure, and containing the following salts in solution, dissolved the given amts Cu in 120 hours

Salt	G salt dissolved in 1 l H <sub>2</sub> O	Mg Cu dissolved
H <sub>2</sub> O		1 0
K <sub>2</sub> CO <sub>3</sub>	0 2	0 2
CaCl <sub>2</sub>	0 2	1 80
NH <sub>4</sub> NO <sub>3</sub>	0 02	1 40
NH <sub>4</sub> NO <sub>3</sub>	0 04	1 40
K <sub>2</sub> CO <sub>3</sub> + NH <sub>4</sub> NO <sub>3</sub>	0 1	1 00
K <sub>2</sub> CO <sub>3</sub> + NH <sub>4</sub> NO <sub>3</sub>	0 02	
K <sub>2</sub> CO <sub>3</sub> + NH <sub>4</sub> NO <sub>3</sub>	0 2	
NH <sub>4</sub> NO <sub>3</sub> + CaCl <sub>2</sub>	0 04	0 1
NH <sub>4</sub> NO <sub>3</sub> + CaCl <sub>2</sub>	0 2	3 6

From a surface of 2100 sq m, H<sub>2</sub>O charged with CO<sub>2</sub> at pressure of 6 atmos dissolved 0.6 mg in 48 hours

H<sub>2</sub>O when charged with CO at 6 atmos and containing

16 mg NH<sub>4</sub>NO<sub>3</sub> per litre, dissolved 0.8 mg in 48 hours

80 mg NH<sub>4</sub>NO<sub>3</sub> per litre, dissolved 1.4 mg in 48 hours

40 mg K<sub>2</sub>CO<sub>3</sub> per litre, dissolved 1.2 mg in 48 hours (Muir, Proc Soc Manchester, 15 31)

Sol in KCN+Aq (Goyder, C N 1894, 69 262)

A solution of (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub> containing 0.829 g

in 110 cc dissolves 0.2050-0.2279 g Cu (Turrentine, J phys Chem 1907, 11 625)

Sl attacked by liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 827)

Amts Cu dissolved by action of various oils on 8 sq in Cu by 10 days' exposure and subsequent 67 days—

	Amt Cu dissolved in 10 days	Amt Cu dissolved in subsequent 67 days
Linseed oil	0 3000 grain	0 2435 grain
Olive oil	0 2200 "	0 0200 "
Colza oil	0 0170 "	0 1230 "
Almond oil	0 1030 "	0 1170 "
Seal oil	0 0485 "	0 0315 "
Sperm oil	0 0030 "	0 0575 "
Castor oil	0 0065 "	0 0035 "
Neatsfoot oil	0 1100 "	
Sesame oil	0 1700 "	0 0015 "
Paraffine oil	0 0015 "	

(Watson, C N 36 200)

Qualitative results of the action of various oils on Cu are also given by Thompson (C N 34 176, 200, 219)

½ ccm oleic acid dissolves 0.0157 g Cu in 6 days (Gates, J phys Chem 1911, 15 143)

Sol in an alkaline solution of gelatine (3.54 %) copper gauze dissolved in 48 hours (Lidoff, C C 1899, II 471)

#### Cuprous acetylde, Cu C<sub>2</sub>

Decomp by heating with H<sub>2</sub>O or KCN+Aq Decomp by HNO<sub>3</sub> (Keiser, Am Ch J 1892, 14 289)

Not decomp by H<sub>2</sub>SO<sub>4</sub>, NH<sub>4</sub>OH, KOH+Aq or acetic acid, even on warming The dry salt is sol in very dil HCl+Aq without evolution of gas Sol in conc KCN+Aq (Böttger, A 1859, 109 356)

#### Cupric acetylde, CuC

Easily sol in HCl Turns brown in the air and becomes insol in acids (Phillips, Z anorg 1894, 6 241)

3Cu<sub>2</sub>C<sub>2</sub>O<sub>4</sub>+2H<sub>2</sub>O Solubility as that of Cu<sub>2</sub>C<sub>2</sub>H<sub>2</sub>O<sub>4</sub> (Soderbaum B 1897 30 764)

Cu<sub>2</sub>C<sub>2</sub>H<sub>2</sub>O<sub>4</sub> Insol in H<sub>2</sub>O When dry is violently decomp by conc H<sub>2</sub>SO<sub>4</sub> or not too dil HNO<sub>3</sub> Rapidly decomp by warming with dil acids especially HCl

Insol in NH<sub>4</sub>OH+Aq in absence of air partially sol in presence of air

Insol in organic solvents (Soderbaum B 1897, 30 762)

#### Cuprous acetylde iodide, Cu C I CuI

Ppt (Berthelot and Delepine A ch 1900, (7) 19 54)

**Cupric arsenide,  $\text{Cu}_3\text{As}_2$** 

(Reinsch, J pr 24 244)  
 $\text{Cu}_3\text{As}_2$  (Gehlen)  
 $\text{Cu}_3\text{As}_2$  Ppt Decomp by acids (Kane, Pogg 44 471)  
 $\text{Cu}_3\text{As}$  Min *Domeykite* Insol in HCl  
 +Aq, sol in  $\text{HNO}_3$   
 $\text{Cu}_3\text{As}$  Min *Algodonite*  
 $\text{Cu}_3\text{As}$  Min *Darwinite*

**Cuprous azoimide,  $\text{CuN}_3$** 

Insol in  $\text{H}_2\text{O}$  (Curtius)  
 Sensitive to sunlight (Wohler, B 1913, 46 2053)

**Cupric azoimide, basic,  $\text{CuO}$ ,  $\text{CuN}_3$** 

Insol in  $\text{H}_2\text{O}$  (Wohler, B 1913, 46 2055)

**Cupric azoimide,  $\text{CuN}_3$** 

Very explosive  
 Very sl sol in  $\text{H}_2\text{O}$  Decomp by boiling with  $\text{H}_2\text{O}$  (Curtius, J pr 1898, (2) 58 296)

**Copper azoimide ammonia,  $\text{CuN}_3$ ,  $2\text{NH}_3$** 

Ppt Insol in  $\text{H}_2\text{O}$  Easily sol in dil acids (Dennis, J Am Chem Soc 1907 29, 19)

**Copper boride,  $\text{Cu}_3\text{B}_2$** 

(Marsden, J B, 1880 330)

**Cuprous bromide,  $\text{Cu}_2\text{Br}_2$** 

1 l  $\text{H}_2\text{O}$  dissolves at  $18^\circ\text{--}20^\circ$   
 0 4320 millimols bromine  
 0 3157 " cupric copper  
 0 1061 " cuprous copper  
 (Bodlander, Z anorg 1902, 31 460)

Sol in HBr, HCl without decomp, or  $\text{HNO}_3$ +Aq with decomp, also in  $\text{NH}_4\text{OH}$ +Aq Insol in boiling conc  $\text{H}_2\text{SO}_4$  or  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq (Berthelot, A ch 44 385)  
 Sol in  $\text{H}_2\text{SO}_3$ +Aq (Lean and Whatmough, Chem Soc 1898, 73 151)  
 Sol in NaCl, and  $\text{Na}_2\text{S}_2\text{O}_3$ +Aq (Renault, C R 59 319)

Solubility of  $\text{Cu}_2\text{Br}_2$  in KBr+Aq  
 All values recorded in millimols per litre

KBr	Total copper	Cupric copper	Cuprous copper
25	0 119	0 012	0 107
40	0 200	0 013	0 187
60	0 310	0 025	0 285
80	0 423	0 012	0 411
100	0 5836	0	0 5836
120	0 6934	0	0 6934
500	8 719		8 719

(Bodlander and Storbeck, Z anorg 1902, 31 462)

Difficultly sol in methyl acetate (Naumann, B 1909, 42 3790)

Sol in ethyl acetate (Naumann, B 1910 43 314)

Insol in acetone (Naumann, B 1904 37 4329, Erdmann, C C 1897, II 1014)

100 g acetonitrile dissolve 3 86 g  $\text{Cu}_2\text{Br}$  at  $18^\circ$  (Naumann and Schier, B 1914, 47 249)

Sol in pyridine (Naumann, B 1904, 37 4609)

Mol weight determined in pyridine methyl and ethyl sulphides (Werner, Z anorg 1897, 15 19, 26, and 28)

**Cupric bromide,  $\text{CuBr}_2$** 

Deliquescent Very sol in  $\text{H}_2\text{O}$  Insol in benzene (Franchimont, B 16 387)

Very sl attacked by cold or even hot  $\text{H}_2\text{SO}_4$  (Viard, C R 1902, 135 169)

Moderately sol in liquid  $\text{NH}_3$  (Horr Am Ch J 1908, 39 219)

100 g 95% formic acid dissolve 0 16 g a  $21^\circ$  (Aschan, Ch Z 1913, 37 1117)

100 g acetonitrile dissolve 24 43 g  $\text{CuBr}_2$  at  $18^\circ$  (Naumann and Schier, B 1914, 47 249)

Sol in benzonitrile (Naumann, B 1914 47 1369)

Sol in methyl acetate (Naumann, B 1909, 42 3790)

Sol in acetone (Naumann, B 1904, 3 4328)

Sol in acetone with a brown color (Erdmann, C C 1899, II 1014)

+ $2\text{H}_2\text{O}$ (?) (Berthelot, A ch 183 44 385)

+ $4\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Sabatier Bull Soc 1894, (3) 11 677)

**Cupric hydrogen bromide,  $\text{CuBr}$ , HBr  $2\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  (Sabatier Bull Soc 1894, (3) 11 681)

+ $10\text{H}_2\text{O}$  (Weinland and Knoll, Z anorg 1905, 44 116)

**Cupric lithium bromide,  $\text{CuBr}_2 \cdot 2\text{LiBr} + 6\text{H}_2\text{O}$** 

Very hygroscopic (Sementschenko, anorg 1899, 19 336)

Very hygroscopic, decomp by  $\text{H}_2\text{O}$  (Kurnakoff, C C 1899, I 16)

**Cupric potassium bromide,  $\text{CuBr}_2$ , KBr**

Decomp by  $\text{H}_2\text{O}$  (Sabatier, Bull Soc 1894, (3) 11 683)

**Cuprous bromide ammonia,  $\text{Cu}_2\text{Br}_2$ ,  $2\text{NH}_3$** 

Stable when dry

Easily sol in  $\text{HNO}_3$  and  $\text{NH}_4\text{OH}$ +Aq Other mineral acids and acetic acid separ

$\text{CuBr}_2$  (Richards, Z anorg 1898, 17 24)

$\text{Cu}_2\text{Br}_2 \cdot 6\text{NH}_3$  (Lloyd)  
 $\text{Cu}_2\text{Br}_2 \cdot 3\text{NH}_3$  (Lloyd, J phys Che 1908, 12 399)

**Cupric bromide ammonia,  $\text{CuBr}_2 \cdot 2\text{NH}_3$** 

Sol in  $\text{NH}_4\text{Br} + \text{Aq}$  without decomp (Richards, B 23 3790)

$3\text{CuBr}_2 \cdot 10\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$  (Richards, Am Ch J 15 651)

$\text{CuBr}_2 \cdot 3\text{NH}_3$  Completely sol in a little  $\text{H}_2\text{O}$ , but is decomp by dilution Insol in alcohol (Rammelsberg, Pogg 55 246)

$\text{CuBr}_2 \cdot 4\text{NH}_3 + \text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  dissolves 69.03 pts  $\text{CuBr}_2 \cdot 4\text{NH}_3$  at  $25^\circ$  (Pudschies, Dissert)

$\text{CuBr}_2 \cdot 5\text{NH}_3$  As above (Rammelsberg)

$\text{CuBr}_2 \cdot 6\text{NH}_3$  Sol in small amts of  $\text{H}_2\text{O}$ , but decomp on dilution (Richards)

**Cupric bromide nitric oxide,  $\text{CuBr}_2 \cdot \text{NO}$** 

Decomp by  $\text{H}_2\text{O}$  (Manchot, B 1914, 47 1607)

**Cuprous chloride,  $\text{Cu}_2\text{Cl}_2$** 

1.53 g  $\text{Cu}_2\text{Cl}_2$  dissolve in 100 g  $\text{H}_2\text{O}$  at  $21.5^\circ$ , 1.55 g at  $26.5^\circ$  (Kremann and Noss, M 1912, 33 1206)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{H}_2\text{O}$  in an atmosphere of hydrogen

Solubility is recorded in mg-atoms per l

$t^\circ$	Total Cu	$\text{CuCl}_2$ by analysis	Cl	Cu Cl <sub>2</sub> calc	$\text{Cu}_2\text{Cl}_2$ by analysis
	2 752	2 124	5 672	0 628	
20 2	2 919	2 254	5 525	0 665	0 420
19 6	2 971	2 294	5 464	0 677	0 474
19 3	2 861	2 245	5 464	0 616	0 499

(Bodlander, Z anorg 1902, 31 12)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{H}_2\text{O}$  in an atmosphere of  $\text{CO}_2$

Solubility is recorded in mg-atoms per l

t	Total Cu	$\text{CuCl}_2$ by analysis	Cl	Cu Cl <sub>2</sub> by analysis	Cu Cl <sub>2</sub> calc
20 6	2 818		5 235	0 525	
21 7	2 805	2 243	5 430	0 516	0 562
	2 880	2 258	5 312	0 391	0 662
19 7	2 805	2 138	5 390	0 336	0 667

(Bodlander, l c)

Sol in conc  $\text{HCl} + \text{Aq}$ , insol in dil  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  Not attacked by cold conc  $\text{H}_2\text{SO}_4$ , and only sl on warming (Rosenfeld, B 12 954) Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , sol in hot  $\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{FeCl}_3$ ,  $\text{ZnCl}_2$ ,  $\text{MnCl}_2$ , etc +  $\text{Aq}$  1 mol  $\text{Na}_2\text{S}_2\text{O}_3$  in aqueous solution dissolves 1 mol  $\text{Cu}_2\text{Cl}_2$  (Winkler, J pr 88 428) Sol in  $\text{KI}$ ,  $\text{I}_2$ ,  $\text{KCN}$ , or  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (Renault, C R 59 558)

Solubility in  $\text{HCl} + \text{Aq}$  at  $17^\circ$   $\frac{\text{Cu}_2\text{Cl}_2}{2} =$   
 $\frac{1}{2}$  mols  $\text{CuCl}_2$  in mgs in 10 ccm solution  $\text{HCl} =$  mols  $\text{HCl}$  in ditto

$\frac{\text{Cu}_2\text{Cl}_2}{2}$	HCl	Sp gr
0 475	8 975	1 050
1 4	15 7	
1 575	18 2	
4 5	34 5	1 080
8 25	47 8	1 135
11 5	57 0	

(Chateher, calc by Engel, A ch (6) 17 377)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{HCl} + \text{Aq}$  at  $0^\circ$

$\frac{\text{Cu}_2\text{Cl}_2}{2}$	HCl	Sp gr
1 5	17 5	1 049
2 9	26 0	1 065
8 25	44 75	1 132
15 5	68 5	1 261
33 0	104 0	1 345

(Engel, l c)

Freshly pptd  $\text{Cu}_2\text{Cl}_2$  is sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Lean and Whatmough, Chem Soc 1898, 73 150)

Sl sol in normal  $\text{NH}_4\text{OH} + \text{Aq}$  only by shaking several hours, a 0.02 normal solution of cuprous copper being obtained (Gaus, Z anorg 1900, 25 258)

Insol in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Siewert, Gm K 5 1, 893)

Sol in alkyl triphosphites (Arbusoff, C C 1906, II 750)

Solubility in  $\text{FeCl}_2 \cdot 4\text{H}_2\text{O} + \text{Aq}$  at  $21.5^\circ$

In 100 g $\text{H}_2\text{O}$		Solid phase
g $\text{FeCl}_2$	g $\text{CuCl}_2$	
	1 535	$\text{Cu}_2\text{Cl}_2$
6 015	1 33	"
11 62	1 81	"
16 30	3 11	"
26 305	7 125	"
29 35	8 06	"
33 125	9 565	"
43 75	12 44	"
54 00	17 04	"
66 40	21 60	"
73 20	23 20	"
71 895	21 655	$\text{Cu}_2\text{Cl}_2 + \text{FeCl}_2 \cdot 4\text{H}_2\text{O}$
69 34	11 895	$\text{FeCl}_2 \cdot 4\text{H}_2\text{O}$
65 10		"

(Kremann and Noss, M 1912, 33 1208)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{KCl} + \text{Aq}$  at  $t^\circ$  Determined in an atmosphere of  $\text{CO}_2$

$t^\circ$	g mol KCl per l	g atoms Cu per l
18 3	0 05	0 002411
16	0 1	0 004702
16	0 2	0 009458
19 2	1 0	0 0970
16 4	2 0	0 3840

(Bodlander and Storbeck, Z anorg 1902, 31 17)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{KCl} + \text{Aq}$  at  $t^\circ$  Determined in an atmosphere of  $\text{CO}_2$   
All values recorded in millimols per litre

$t^\circ$	KCl	Cupric copper	Total copper	Cuprous copper calc	Cl
20°	0	2 222	2 851	0 629	5 436
19	1	1 901	2 385	0 484	5 287
19	2	1 571	2 150	0 589	5 614
19	2 5	1 421	1 955	0 534	6 015
19	3	1 523	1 983	0 460	6 247
16	5	1 008	1 522	0 514	7 525
18	10	0 475	1 236	0 761	11 735
20	15	0 322	1 344	1 022	16 437
19	20	0 324	1 446	1 122	21 356
19	30	0 1308	1 761	1 630	31 911
18	50	0 1038	2 411	2 302	
16	100	0	4 702	4 702	
16	200	0	9 485	9 485	
19	1000	0	97 0	97 0	
16	2000	0	384 0	384 0	

(Bodlander and Storbeck, Z anorg 1902, 31 24)

Solutions of 0.05 = 0.4 normal KCl dissolve  $\text{Cu}_2\text{Cl}_2$  with the formation of  $\text{KCuCl}_2$ , those of higher concentration with the formation of  $\text{K}_2\text{CuCl}_3$  (Bodlander and Storbeck, Z anorg 1902, 31 41)

Solubility of  $\text{Cu}_2\text{Cl}_2 + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $22^\circ$

G in 1 g of solution		Solid Phase
$\text{Cu}_2\text{Cl}_2$	KCl	
0 00115	0 0387	$\text{Cu}_2\text{Cl}_2$
0 00405	0 0656	"
0 00861	0 0824	"
0 0137	0 0984	"
0 0219	0 1133	"
0 0390	0 1406	"
0 0484	0 1530	"
0 0675	0 1639	"
0 0719	0 1747	"
0 0863	0 1839	"
0 1043	0 2027	"
0 1084	0 2018	"
0 1021	0 2031	"
0 1204	0 2095	"
0 1332	0 2164	"

Solubility of  $\text{Cu}_2\text{Cl}_2 + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $22^\circ$  — Continued

G in 1 g of solution		Solid Phase
$\text{Cu}_2\text{Cl}_2$	KCl	
0 1621	0 2330	$\text{Cu}_2\text{Cl}_2$
0 1723	0 2384	"
0 1907	0 2374	"
0 2148	0 2516	"
0 2145	0 2506	$\text{Cu}_2\text{Cl}_2 + \text{Cu}_2\text{Cl}_2, 4\text{KCl}$
0 2149	0 2549	$\text{Cu}_2\text{Cl}_2, 4\text{KCl}$
0 1548	0 2387	"
0 1473	0 2363	"
0 1399	0 2357	"
0 1439	0 2389	"
0 1451	0 2363	"
0 1155	0 2320	"
0 1139	0 2350	"
0 0953	0 2359	"
0 0735	0 2349	"
0 0555	0 2389	"
0 0453	0 2404	"
0 0366	0 2433	"
0 0314	0 2503	"
0 0285	0 2499	"
0 0265	0 2523	"
0 0220	0 2628	"
0 0193	0 2687	"
0 0176	0 2698	"
0 0193	0 2703	$\text{Cu}_2\text{Cl}_2, 4\text{KCl} + \text{KCl}$
0 0160	0 2706	$\text{KCl}$
0 0124	0 2668	"
0 0058	0 2632	"
0 0000	0 2568	"

(Bronsted, Z phys Ch 1912, 80 205)

Solubility in  $\text{NaCl} + \text{Aq}$

Sat  $\text{NaCl} + \text{Aq}$  dissolves 16.9%  $\text{Cu}_2\text{Cl}_2$  90°, 11.9% at 40°, and 8.9% at 11°  
15%  $\text{NaCl} + \text{Aq}$  dissolves 10.3%  $\text{Cu}_2\text{Cl}_2$  90°, 6.0% at 40°, and 3.6% at 14°  
5%  $\text{NaCl} + \text{Aq}$  dissolves 2.6%  $\text{Cu}_2\text{Cl}_2$  90°, and 1.1% at 40° (Hunt, Sill Am (2) 49 154)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $26.5^\circ$

In 100 g $\text{H}_2\text{O}$		Solid Phase
$\text{Cu}_2\text{Cl}_2$	$\text{NaCl}$	
1 55		$\text{Cu}_2\text{Cl}_2$
3 15	10 80	"
7 30	20 70	"
40 60	27 00	"
49 10	36 48	"
57 21	44 14	$\text{Cu}_2\text{Cl}_2 + \text{NaCl}$
41 40	55 95	$\text{NaCl}$
18 70	50 90	"

(Kremann and Noss, M 1912, 33 1210)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{CuSO}_4 + \text{Aq}$  at  $t^\circ$   
Values recorded in millimols per l

$t^\circ$	Conc of $\text{CuSO}_4$	Cupric copper	Total copper	Cuprous copper calc	Cl
19 7		2 258	2 880	0 622	5 312
16 3	0 49375	2 746	3 125	0 379	4 805
18 6	0 9875	3 145	3 602	0 457	4 908
17 5	1 4812	3 315	3 915	0 600	4 530
19 4	1 975	4 131	4 553	0 422	4 687
20 4	2 4687	4 349	4 786	0 437	4 287
20 5	2 9625	4 625	5 193	0 509	4 256
20 1	4 9375	6 546	7 276	0 730	4 329

(Bodlander and Storbeck, Z anorg 1902, 31 22)

Insol in  $\text{SbCl}_3$  (Klemensiewicz, Bull Acad Crac 1908, 6, 485)

Sl sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20, 827)

Insol in alcohol

Sl sol in ether (Gehlen)

Sol in quinoline (Beckmann and Gabel, Z anorg 1906, 51 236)

Sol in pyridine (Schroeder, Dissert 1901)

Insol in phosgene (Eidmann, Dissert 1899)

Insol in acetone (Naumann, B 1904, 37 4329)

Insol in acetone and in methylal (Eidmann, C C 1899, II 1014)

Difficultly sol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in ethyl acetate (Alexander, Dissert 1899) (Naumann, B 1904, 37 3601)

Difficultly sol in ethyl acetate (Naumann, B 1910, 43 314)

100 g acetonitrile dissolve 13 33 g  $\text{CuCl}_2$  at  $18^\circ$  (Naumann and Schier, B 1914, 47 249)

Sol in benzonitrile (Naumann, B 1914, 47 1369)

Sol in hot benzonitrile and other aromatic nitriles (Werner, Z anorg 1897, 15 7)

Mol weight determined in pyridine methyl and ethyl sulphides (Werner, Z anorg 1897, 15 19, 25 and 28)

Min Nantokite Sol in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq}$

### Cupric chloride, $\text{CuCl}_2$

Deliquescent 100 pts  $\text{H}_2\text{O}$  dissolve 70 6 pts  $\text{CuCl}_2$  at  $0^\circ$ , 100 pts  $\text{CuCl}_2 + \text{Aq}$  contain 41 4 pts  $\text{CuCl}_2$  (Engel, A ch (6) 17 350)

100 pts  $\text{H}_2\text{O}$  dissolve 76 2 pts  $\text{CuCl}$  at  $16 1^\circ$ , or 100 pts  $\text{CuCl}_2 + \text{Aq}$  sat at  $16 1^\circ$  contain 43 25 pts  $\text{CuCl}_2$  (Rudorff, B 6 484)

100 pts  $\text{CuCl}_2 + \text{Aq}$  sat at  $17^\circ$  contain 43 06 pts  $\text{CuCl}_2$  at  $31 5^\circ$ , contain 44 7 pts  $\text{CuCl}_2$  Coefficient of solubility =  $41 4 + 0 105t$  (Reicher and Deventer, Z phys Ch 5 560)

Sat  $\text{CuCl}_2 + \text{Aq}$  contains at

$-20^\circ$	$-5^\circ$	$+12^\circ$	$17^\circ$	$32^\circ$
37	38 8	39 3	41 7	43 2 $\frac{1}{2}$ $\text{CuCl}_2$
39	55	68	73	91
44 0	46 5	47 9	48 6	51 0 $\frac{1}{2}$ $\text{CuCl}_2$

(Etard, A ch 1894, (7) 2 536)

Sp gr of  $\text{CuCl}_2 + \text{Aq}$  at  $17 5^\circ$

% $\text{CuCl}_2$	Sp gr	% $\text{CuCl}_2$	Sp gr
5	1 0455	25	1 2918
10	1 0920	30	1 3618
15	1 1565	35	1 4447
20	1 2223	40	1 5284

(Franz, J pr (2) 5 274)

Sp gr of  $\text{CuCl}_2 + \text{Aq}$  at  $22 9^\circ$ , containing in 1000 g  $\text{H}_2\text{O}$ , g  $\text{CuCl}_2 + 2\text{H}_2\text{O}$

85 5 (=  $\frac{1}{2}$  mol) 171 255 5 g  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ , 1 057 1 108 1 154

342 427 5 513 g  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ , 1 197 1 238 1 275

598 5 684 g  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ , 1 309 1 341

769 5 855 g  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ , 1 371 1 399

940 5 1 026 g  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ , 1 425 1 449

Containing  $\text{CuCl}$  (anhydrous)

67 5 (=  $\frac{1}{2}$  mol) 135 202 5 270 g  $\text{CuCl}_2$ , 1 059 1 114 1 165 1 213

337 5 405 472 5 g  $\text{CuCl}$ , 1 257 1 299 1 330

540 607 5 675 g  $\text{CuCl}$ , 1 379 1 416 1 453

(Gerlach, Z anal 28 465)

Sp gr of  $\text{CuCl} - \text{Aq}$  at 0  $S = \text{pts CuCl}$  in 100 pts solution  $S = \text{mols CuCl}$  in 100 mols of solution

S	S	S
39 4170	8 00	1 4 $\frac{1}{2}$
35 3839	6 52	1 41 $\frac{1}{2}$
30 9255	5 65	1 352 $\frac{1}{2}$
26 1129	4 51	1 285 $\frac{1}{2}$
20 6697	3 56	1 2204
14 5820	2 25	1 144 $\frac{1}{2}$
8 0732	1 16	1 0 $\frac{1}{2}$

(Charpy, A ch (6) 29 2)

Tables for  $7^\circ$ ,  $30^\circ$ ,  $49 2^\circ$  and  $60^\circ$  are also given by Charpy

Sp gr of  $\text{CuCl} - \text{Aq}$  at room temp containing

12 006 21 349 35 027 $\frac{1}{2}$   $\text{CuCl}$ , 1 1037 1 2154 1 3512

(Wagner, W Ann 1885 18 273)

Sp gr at 20° of $\text{CuCl}_2 + \text{Aq}$ containing M mols $\text{CuCl}_2$ per liter			
M	0 01	0 05	0 075
Sp gr	1 001208	1 00637	1 009264
M	0 10	0 20	0 50
Sp gr	1 012614	1 030991	1 051479
M	0 75		1 0
Sp gr	1 090912		1 120249
M	1 5		2 0
Sp gr	1 177618		1 234551

(Jones and Pearce, Am Ch J 1907, 38 717 )

Sp gr of  $\text{CuCl}_2 + \text{Aq}$  at 25°

Concentration of $\text{CuCl}_2 + \text{Aq}$	Sp gr
1—normal	1 0624
$\frac{1}{2}$ —	1 0313
$\frac{1}{4}$ —	1 0158
$\frac{1}{8}$ —	1 0077

(Wagner, Z phys Ch 1890, 5 38)

Much less sol in  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$   
 1 l  $\text{HCl} + \text{Aq}$  containing 45 pts  $\text{HCl}$  to 100  
 pts  $\text{H}_2\text{O}$  dissolves only 290 g  $\text{CuCl}_2$  at 12°;  
 whereas 1 l  $\text{H}_2\text{O}$  at 12° dissolves 630 g  $\text{CuCl}_2$   
 (Ditt, C R 1881, 92 353)

Solubility in  $\text{HCl} + \text{Aq}$  at 0°  $\frac{\text{CuCl}_2}{2} =$   
 $\frac{1}{2}$  mols in milligrammes in 10 cem  
 solution  $\text{HCl} = \text{mols HCl}$  in ditto,  $\text{H}_2\text{O}$   
 $= \text{g H}_2\text{O}$

$\frac{\text{CuCl}_2}{2}$	HCl	Sum of equiv	Sp gr	H O
91 75	0	91 75	1 490	8 73
86 8	1 5	91 3	1 475	8 74
83 2	7 8	91	1 458	
79 35	10 5	89 8	1 455	8 64
68 4	20 25	88 6	1 359	8 36
50 0	37	87	1 319	8 47
22 8	70 25	93 0	1 231	8 21
23 5	102 5	126	1 288	7 56
26 7	128	154 7	1 323	6 77

(Engel A ch (6) 17 311)

Not decomp by cold  $\text{H}_2\text{SO}_4$

Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  Very sol in conc  
 $\text{NH}_4\text{Cl} + \text{Aq}$  (Boussingault)

Solubility of  $\text{CuCl}$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at 30°

$\text{NH}_4\text{Cl}$	$\text{CuCl}$	Solubility
29 5	0	$\text{NH}_4\text{Cl}$
28 6	1 9	$\text{NH}_4\text{Cl} + \text{CuCl} \cdot 2\text{NH}_4\text{Cl} \cdot \text{H}_2\text{O}$
12 1	15 6	$\text{CuCl} \cdot 2\text{NH}_4\text{Cl} \cdot \text{H}_2\text{O}$
2 03	15 2	$\text{CuCl} \cdot 2\text{NH}_4\text{Cl} \cdot \text{H}_2\text{O} + \text{CuCl} \cdot 2\text{H}_2\text{O}$
0	13 95	$\text{CuCl} \cdot 2\text{H}_2\text{O}$

(Schreinemakers, Z phys Ch 1909, 66 688)

See also  $\text{NH}_4\text{Cl} + \text{CuCl}_2$  under ammonium chloride

Solubility of $\text{CuCl}_2 + \text{HgCl}_2$ in $\text{H}_2\text{O}$ at 35°		
% $\text{HgCl}_2$	% $\text{CuCl}_2$	Solid Phase
0	44 47	$\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
21 03	33 50	"
37 30	26 07	"
44 47	23 31	"
50 47	21 50	$\text{CuCl}_2 + \text{HgCl}_2$
52 44	19 40	$\text{HgCl}_2$
52 54	18 46	"
52 81	18 06	"
51 03	14 73	"
49 50	5 94	"
23 87	2 64	"
8 51	8 51	"

(Schreinemakers and Thonus, Proc K Akad Wet 1912, 15 472)

Solubility of  $\text{CuCl}_2 + \text{KCl}$  in  $\text{H}_2\text{O}$  at t°

t°	Cl per g of solution		Mols per 100 mols $\text{H}_2\text{O}$		
	As $\text{CuCl}_2$	As $\text{KCl}$	$\text{CuCl}_2$	$\text{KCl}$	
39 4	0 120	0 107	5 56	9 93	$\text{CuCl} \cdot 2\text{KCl} \cdot 2\text{H}_2\text{O} + \text{KCl}$
40 0	0 120	0 115	6 39	11 4	
41 0		2	7 1	13 6	
42 0			1	18 8	
90 5	0 158	0 154	14 9	21 4	$\text{CuCl} \cdot \text{KCl} + \text{KCl}$
93 7	0 191	0 136	16 2	26 0	
98 5		17	28 7		$\text{CuCl} \cdot 2\text{KCl} \cdot 2\text{H}_2\text{O} + \text{CuCl} \cdot 3\text{H}_2\text{O}$
0	-	9 84	1 94		
39 6	0 232	0 049	12 9	5 44	
40 1	0 233	0 059	13 7	6 90	
42 9	0 241	0 062	14 8	7 63	
40 2	0 216	0 066	13 8	8 19	$\text{CuCl} \cdot \text{KCl} + \text{CuCl} \cdot 2\text{H}_2\text{O}$
42 6	0 233	0 063	16 8	8 33	
61 2			11 9	11 6	$\text{CuCl} \cdot 2\text{KCl} \cdot 2\text{H}_2\text{O} + \text{CuCl} \cdot \text{KCl}$
72			11 8	1 30	$\text{CuCl} \cdot \text{KCl}$

(Meyrhofer Z phys Ch 1890, 5 102)

100 g  $\text{H}_2\text{O}$  dissolve 72 6 g  $\text{CuCl} + 16 0 \text{ g}$   
 $\text{NaCl}$  (Rudorff, B 6 684)

Solubility of  $\text{CuCl} + \text{NaCl}$  in  $\text{H}_2\text{O}$  at 30

$\text{NaCl}$	$\text{CuCl}$	Solubility
0		13 95
3 10		11 14
1 28		11 06
6 11		9 10
10 25		36 86
12 02		32 38
12 25		32 40
13 54		28 64
15 40		23 72
18 41		16 98
20 61		11 03
26 47		0

(Schreinemakers and de Baat, Z phys Ch 1909, 65 586)

Solubility of  $\text{CuCl}_2$  in  $\text{CuSO}_4 + \text{Aq}$  at  $30^\circ$ 

Composition of the solution		Solid phase
% by wt $\text{CuCl}_2$	% by wt $\text{CuSO}_4$	
0	20 32	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
6 58	13 62	"
15 68	8 93	"
25 67	4 77	"
39 48	3 21	"
42 77	2 89	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} + \text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
42 47	2 90	"
43 25	1 14	$\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
43 95	0	"

(Schreinemakers, Z phys Ch 1909, 69 561)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 827)

Sl sol in liquid HF (Franklin, Z anorg 1905, 46 2)

Sol in alcohol and ether

Sol in 1 pt strong alcohol

100 pts absolute methyl alcohol dissolve 68 pts  $\text{CuCl}_2$  at  $15.5^\circ$ , 100 pts absolute ethyl alcohol dissolve 53 pts  $\text{CuCl}_2$  at  $15.5^\circ$  (de Bruyn, Z phys Ch 10 783)See also under  $\text{CuCl} + 2\text{H}_2\text{O}$ Solubility of  $\text{CuCl} + \text{KCl}$  in absolute alcohol at  $25^\circ$ 

% $\text{CuCl}_2$	% $\text{KCl}$	Solid Phase
1 27	0 28	$\text{KCl} + \text{KCl}, \text{CuCl}_2$
1 51	0 28	
2 15		$\text{KCl}, \text{CuCl}_2$
5 25		
30 16		$\text{KCl}, \text{CuCl} + \text{CuCl}, \text{C}_2\text{H}_5\text{OH}$
34 17	0 21	
34 45	0 21	$\text{CuCl}, \text{C}_2\text{H}_5\text{OH}$
34 29	0 21	
33 97	0 00	

(Foote and Walden, J Am Chem Soc 1911, 33 1032)

Solubility of  $\text{CuCl} + \text{KCl}$  in acetone at  $25^\circ$ 

% $\text{CuCl}_2$	% $\text{KCl}$	Solid Phase
0 34	0 38	$\text{KCl} + \text{KCl}, \text{CuCl}_2$
0 48		
1 50		$\text{KCl}, \text{CuCl}_2$
2 06		
2 49	0 27	$\text{KCl}, \text{CuCl} + \text{CuCl}, \text{C}_2\text{H}_5\text{OH}$
2 32		

(Foote and Walden, J Am Chem Soc 1911, 33 1032)

100 g of sat solution of  $\text{CuCl}_2$  in ethyl alcohol contains 33.97 g  $\text{CrCl}_2$  (Foote and Walden, J Am Chem Soc 1911, 33 1032)Easily sol in acetone (Krug and M Elroy, J Anal Ch 6 184)  
Insol in benzene

## Solubility in organic solvents

Solvent	t	Sat solution contains % $\text{CuCl}$
Methyl alcohol	22	36.8
	40	37.5
	50	37.1
	60	37.5
Abs ethyl alcohol	0	32.0
	19	35.7
	20	35.9
	38	38.5
	50	41.7
Propyl alcohol	-15	26.8
	19	30.9
	37	30.7
	57	30.3
	62	30.5
Allyl alcohol	-20	23.4
	-4	23.6
	27	22.9
	32	23.3
N-butyl alcohol	0	15.2
	23	15.8
	37	15.7
	55	16.1
	84	16.2
	92	16.7
Ethyl formate	-20	10.2
	+24	9.4
	37	7.4
	50	7.2
Ethyl acetate	+20	3.0
	40	2.5
	72	1.3
Acetone	-20	18.4
	-8	18.8
Isopropyl alcohol	52	11.0
	70	28.3
	84	28.7

(Etard, A ch 1894 (7) 2 560)

See also under  $\text{CuCl} + 2\text{H}_2\text{O}$ 1 g  $\text{CuCl}$  is sol in 1.1 g methyl acetate at  $18^\circ$ . Sp gr  $18.4^\circ$  of the sat solution = 0.939 (Naumann, B 1909, 42 3793)1 g  $\text{CuCl}$  is sol in 2.49 g ethyl acetate at  $18^\circ$ . Sp gr of sat solution  $18.4^\circ = 0.9055$  (Naumann, B 1904, 37 3603)

Difficultly sol in ethyl acetate (Naumann, B 1910, 43 314)



1 pt sol in 249.3 pts ethyl acetate at 10° (Alexander, Dissert 1899)

Solubility in acetone

34.7 g acetone dissolve 1 g  $\text{CuCl}_2$  at 18°  
Sp gr of sat solution 18°/4° = 0.8154 (Naumann, B 1904, 37 4329)

140 pts are sol in 100 pts acetone at 56° (Laszczyński, B 1894, 27 2287)

Sol in acetone and methylal 1 gram dissolves in 34.08 grams of acetone at 18° (Eidmann, C C 1899, II, 1014)

100 pts absolute ether dissolve 0.043 g  $\text{CuCl}_2$  (Bodtker, Z phys Ch 1897, 22 511)

Mol weight determined in pyridine and methyl sulphide (Werner, Z anorg 1897, 15 20 and 25)

100 g sat solution in acetonitrile contains 1.57 g  $\text{CuCl}_2$  (Naumann and Schier, B 1914, 47 249)

Sl sol in benzonitrile (Naumann, B 1914, 47 1369)

Sol in boiling dipropylamine (Werner, Z anorg 1897, 15 34)

Sol in urethane (Lcy, Z phys Ch 1897, 22 81), (Castoro Z anorg 1899, 20, 61)

+ $\text{H}_2\text{O}$  (Ditte, A ch (5) 22 551)

Sol in  $\text{H}_2\text{O}$  with slight decomp (Sabatier, Bull Soc 1895, (3) 13 601)

+ $2\text{H}_2\text{O}$  Deliquescent 100 g  $\text{H}_2\text{O}$  dissolve 121.4 g  $\text{CuCl} + 2\text{H}_2\text{O}$  at 16.1° (Rudorff)

Aq sol at 35° contains 9.659 Mol %  $\text{CuCl}$   
" 15° " 9.934 " "

(Schlenker, C C 1911, II 349)

$\text{CuCl} + 2\text{H}_2\text{O} + \text{Aq}$  sat at 30° contains 43.95%  $\text{CuCl}$  (Moorburg, C C 1904, II 1362)

43.95 g anhydrous  $\text{CuCl}$  are dissolved in 100 g  $\text{CuCl} + \text{Aq}$  at 30° (Schlenker, Arch neer Sc 1910 [2] 15 117)

44.47% by weight anhydrous  $\text{CuCl}$  is dissolved in  $\text{H}_2\text{O}$  at 35° (Schlenker and Thoms Verh k Akad Wet Amst 1912, 21 333)

Solubility of  $\text{CuCl} + 2\text{H}_2\text{O}$  in ethyl alcohol + Aq at 11°

Percent ethyl alcohol by volume	Gram $\text{CuCl} + 2\text{H}_2\text{O}$ in
99 %	1.175
98 %	1.116
96 %	1.097
95 %	1.070
94 %	1.059

Anhydrous salt dissolves readily in absolute ethyl alcohol,  $\text{CuCl} + 2\text{H}_2\text{O}$  is precipitated by  $\text{H}_2\text{O}$

Solubility of  $\text{CuCl}_2 + 2\text{H}_2\text{O}$  in ethyl alcohol + Aq at 11.5° C under addition of increasing amounts of  $\text{CuCl}_2$

P = Percent of ethyl alcohol by volume

G = Grams of  $\text{CuCl}_2$  added

Cc = Grams of  $\text{CuCl}_2$  in 5 cc of the solution

Cw = Grams of water in 5 cc of the solution, calculated from

- (1) the water content of the alcohol
- (2) the water of crystallization which had gone into solution
- (3) the water held mechanically in  $\text{CuCl}_2 + 2\text{H}_2\text{O}$

P	G	Cw	Cc
89.3	0.000	0.794	1.137
90.3	"	0.744	1.122
91.3	"	0.695	1.104
92.3	"	0.648	1.090
94.3	"	0.561	1.096
95.3	"	0.517	1.095
96.3	"	0.478	1.116
97.3	"	0.440	1.140
98.3	"	0.396	1.194
99.3	"	0.369	1.208
"	0.223	0.330	1.295
"	0.444	0.290	1.395
"	0.665	0.270	1.506
"	0.887	0.247	1.639
"	1.106	0.223	1.772
"	1.324	0.205	1.921
"	1.540	0.191	2.086
"	1.739	0.179	2.236
"	1.957	0.164	2.400

(Bodtker, Z phys Ch 1897, 22 506-507)

100 pts absolute ether dissolve 0.061 g  $\text{CuCl} + 2\text{H}_2\text{O}$  (Bodtker, Z phys Ch 1897 22 511)

0.11 pts are sol in 100 pts ether at 16°

0.11 " " " 100 " " 35°

8.86 " " " 100 " acetone " 0°

8.92 " " " 100 " " " 13.5°

(Laszczyński, B 1894 27 2286 and 2287)

Solubility in organic solvents at 10°

Solvent	t	Parts solvent require to dissolve 1 pt $\text{CuCl} + 2\text{H}_2\text{O}$ at t
Pure methyl alcohol	20°	7.3
	18.9	7.6
Ethyl alcohol (95%)	20.3	11.6
	19.6	11.9
Pure acetone	22.1	43.6
	20.0	44.2
90 pts ethyl alcohol (98%) + 10 pts $\text{H}_2\text{O}$	21.8	9.0
	23.0	8.5

## Solubility in organic solvents at t°—Cont

Solvent	t°	Pts or solvent required to dissolve 1 pt CuCl <sub>2</sub> + 2H <sub>2</sub> O at t°
80 pts abs alcohol+20 pts H <sub>2</sub> O	28 1	6 0
	20 7	6 2
80 pts acetone+20 pts H <sub>2</sub> O	23 1	5 3
	21 8	5 6
80 pts acetone+20 pts methyl alcohol	23 1	12 0
	24 0	11 6
10 pts methyl alcohol+90 pts ethyl alcohol (98°)	24 2	5 4
	25 0	5 1
20 pts methyl alcohol+80 pts ord ether	24 1	15 1
	22 4	15 7
80 pts abs alcohol+20 pts ord ether	24 1	8 8
	25 0	8 5
Comm methyl alcohol	23 9	5 4
	23 0	5 6
85 pts pyridine+15 pts H <sub>2</sub> O	24 4	63 4
	23 6	63 7
60 pts pyridine+40 pts H <sub>2</sub> O	27 3	26 7
	28 0	26 2
75 pts α picoline+25 pts H <sub>2</sub> O	26 1	51 6
	25 1	52 3
70 pts α picoline+30 pts H <sub>2</sub> O	26 1	47 3

(de Coninck, C R 1900, 131 59)

## Solubility in organic solvents

Sol in propyl alcohol, hot glycol, hot glycerine, hot paraldehyde, hot crys acetic acid, pure acetone, 30% methylamine+aq, pure pyridine, pure α-picoline, acetonitrile, sl sol in isobutyl and amyl alcohols, crystallizable formic acid, ethyl acetate, insol in cold glycol, cold glycerine, cold paraldehyde, benzaldehyde, cold crystallizable acetic acid, ord ether, abs ether, hot and cold CS<sub>2</sub>, cold aniline, cold orthotoluidine, methylene chloride, ethyl iodide, propyl iodide, ethylene bromide, benzene, toluene, xylene, ligroin, nitrobenzene, cold piperidine and essence of terebenthine (de Coninck, C R 1900, 131 59)

+5H<sub>2</sub>O

Aq sol at 35° contains 2.921 Mol % CuCl<sub>2</sub>  
15° " 1 11

(Schreinemakers, C C 1911, II 349)

## Cuprous hydrogen chloride, CuCl, HCl

Sol in H<sub>2</sub>O (Neumann, M 1894, 15 493)Cupric hydrogen chloride, CuCl<sub>2</sub>, HCl+3H<sub>2</sub>O

Decomp by H<sub>2</sub>O Sol in HCl+aq below 0° (Engel, C R 106 273)

CuCl, 2HCl Deliquescent Very sol in H<sub>2</sub>O (Alexander, Dissert 1899)

+5H<sub>2</sub>O Properties as above (Sabbatier, C R 106 1724)

CuCl<sub>2</sub>, 3HCl Sol in H<sub>2</sub>O (Neumann M 1894, 15 493)

Cupric gold (auric) chloride, CuCl<sub>2</sub>, 2AuCl<sub>3</sub>+6H<sub>2</sub>O

10% is sol in H<sub>2</sub>O at 18° Valhuysen Z anorg 1911, 70 210

Cupric lithium chloride, CuCl<sub>2</sub>, LiCl+2½H<sub>2</sub>O

Decomp on air Decomp by dissolving in H<sub>2</sub>O Sol in conc LiCl+aq without decomp

Decomp by alcohol (Chassevant, A ch (6) 30 33)

+2H<sub>2</sub>O (Meyerhoffer, W A B 100, 2b 621)

Cupric mercuric chloride

Easily sol in H<sub>2</sub>O (v Bonsdorff)

Cupric mercuric potassium chloride, CuCl<sub>2</sub>, 3HgCl, 6KCl+2H<sub>2</sub>O

Deliquescent in moist air Sol in boiling H<sub>2</sub>O without decomp, and recrystallises if cooled slowly Insol in absolute alcohol (v Bonsdorff, Pogg 33 81)

Cuprous nitrosyl chloride, Cu<sub>2</sub>Cl, 2NOCl

Very deliquescent and sol in H<sub>2</sub>O with immediate decomp (Sudborough, Chem Soc 59 638)

Cuprous potassium chloride, CuCl, 4KCl

Sol in H<sub>2</sub>O (Vitscherlich, A ch 73 384)  
For solubility data, see CuCl—KCl under cuprous chloride

Cupric potassium chloride

CuCl, KCl (Meyerhoffer, Z phys Ch 3 336)

Sol in H<sub>2</sub>O, only sl sol in conc HCl—aq (Groger, Z anorg 1899 19 330)

CuCl, 2KCl—2H<sub>2</sub>O Sol in H<sub>2</sub>O and alcohol (Berzelius Pogg 13 478)

The composition of the hydrates formed by this salt at different dilutions is calculated from determinations of the lowering of the fr pt produced by the salt and on the conductivity and sp gr of its aqueous solutions (Jones, Am Ch J 1905 34 322)

For solubility data see CuCl—KCl under cupric chloride

Cupric rubidium chloride, CuCl, 2RbCl

Easily sol in H<sub>2</sub>O and HCl—aq (Godefroy, B 8 9)

+2H<sub>2</sub>O Sol in H<sub>2</sub>O Wvrouboff, J B 1887 538)

Cuprous sodium chloride

Very sol in H<sub>2</sub>O

**Cupric sodium chloride**

Easily sol in conc NaCl+Aq Sol in alcohol of 0.837 sp gr

No double salt exists (Scheinemakers and de Paat, Z phys Ch 1909, 65 586)

**Cupric thallic chloride,  $\text{CuCl}_2 \cdot 2\text{TlCl}_3$** 

Sol in  $\text{H}_2\text{O}$  (Willm, A ch (4) 5 55)  
+6 $\text{H}_2\text{O}$  Can be cryst from  $\text{H}_2\text{O}$   
(Gewecke, A 1909, 366 225)

**Cuprous chloride ammonia,  $\text{Cu}_2\text{Cl}_2 \cdot \text{NH}_3$** 

(Lloyd, J phys Chem 1908, 12 399)  
 $\text{Cu}_2\text{Cl}_2 \cdot 2\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$  or acids,  
not by alcohol (Ritthausen, J pr 59 369)  
 $\text{Cu}_2\text{Cl}_2 \cdot 3\text{NH}_3$  (Lloyd, J phys Chem  
1908, 12 399)  
 $\text{Cu}_2\text{Cl}_2 \cdot 6\text{NH}_3$  (Lloyd, J phys Chem 1908  
12 399)

**Cupric chloride ammonia,  $\text{CuCl}_2 \cdot 2\text{NH}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Kane, A ch 72 273)  
 $\text{CuCl}_2 \cdot 4\text{NH}_3$  Sol in  $\text{H}_2\text{O}$  (Bouzat, C R  
1902, 135 294)

+ $\text{H}_2\text{O}$  (*Cuprammonium chloride*) Sol  
in  $\text{H}_2\text{O}$  and hot  $\text{NH}_4\text{OH}$ +Aq  
+2 $\text{H}_2\text{O}$  Sol in small amt of  $\text{H}_2\text{O}$   
 $\text{Cu}(\text{OH})_2$  is pptd by dilution (Bouzat,  
A ch 1903, (7) 29 350)  
 $\text{CuCl}_2 \cdot 5\text{NH}_3$  (Bouzat, A ch 1903, (7) 29  
350)

+11 $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  On dilution  
 $\text{Cu}(\text{OH})_2$  is pptd Sol in  $\text{NH}_4\text{OH}$ +Aq,  
solubility decreases as  $\text{NH}_3$  concentration  
increases (Bouzat, A ch 1903, (7) 29 350)  
 $\text{CuCl}_2 \cdot 6\text{NH}_3$  (completely sol in  $\text{H}_2\text{O}$   
(Rose, Pogg 20 55)

Sol in  $\text{H}_2\text{O}$  but decomp by great dilution  
with pptn of  $\text{Cu}(\text{OH})_2$

Sol in liquid  $\text{NH}_3$  (Bouzat, A ch  
1903 (7) 29 350)

**Cuprocupric chloride ammonia,  $\text{CuCl} \cdot \text{CuCl} \cdot \text{NH}_3 + \text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  or alcohol Abundantly  
sol in  $\text{NH}_4\text{Cl}$ +Aq but with partial decom-  
position (Ritthausen)

**Cupric chloride ammonia platinous chloride,**

$\text{CuCl} \cdot 4\text{NH}_3 \cdot \text{PtCl}_2$   
See Platodiamine cupric chloride

**Cuprous chloride carbon monoxide,**

$\text{CuCl} \cdot 2\text{CO} + \text{H}_2\text{O}$   
Very sol in  $\text{HCl}$  (sp gr 1.19) with evolu-  
tion of  $\text{CO}$  Sol in  $\text{NH}_4\text{OH}$ +Aq (Min-  
chot and Friend, A 1908, 359 110)  
 $2\text{CuCl} \cdot \text{CO} + 2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Ber-  
thelot, A ch 1896, (3) 46 488)  
 $4\text{CuCl} \cdot 3\text{CO} + 7\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ ,  
but decomp therewith very quickly Sol  
in  $\text{CuCl}$ + $\text{HCl}$

**Cupric chloride hydrazine,  $\text{CuCl}_2 \cdot 2\text{N}_2\text{H}_4$** 

Easily decomp (Hofmann and Marburg,  
A 1899, 305 222)

**Cuprous chloride mercuric sulphide,  $\text{Cu}_2\text{Cl}_2 \cdot 2\text{HgS}$** 

Insol in  $\text{H}_2\text{O}$ , sol in conc hot  $\text{HCl}$ +Aq,  
not decomp by boiling dil  $\text{H}_2\text{SO}_4$ +Aq, but  
decomp by conc  $\text{H}_2\text{SO}_4$  (Heumann, B 7  
1390)

**Cuprous fluoride,  $\text{Cu}_2\text{F}_2$** 

Insol in  $\text{H}_2\text{O}$  or  $\text{HF}$  Sol in conc  $\text{HCl}$ +  
Aq, from which it is precipitated by  $\text{H}_2\text{O}$   
Insol in alcohol (Berzelius, Pogg 1 28)  
Decomp by  $\text{H}_2\text{O}$  into sol  $\text{CuF}_2$  Sol in  
boiling  $\text{HCl}$ +Aq and in  $\text{HNO}_3$ +Aq Only  
sl attacked by warm  $\text{H}_2\text{SO}_4$  (Poulenc, C R  
116 1447)

**Cupric fluoride,  $\text{CuF}_2$** 

Easily takes up  $\text{H}_2\text{O}$  to form  $\text{CuF}_2 \cdot 2\text{H}_2\text{O}$   
Sol in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{HF}$ +Aq (Poulenc, C  
R 116 1448)

**Solubility at 25° in  $\text{HF}$ +Aq**

Normality of $\text{HF}$ +Aq	g atoms Cu in 1000 c c of solution
0.12	0.0307
0.28	0.1164
0.57	0.2494
1.05	0.388
2.25	0.463

Solubility is decreased by presence of  $\text{Kf}$   
(Jugot, Z anorg 1901, 27 29)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J  
1895, 20 527)

Insol in methyl acetate (Naumann, B  
1909 42 3790) ethyl acetate (Naumann  
B 1910 43 311)

Insol in acetone (Fidmann, C C 1899  
II 1014, Naumann B 1904, 37 4329)  
+2 $\text{H}_2\text{O}$  Sl sol in cold, decomp by ho  
 $\text{H}_2\text{O}$  (Berzelius)

**Cupric hydrogen fluoride,  $\text{CuF}_2 \cdot 5\text{H}_2\text{O} + 2\text{H}_2\text{O}$** 

Deliquescent  
Easily sol in  $\text{H}_2\text{O}$  and dil acids  
Sol in  $\text{NH}_4\text{OH}$ +Aq with decomp (Bohm  
Z anorg 1901, 43, 329)

**Cupric potassium fluoride,  $\text{CuF}_2 \cdot 2\text{Kf}$** 

Easily sol in  $\text{H}_2\text{O}$   
 $\text{CuF}_2 \cdot \text{Kf}$  Very sl sol in  $\text{H}_2\text{O}$  sl sol in  
dil acids (Helmholt, Z anorg 3 115)

**Cupric rubidium fluoride,  $\text{CuF}_2 \cdot \text{Rbf}$** 

As the K salt (Helmholt)

**Cupric silicon fluoride**

See Fluosilicate, cupric

**Copper stannic fluoride**  
See Fluostannate, copper

**Copper tantalum fluoride**  
See Fluotantalate, copper

**Copper titanium fluoride**  
See Fluotitanate, copper

**Copper tungstyl fluoride**  
See Fluoxytungstate, copper

**Copper zirconium fluoride**  
See Fluozirconate, copper

**Cupric fluoride ammonia,  $\text{CuF}_2 \cdot 4\text{NH}_3 + 5\text{H}_2\text{O}$**

Decomp rapidly in the air  
Easily sol in  $\text{H}_2\text{O}$   
Decomp by boiling with  $\text{H}_2\text{O}$  with evolution of  $\text{NH}_3$   
Easily sol in dil acids (Bohm, Z anorg 1905, 43 333)

**Cuprous hydride,  $\text{CuH}$**

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  (Wurtz, C R 18 102)  
Sol in warm conc  $\text{HCl}$  with decomp (Bartlett, Am Ch J 1895, 17 187)

**Cupric hydride,  $\text{CuH}_2$**

Sol in  $\text{HCl}$  with decomp (Bartlett, Am Ch J 1895, 17 187)

**Copper hydrosulphide,  $7\text{CuS} \cdot \text{H}_2\text{S}$**

(Linder and Picton, Chem Soc 1892, 61 120)

$9\text{CuS} \cdot \text{H}_2\text{S}$  (Linder and Picton)  
 $22\text{CuS} \cdot \text{H}_2\text{S}$  (Linder and Picton)

**Cuprous hydroxide,  $\text{Cu}_2\text{O} \cdot x\text{H}_2\text{O}$**

Sol in acids as cupric salt Insol in  $\text{NaOH}$ , or  $\text{KOH} + \text{Aq}$   
Sol in  $\text{NH}_4\text{OH}$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , sol in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$

**Cuprocupric hydroxide,  $\text{CuOH} \cdot 3\text{Cu}(\text{OH}) + 3\text{H}_2\text{O}$**

Sol in acids (Francke, Dissert 1907)

**Cupric hydroxide,  $3\text{CuO} \cdot \text{H}_2\text{O}$**

Insol in  $\text{H}_2\text{O}$  or dil alkalies Easily sol in warm  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rose)  
Much more difficultly sol than  $\text{Cu}_2\text{O} \cdot \text{H}_2\text{O}$  in  $\text{KOH} + \text{Aq}$  (Chodnew, J pr 28 220)  
True composition is  $6\text{CuO} \cdot \text{H}_2\text{O}$   
See also Cupric oxide  
 $\text{CuO}_2 \cdot \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , but decomp into  $6\text{CuO} \cdot \text{H}_2\text{O}$  by being boiled therewith  
Extremely easily sol in acids  
Sol in  $\text{NH}_4\text{OH}$ , and  $\text{NH}_4$  salts +  $\text{Aq}$

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$

$\text{NH}_3$ norm	g Cu per l	equiv Cu per H per l
2 63	3 05	0 096
2 00	2 12	0 067
1 32	1 08	0 034
2 540	6 26	0 197
1 965	6 28	0 166
1 280	4 13	0 129
0 973	3 36	0 106
0 870	3 08	0 097
0 540	2 36	0 074
0 391	2 04	0 064
3 176	8 06	0 253
2 070	5 72	0 180
1 272	4 75	0 149
0 451	2 54	0 080
0 320	2 13	0 067

The non-agreement of the results is due to the presence of different modifications of  $\text{CuO}_2 \cdot \text{H}_2$

(Bonsdorff, Z anorg 1904 41 182)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $18^\circ$

$\text{NH}_3$ mols per l	Cu g atom per l
0 20	0 00054
0 50	0 0055
1 0	0 0109
1 5	0 0204
2 0	0 0514
2 5	0 0442
3 0	0 0548
4 0	0 0754
5 0	0 1041
6 0	0 1254
8 0	0 1799
9 96	0 1757

(Dawson, Z phys Ch 1909 69 111)

Sol in cold  $\text{NaOH}$  or  $\text{KOH} + \text{Aq}$  Prod but  $\text{CuO}$  is pptd on boiling Ber 18 not pptd (Chodnew J pr 28 220)

Insol in  $\text{NaOH}$  or  $\text{KOH} + \text{Aq}$  unless contain organic matter Berz 1 contradicted by Volckr A 59 54  
Entirely sol in conc  $\text{KOH} + \text{Aq}$  but solution is decomp by heating Franck, A 10 (3) 12 510

Sol in  $\text{NaOH} + \text{Aq}$  70%  $\text{NaOH}$  Los Z anal 9 463

The solubility in  $\text{NaOH}$  or  $\text{CO}_2\text{H}$ , prepared either from  $\text{CuSO}_4$  or  $\text{Cu}(\text{NO}_3)_2$ , increases with decrease in concentration of base The solubility of  $\text{CuO} \cdot \text{H}_2\text{O}$  in  $\text{NaOH}$  is only very slightly affected by the addition of sodium or potassium carbonate Franck Z anorg 1904, 40 41

Solubility of crystalline  $\text{CuO}_2\text{H}_2$  in ammoniacal  $\text{Ba}(\text{OH})_2$  and  $\text{NaOH}$  solutions at  $18^\circ$

Solvent contains per litre	Cu concentration g atoms per l
1 mol $\text{NH}_3$ +0 mol $\text{Ba}(\text{OH})_2$	0 01090
" +0 0025 "	0 00907
" +0 005 "	0 00801
" +0 01 "	0 00633
" +0 02 "	0 00526
2 mols $\text{NH}_3$ +0 mol $\text{Ba}(\text{OH})_2$	0 0314
" +0 01 "	0 0277
4 mols $\text{NH}_3$ +0 mol $\text{Ba}(\text{OH})_2$	0 0784
" +0 01 "	0 0747
1 mol $\text{NH}_3$ +0 mol $\text{NaOH}$	0 0109
" +0 01 "	0 00766
" +0 02 "	0 00655
" +0 03 "	0 00531
" +0 05 "	0 00456
" +0 10 "	0 00410

(Dawson, Chem Soc 1909, 95 377)

Solubility of crystalline  $\text{CuO}_2\text{H}_2$  in ammoniacal salt solutions at  $18^\circ$

Solvent contains per litre	Conc of dissolved Cu g atoms per l
1 mol $\text{NH}_3$	0 0109
0 05 mol $\text{NH}_3$ +0 01 mol $(\text{NH}_4)_2\text{SO}_4$	0 00129
" +0 025 "	0 00511
0 1 mol $\text{NH}_3$ +0 01 mol $(\text{NH}_4)_2\text{SO}_4$	0 00326
" +0 025 "	0 0108
" +0 05 "	0 0233
0 2 mol $\text{NH}_3$ +0 00 mol $(\text{NH}_4)_2\text{SO}_4$	0 00054
" +0 01 "	0 00649
" +0 025 "	0 0175
" +0 05 "	0 0384
" +0 10 "	0 0690
0 5 mol $\text{NH}_3$ +0 00 mol $(\text{NH}_4)_2\text{SO}_4$	0 0033
" +0 01 "	0 0127
" +0 025 "	0 0284
" +0 05 "	0 0536
" +0 10 "	0 1013
" +0 20 "	0 1844
1 0 mol $\text{NH}_3$ +0 00 mol $(\text{NH}_4)_2\text{SO}_4$	0 0109
" +0 01 "	0 0210
" +0 025 "	0 0386
" +0 05 "	0 0660
" +0 10 "	0 1185
" +0 20 "	0 2275
" +0 40 "	0 4135
2 mol $\text{NH}_3$ +0 00 mol $(\text{NH}_4)_2\text{SO}_4$	0 0314
" +0 01 "	0 0462
" +0 025 "	0 0605
" +0 05 "	0 0886
" +0 10 "	0 1468
" +0 20 "	0 2591
" +0 40 "	0 4718
3 mol $\text{NH}_3$ +0 00 mol $(\text{NH}_4)_2\text{SO}_4$	0 0548
" +0 01 "	0 0672
" +0 025 "	0 0847
" +0 05 "	0 1156

Solubility of crystalline  $\text{CuO}_2\text{H}_2$  in ammoniacal salt solutions at  $18^\circ$ —*Continued*

Solvent contains per litre	Conc of dissolved Cu g atoms per l
3 mol $\text{NH}_3$ +0 10 mol $(\text{NH}_4)_2\text{SO}_4$	0 1740
" +0 20 "	0 2861
" +0 40 "	0 5044
4 mol $\text{NH}_3$ +0 00 mol $(\text{NH}_4)_2\text{SO}_4$	0 0784
" +0 01 "	0 0922
" +0 025 "	0 1101
" +0 05 "	0 1397
" +0 10 "	0 2002
" +0 20 "	0 3188
" +0 40 "	0 5451
5 mol $\text{NH}_3$ +0 00 mol $(\text{NH}_4)_2\text{SO}_4$	0 1041
" +0 01 "	0 1154
" +0 025 "	0 1320
" +0 05 "	0 1639
" +0 10 "	0 2239
" +0 20 "	0 3415
" +0 40 "	0 5615
1 mol $\text{NH}_3$ +0 00 mol $\text{Na}_2\text{SO}_4$	0 0109
" +0 025 "	0 0134
" +0 10 "	0 0162
" +0 20 "	0 0192
" +0 40 "	0 0784
4 mol $\text{NH}_3$ +0 10 mol $\text{Na}_2\text{SO}_4$	0 0994
" +0 20 "	0 1161

(Dawson, Chem Soc 1909, 95 373)

Sl sol in alkali carbonates + Aq, especially  $\text{KHCO}_3$  and  $\text{NaHCO}_3$  (Berzelius)

Sol in cold  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq, but pptd on warming (Field, Chem Soc (2) 1 28)

Partially sol when freshly pptd in  $\text{KC}_2\text{O}_8$  + Aq (Rodgers, 1834)

Sol in  $(\text{NH}_4)_2\text{S}_2\text{O}_8$  + Aq (Moreau, Apot Ztg 1901, 16 383)

Sol in  $\text{MSCN}$  + Aq, more difficultly sol in  $\text{NH}_4\text{SCN}$  + Aq than  $\text{ZnO}_2\text{H}_2$  (Gronmann, Z anorg 1908, 58 269)

Very sol in hydroxylamine (Jannasch and Cohen, J pr 1905, (2), 72 14)

Insol in acetone (Fudmann, C C 1896, II 1014)

Sol in large amt in  $\text{NaC}_2\text{H}_3\text{O}_2$  + Aq (Mecer, 1844)

Not pptd in presence of  $\text{Na}_2\text{C}_2\text{O}_4$  (Sillman, 1844)

Insol in cane sugar + Aq, unless an alkali or alkaline earth is present (Peschier)

Recently pptd  $\text{CuO}_2\text{H}_2$  is easily sol in cane sugar with  $\text{NaOH}$ ,  $\text{KOH}$ , or  $\text{Ca}(\text{OH})_2$  + Aq, less sol in presence of  $\text{SrO}_2\text{H}_2$  or  $\text{BaO}_2$  (Becquerel)

Not pptd by  $\text{KOH}$  + Aq in solutions containing tartaric acid, cane sugar, and many other non-volatile organic substances

Sol in  $\text{Ca}$ ,  $\text{Ba}$ ,  $\text{Sr}$ ,  $\text{K}$  or  $\text{Na}$  sucrates + Aq, and ppts of double sucrates form when solutions of the first three bases are heated, but no

ppt forms in the last two cases even at 100° (Hunton)

Insol in simple Ca, Ba, or K succates + Aq, but immediately sol when an excess of cane sugar + Aq is present (Pelgot)

Moderately sol in amylamine, easily sol in methyl, less in ethylamine (Wurtz)

Sol in sorbine + Aq (Pelouze)

Not pptd in presence of aromatic oxyacids or phenols of the ortho series. Thus in presence of salicylic acid, pyrocatechin, gallic acid, pyrogallie acid, etc., NaOH + Aq does not ppt  $\text{CuO}_2\text{H}_2$  from Cu solutions, but pptn is not prevented by benzoic acid, resorcin, hydroquinone, etc (Weith, B 9 342)

Sol in solutions of alkali salts of "spaltungsprodukte" of albumen (Kalle and Co, Pat 1901)

Sol in starch emulsion which has become thin liquid in an alternating magnetic field (Rosenthal, C C 1908, I 593)

$\text{CuO}$ ,  $2\text{H}_2\text{O}$  (Rubénovitch, C R 1899, 129 336)

$\text{CuO}$ ,  $3\text{H}_2\text{O}$  (Kosmann, Z anorg 1893, 3 373)

$2\text{CuO}$ ,  $3\text{H}_2\text{O}$  (Cross, Gm — K 5 1, 753)

$4\text{CuO}$ ,  $\text{H}_2\text{O}$  Insol in  $\text{NH}_4\text{OH}$  + Aq (Mailhe, A ch 1902, (7) 27 393)

**Cupric hydroxide ammonia**,  $\text{CuO}_2\text{H}_2$ ,  $4\text{NH}_3$

Present in ammoniacal solution of  $\text{CuO}_2\text{H}_2$  (Dawson, Z phys Ch 1909, 69 110)

**Cuprous imide**,  $\text{Cu}_2\text{NH}$

Decomp at 160° forming  $\text{Cu}_3\text{N}$

Readily hydrolysed by  $\text{H}_2\text{O}$

Sol in liquid  $\text{NH}_3$  solutions of  $\text{NH}_4\text{NO}_3$  (Franklin, J Am Chem Soc 1912, 34 1502)

**Cuprous iodide**,  $\text{Cu}_2\text{I}_2$

Insol in  $\text{H}_2\text{O}$ , or dil acids

Calculated from electrical conductivity of  $\text{Cu}_2\text{I}_2$  + Aq, 1 l  $\text{H}_2\text{O}$  dissolves about 8 mg  $\text{Cu}_2\text{I}_2$  at 18° (Kohlrausch and Rose, Z phys Ch 12 241)

Sol in conc  $\text{H}_2\text{SO}_4$  (Vitali, Gm — K 5 1, 947)

Sol with difficulty in conc  $\text{HCl}$  + Aq. Decomp by conc  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4$ . Insol in  $\text{NaCl}$ ,  $\text{KNO}_3$ ,  $\text{Na}_2\text{SO}_3$ ,  $\text{KBr}$ , or  $\text{NH}_4\text{Cl}$  + Aq. Sol in  $\text{NH}_4\text{OH}$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $\text{KCN}$ , or  $\text{KI}$  + Aq (Renault, C R 59 558)

Appreciably sol in N/10  $\text{HCl}$ . Practically insol in N/10  $\text{H}_2\text{SO}_4$  (Moser, Z anal 1904, 43 604)

Results of experiments on solubility of  $\text{Cu}_2\text{I}_2$  in  $\text{I}_2$  + Aq in presence of acids and salts are given by Bray and MacKay.

$\text{Cu}_2\text{I}_2$  was found to be sl sol in  $\text{H}_2\text{O}$  but a considerable amt dissolves in presence of  $\text{I}_2$ , owing to formation of  $\text{CuI}_2$  and  $\text{CuI}_3$  (J Am Chem Soc 1910, 32 1207)

Solubility of  $\text{Cu}_2\text{I}_2$  in  $\text{I}_2$  + Aq at 20°

g per l		Solid Phase
Cu	I	
0 285	0 585	$\text{Cu}_2\text{I}_2$
0 482	1 305	"
0 583	1 922	"
0 678	2 557	"
0 756	3 204	"
0 844	3 954	"
0 898	4 436	"
0 964	5 085	"
1 032	5 685	"
1 090	6 282	"
1 112	6 530	"
1 232	7 653	$\text{Cu}_2\text{I}_2 + \text{I}$
1 040	6 449	$\text{I}_2$
0 898	5 594	"
0 748	4 711	"
0 606	3 856	"
0 448	2 949	"
0 300	2 069	"
0 159	1 230	"
0 925*	5 461	$\text{Cu}_3\text{I}_2 + \text{I}_2$
1 658**	11 366	"

\* at 0° \*\* at 40°

(Fedotieff, Z anorg 1911, 69 26)

Solubility

$\text{NH}_4\text{Br} + \text{Aq}$	-
2-N	1 9068
3-N	3 6540
4-N	6 0588

(Kohn and Klein, Z anorg 1912, 77 254)

Sol in  $\text{FeCl}_3$  + Aq (Fleischer, C N 1869, 19 206)

Solubility in  $\text{KBr}$  + Aq at t°

t°	$\text{KBr} + \text{Aq}$	g $\text{CuI}$ in 1 l of the solution
19 5	2-N	1 4666
24 0	2-N	1 5576
19 5	3-N	3 4094
23 0	3-N	3 5949
22 0	4-N	7 1263
22 0	4-N	6 9768

The solutions undergo change in the course of a few days, iodine being set free, the solubility of the cuprous iodide is not markedly affected thereby

(Kohn, Z anorg 1909, 63 337)

1 l of a 0.2N solution of  $\text{KI}$  dissolves 0.000157 g mol  $\text{CuI}$  (Bodlander, Z anorg 1902, 31 475)

Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

Insol in  $\text{CS}_2$  (Arctowski, Z anorg 1894, 6 257)

Practically insol in methylene iodide (Retgers, Z anorg 1893, 3 347)  
Sol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in acetone (Naumann, B 1904, 37 4329), (Eidmann, C C 1899, II 1014)  
100 g acetonitrile dissolve 3.52 g  $\text{Cu}_2\text{I}_2$  at  $18^\circ$  (Naumann and Schier, B 1914, 47 249)

Min *Marshale* (Gm—K 5 1, 945)

### Cupric iodide, $\text{CuI}_2$

Exists only in very dil aqueous solution (Traube, B 17 1064)

### Copper periodide, $\text{CuI}_4$

Sol in  $\text{H}_2\text{O}$  (Walker and Dover, Chem Soc 1905, 87 1588)

### Copper ammonium iodide ammonia

See Cupriammonium iodide ammonia

### Cuprous mercuric iodide, $\text{Cu}_2\text{I}_2, \text{HgI}_2$

$\text{KI} + \text{Aq}$  dissolves out  $\text{HgI}_2$

### Cuprous mercuric iodide ammonia, $\text{CuI}_2, 2\text{HgI}_2, 4\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  or acids Sol in a mixture of acetic acid and alcohol

$\text{CuI}_2, \text{HgI}_2, 4\text{NH}_3$  As above (Jorgensen, J pr (2) 2 347)

### Cupric nitrogen iodide, $\text{CuI}_2, \text{N}_2\text{H}_4\text{I}_2$

Decomp by  $\text{H}_2\text{O}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  (Guyard, C R 97 526)

### Cupric thallic iodide ammonia, $\text{CuI}_2, 2\text{THI}_3, 4\text{NH}_3$

Decomp slowly by  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp Sol in alcohol

### Cuprous iodide ammonia, $\text{CuI}, \text{NH}_3$

Ppt (Anderline, Gazz ch it 1912, 42 I, 321)

$+4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Very sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Silberad, Chem Soc 1905, 87 67)

$\text{Cu}_2\text{I}_2, 3\text{NH}_3$  (Lloyd, J phys Chem 1908, 12 399)

$\text{Cu}_2\text{I}_2, 4\text{NH}_3$  (Lloyd, J Phys 4 328)

$+ \text{H}_2\text{O}$  (Saglier, C R 104 1440)

$\text{Cu}_2\text{I}_2, 6\text{NH}_3$  (Lloyd)

### Cupric iodide ammonia, $\text{CuI}_2, 4\text{NH}_3 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp Not attacked by cold

alcohol or ether (Berthelmont, J P r m 15 445) (Pozzi-Escot, C R 1900, 130 30)

$\text{CuI}_2, 6\text{NH}_3$  Sol in liquid  $\text{NH}_3$  (Lloyd, Am Ch J 1908, 39 205)

$3\text{CuI}_2, 10\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$  (Chardas, Am Ch J 1895, 17 302)

Sol in liq  $\text{NH}_3$  (Horn, Am Ch J 1908, 39 204)

### Cupriammonium iodide ammonia,

$3\text{Cu}(\text{NH}_3)_2\text{I}_2, 4\text{NH}_3$

Decomp by air and by  $\text{H}_2\text{O}$  (Richardson, Am Ch J 1895, 17 302)

### Copper periodide ammonia, $2\text{CuI}, \text{I}_2, 1\text{H}_2\text{O}$

Because of its insolubility it cannot be recryst from any solvent (Silberad, Chem Soc 1905, 87 66)

### Copper tetraiodide, ammonia, $\text{CuI}_4, 4\text{NH}_3$

(Jorgensen, J pr (2) 2 353)

### Copper hexaiodide ammonia, $\text{CuI}_6, 4\text{NH}_3$

Not decomp in  $\text{H}_2\text{O}$  in closed vessels (Jorgensen)

### Copper mercuric iodide ammonia,

$\text{CuHg}_2\text{I}_6, 5\text{NH}_3$

$\text{CuHgI}_3, 2\text{NH}_3$  Ppt Decomp by  $\text{H}_2\text{O}$  and by alcohol

$\text{CuHg}_2\text{I}_6, 3\text{NH}_3$  Ppt Decomp by long washing with  $\text{H}_2\text{O}$

$\text{CuHg}_2\text{I}_6, 4\text{NH}_3$  Ppt Decomp by  $\text{I}_2\text{O}$  Sl attacked by abs alcohol

$\text{CuI}_2, \text{HgI}_2, 4\text{NH}_3$  Ppt (Anderline, Gazz ch it 1912, 42, (1) 321, C C 1912, I 95)

### Copper nitride, $\text{Cu}_3\text{N}_2$

Decomp by dil or conc acids

Easily decomp by  $\text{H}_2\text{O}$  when finely powdered (Rossel, C R 1895, 121 942)

### Copper suboxide, $\text{Cu}_4\text{O}$

Not attacked by  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{SO}_4 + \text{Aq}$  into  $\text{Cu}$  and  $\text{CuSO}_4$ , dil  $\text{HCl} + \text{Aq}$  has similar action Not attacked by  $\text{NH}_4\text{OH}$

$+ \text{Aq}$  or  $\text{NH}_4\text{OH} + (\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Pogg 120 1)

$\text{Cu}_2\text{O}$  Not attacked by dil or conc acids, even aqua regia Slowly sol in  $\text{Aq}$  (Bailey and Hopkins, Chem Soc 1890, 57 272)

Is a solution of oxide in  $\text{Cu}$  (Zeit angew Ch 1908, 21 51)

Converted by  $\text{Cl} + \text{Aq}$  into cuprous chloride

### Cuprous oxide, $\text{Cu}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{SO}_4 + \text{Aq}$  or cold very dil  $\text{HNO}_3 + \text{Aq}$  into a cupric salt and  $\text{Cu}$

Converted by  $\text{Cl} + \text{Aq}$  into cuprous chloride

Solubility of  $\text{Cu}_2\text{O}$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ 

Conc of total Cu		Conc of total $\text{NH}_3$	
G in 1000 g of solution	G mol in 1000 g of solution	G in 1000 g of solution	G mol in 1000 g of solution

## Preparation I

0 3593	0 00566	3 91	0 23
0 5024	0 00791	12 07	0 71
0 6869	0 01080	13 77	0 81
0 6964	0 01095	16 15	0 95
1 0144	0 01597	27 03	1 59
1 0462	0 01645	32 64	1 92
1 0557	0 01660	36 89	2 17
1 2243	0 01924	45 73	2 69
1 3229	0 02081	68 68	4 04
1 4882	0 02340	74 12	4 36
1 5105	0 02375	81 26	4 78
1 6313	0 02565	98 52	5 56
1 6981	0 02670	122 40	7 20

## Preparation II

0 4229	0 00665	7 82	0 46
0 6678	0 01050	8 16	0 48
0 9890	0 01555	22 61	1 33
1 0494	0 01650	28 39	1 67
1 3528	0 02127	54 15	3 19
1 5047	0 02366	72 08	4 24
1 5963	0 02510	78 20	4 60
1 6555	0 02603	102 05	6 00

(Donnan and Thomas, Chem Soc 1911, 99 1791)

Sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rose)

Sl sol in excess of  $\text{KOH} + \text{Aq}$  (Chodnew)

Sol in conc  $\text{MgCl}_2$  and  $\text{FeCl}_2 + \text{Aq}$  (Hunt, C R 69 1357)

Sl attacked by liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 827)

Mn (cuprite) Sol in  $\text{HCl}$ ,  $\text{HNO}_3$ , and  $\text{NH}_4\text{OH} + \text{Aq}$

Cupric oxide,  $\text{CuO}$ 

Insol in  $\text{H}_2\text{O}$  Easily sol in acids Sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  but dissolves on addition of a few drops of acid or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  Insol in dil, but sol in warm conc  $\text{NaOH}$ , and  $\text{KOH} + \text{Aq}$  (Low, Z anal 9 463)

$\text{CuO}$  prepared at a low temp is easily sol in dil acids, but when ignited is slowly sol in boiling conc acids, but moderately rapidly in a cold mixture of  $\text{NH}_4\text{I} + \text{HCl}$  (Joannis, C R 1886, 102 1161)

Solubility in  $\text{N-HNO}_3$  1 l of the solution contains 0 4802 g atoms Cu at  $25^\circ$  (Jaeger, Z anorg 1901, 27, 33)

Solubility of  $\text{CuO}$  in  $\text{HF} + \text{Aq}$  at  $25^\circ$ 

	Time	G $\text{CuO}$ in 10 cem of the solution
0 25N-HF	1 1/4 hrs	0 0431
	3 3/4 "	0 0619
	25 1/4 "	0 0812
	71 1/2 "	0 0823
	170 1/2 "	0 0907
N-HF (a)	5 1/2 "	0 3018
	21 1/2 "	0 2797
	52 "	0 2747
	201 1/2 "	0 2339
	226 1/2 "	0 2353
N-HF (b)	4 1/4 "	0 3220
	44 1/4 "	0 2930
	117 3/4 "	0 2431
	167 3/4 "	0 2219
2 02N-HF	1 1/2 "	0 3646
	5 "	0 4533
	71 1/2 "	0 3583
	156 1/2 "	0 3311

(Deussen, Z anorg 1905, 44 421)

Solubility of  $\text{CuO}$  in  $\text{HF}$  at  $25^\circ$ 

$\text{Cu} = \text{g-atoms Cu}$  in 1 l of the solution

HF normality	Cu
0 12	0 0307
0 28	0 1164
0 57	0 2494
1 08	0 388
2 28	0 463

(Jaeger, Z anorg 1901, 27 29)

Solubility of  $\text{CuO}$  in  $\text{HF} + \text{KF}$  at  $25^\circ$ 

$\text{Cu} = \text{g-atoms Cu}$  in 1 l of the solution

HF normality	Cu
0 12	0 0356
0 28	0 06437
0 57	0 1442
1 11(1 08)	0 2451
2 17(2 28)	0 2517

(Jaeger, l c)

Sl sol in large excess of  $\text{KOH} + \text{Aq}$  (de Coninck, C C 1904, II, 65)

Slowly sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$  and less easily in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Rose)

Sol in boiling  $\text{H}_2\text{O}$  solutions of  $\text{Al}$ ,  $\text{Gl}$ ,  $\text{U}$ ,  $\text{Cr}_2$ ,  $\text{Fe}_2$ , or  $\text{Bi}$  nitrates and chlorides,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{Hg}_2(\text{NO}_3)_2$ ,  $\text{SbCl}_3$ ,  $\text{SnCl}_4$ , and  $\text{SnCl}_4$ , with pptn of oxides of the bases of those salts Unacted upon by boiling  $\text{H}_2\text{O}$  solutions of  $\text{Mn}$ ,  $\text{Mg}$ ,  $\text{Ni}$ ,  $\text{Co}$ ,  $\text{Zn}$ ,  $\text{Ce}$ , or



Fe nitrates or chlorides,  $\text{AgNO}_3$ ,  $\text{Pb(NO}_3)_2$ ,  $\text{Cd(NO}_3)_2$ , and  $\text{HgCl}_2$  (Persoz)

Pure  $\text{CuO}$  is very sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  but the solution is greatly increased by the addition of  $\text{NH}_4$  salts (Muthmann, C C 1904 II, 410)

Sol in hot  $(\text{NH}_4)_2\text{SO}_4$  or  $(\text{NH}_4)_2\text{SO}_3 + \text{Aq}$  (Jumau, Electrochem Ind 1908, 6 258)

15% dissolves in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  in 24 hrs (Schnabel, Z B H Sal 1880, 23 282)

Sl attacked by liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

Solubility in N-acetic acid 1 l of the solution contains 0.1677 g-atoms Cu at 25° (Jaeger, Z anorg 1902, 27 33)

Insol in acetone (Naumann, B 1904, 37 4329, Erdmann, C C 1899, II 1014)

Sl sol in benzamide (Dessaignes, A ch 1852, (3), 34 146)

Insol in piperidine (Cahours, C R 1852, 34 481)

Sol in acid amines as asparagin (Piria, A ch 1848, (3), 22 160)

Sol in amines alone or mixed with  $\text{NH}_3$  (Lance, Dissert 1905)

Slowly sol in Ca or any other alkali succrate + Aq, but not in cane sugar + Aq (Hunton)

Solubility in (calcium succrate + sugar) + Aq  
1 l solution containing 418.6 g sugar and 34.3 g  $\text{CaO}$  dissolves 10.26 g  $\text{CuO}$

1 l solution containing 296.5 g sugar and 24.2 g  $\text{CaO}$  dissolves 5.68 g  $\text{CuO}$

1 l solution containing 174.4 g sugar and 14.1 g  $\text{CaO}$  dissolves 3.47 g  $\text{CuO}$  (Bodenbender, J B 1866 600)

Polypeptides in aqueous solution dissolve  $\text{CuO}$  by short boiling (Fischer, B 1906, 39 576)

$+ \frac{1}{2} \text{H}_2\text{O} = 6\text{CuO} + \text{H}_2\text{O}$  Insol in dil, but sol in conc  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$

Sol in volatile oils

See also Cupric hydroxide

Min *Melaconite* Sol in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$

**Cuprocupric oxide**,  $\text{Cu}_5\text{O}_3 = 2\text{Cu}_2\text{O}$ ,  $\text{CuO}$  (Favre and Maumené)

$\text{Cu}_5\text{O}_3 + \text{H}_2\text{O} = \text{Cu}_2\text{O}$ ,  $\text{CuO} + \text{H}_2\text{O}$  When freshly pptd., sol in  $\text{HCl} + \text{Aq}$ , but insol after drying (Siewert, J B 1866 257)

$\text{Cu}_4\text{O}_3 = \text{Cu}_2\text{O}$ ,  $2\text{CuO}$  (Siewert)

All oxides of Cu except  $\text{Cu}_2\text{O}$ ,  $\text{Cu}_3\text{O}$ ,  $\text{CuO}$ , and  $\text{Cu}_2\text{O}$ , are mixtures (Osborne, Sil Am J (3) 32 33, Debray, C R 99 583)

**Copper dioxide**,  $\text{CuO}_2 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Decomp by acids with formation of cupric salt and  $\text{H}_2\text{O}_2$  (Weltzien, A 140 207)

**Cuprous oxide ammonia** (cuprosammonium oxide)

Known only in solution (Wagner, C C 1863 239)

**Cupric oxide ammonia** (cuprammonium hydroxide),  $3\text{CuO}$ ,  $4\text{NH}_3 + 6\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Kane, A ch 72 283)

$\text{CuO}$ ,  $4\text{NH}_3 + 4\text{H}_2\text{O}$  Very deliquescent  
Decomp in the air and by  $\text{H}_2\text{O}$  (Malaguti and Sarreau, A ch (3) 9 438)

**Cuprous oxybromide**,  $\text{Cu}_2\text{Br}_2$ ,  $\text{CuO} + \text{H}_2\text{O}$

(Spring and Lucion, Bull Ac Belg (3) 24 21)

**Cupric oxybromide**,  $\text{CuBr}_2$ ,  $3\text{CuO} + 3\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Easily sol in dil acids or  $\text{NH}_4\text{OH} + \text{Aq}$  (Brun, C R 109 66)

Insol in  $\text{H}_2\text{O}$  but decomp by continued boiling Sol in conc acetic acid, sl sol in conc  $\text{CuBr}_2 + \text{Aq}$  Insol in dil  $\text{KBr} + \text{Aq}$  (Richards, Proc Am Acad 1890, 25 215)

**Cupric oxybromide ammonia**,  $2\text{CuO}$ ,  $\text{CuBr}_2$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$

(Kohlschutter and Pudsches, B 1904, 37 1159)

**Cuprous oxychloride**,  $\text{Cu}_2\text{Cl}_2$ ,  $\text{CuO} + 3\text{H}_2\text{O}$

(Spring and Lucion, Bull Ac Belg (3) 24 21)

**Cupric oxychloride**,  $\text{CuO}$ ,  $\text{CuCl}_2 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$ . (Rousseau, C R 1890, 110 1263)

$2\text{CuO}$ ,  $\text{CuCl}_2$  Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$ , from which it is reprecipitated by dilution with  $\text{H}_2\text{O}$

$+ \text{H}_2\text{O}$  (Kane, A ch 72 277)

$+ 4\text{H}_2\text{O}$  (Gladstone, Chem Soc 8 211)

$3\text{CuO}$ ,  $\text{CuCl}_2 + 2\text{H}_2\text{O}$  (Miller and Kendrick, Trans Roy Soc Can 1901, (2) 8, III 35)

$+ 3\text{H}_2\text{O}$  (Dupont and Jansen, Bull Soc 1893, (3), 9 193)

$+ 3\frac{1}{2}\text{H}_2\text{O}$  Insol in cold  $\text{H}_2\text{O}$ , sl decomp by boiling (Reindel, J pr 106 378)

Insol in boiling  $\text{H}_2\text{O}$  (Habermann, W A B 90 2 268)

$+ 4\text{H}_2\text{O}$  Sol in alkaline solution of  $\text{KNa}$  tartrate (Groger, Z anorg 1902, 31 327)

(Brunswick green) Insol in  $\text{H}_2\text{O}$  Easily sol in acids

Min *Atacamite* Sol in acids, and  $\text{NH}_4\text{OH} + \text{Aq}$

Sol in cold sat citric acid + Aq (Bolton, B 1880, 13 732)

$4\text{CuO}$ ,  $\text{CuCl}_2 + 6\text{H}_2\text{O}$  (Kane, Gm — K 5 1, 919)

$+ 8\text{H}_2\text{O}$  Min *Tallngite* (Church, Gm — K 5 1, 919)

$5\text{Cu(OH)}$ ,  $\text{Cu Cl}_2\text{Cl(OH)}$  Insol in  $\text{H}_2\text{O}$

Decomp by hot  $\text{H}_2\text{O}$  (Kuhling, B 1901, 34 2852)

$7\text{CuO}$ ,  $2\text{CuCl}_2 + 9\text{H}_2\text{O}$  (Reindel)

$6\text{CuO}$ ,  $\text{CuCl}_2 + 9\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in acetic acid (Neumann, Repert, 37 304)

$8\text{CuO}$ ,  $\text{CuCl}_2 + 12\text{H}_2\text{O}$  Min *Footelite* (König, Zeit Kryst 1891, 19 601)

**Cupric zinc oxychloride**,  $\text{ZnO}$ ,  $2\text{ZnCl}_2$ ,  $5\text{CuO} + 6\text{H}_2\text{O}$   
(André, C R 1888, 106 855)

**Cupric oxychloride ammonia**,  $2\text{CuO}$ ,  $\text{CuCl}_2$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$   
(Dehéran, Gm — K 5 1, 932)

**Cupric oxyfluoride**,  $\text{CuO}$ ,  $\text{CuF}_2 + \text{H}_2\text{O}$   
Insol in  $\text{H}_2\text{O}$  (Berzelius) (Balbiano, Gazz ch it 14 74)

**Cupric oxyfluoride ammonia (cuprammonium oxyfluoride)**,  $\text{Cu}(\text{OH})\text{F}$ ,  $2\text{NH}_3$   
(Balbiano, Gazz ch it 14 74)  
 $3\text{CuO}$ ,  $\text{CuI}_2 + x\text{H}_2\text{O}$  (Tschirwinski, Gm — K, 5 1, 1584)

**Cuprous oxyiodide**,  $\text{Cu}_2\text{I}_2$ ,  $\text{CuO} + \text{H}_2\text{O}$   
(Spring and Lucion, Bull Ac Belg (3) 24 21)

**Cupric oxyiodide**,  $2\text{CuI}_2$ ,  $\text{CuO} + 4\text{H}_2\text{O}$   
Easily decomp by  $\text{H}_2\text{O}$  (Carnegie, Watts' Dict II, 257)

**Copper oxysulphide**,  $2\text{Cu}_2\text{S}$ ,  $\text{CuO}$   
Insol in  $\text{H}_2\text{O}$  (Maumené, A ch (3) 18 311)  
 $5\text{CuS}$ ,  $\text{CuO}$  Ppt (Pelouze)  
 $2\text{CuS}$ ,  $\text{CuO}$  Insol in  $\text{H}_2\text{O}$   
 $\text{CuS}$ ,  $\text{CuO}$  Insol in  $\text{H}_2\text{O}$   
Above comps do not exist (Pickering, Chem Soc 33 136)

**Copper phosphide**,  $\text{Cu}_3\text{P}_2$   
Easily sol in  $\text{HNO}_3$  or aqua regia, insol in  $\text{HCl} + \text{Aq}$  (Rose, Pogg 6 209)  
Sol in  $\text{HNO}_3$  and  $\text{Br} + \text{Aq}$  Decomp by hot conc  $\text{H}_2\text{SO}_4$  (Rubcnovitch, C R 1899, 128 1399)  
 $\text{Cu}_3\text{P}$  Sol in  $\text{HNO}_3 + \text{Aq}$  (Granger, A ch 1898, (7), 14 64)  
Crystallized Completely sol in hot  $\text{HNO}_3$ , aqua regia and  $\text{HF} + \text{HNO}_3$  Slowly sol in hot  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$  Not attacked by hot or cold  $\text{HF}$  or acetic acid (Maronneau, C R 1899, 128 939)  
 $\text{Cu}_3\text{P}_2$  Easily sol in  $\text{HNO}_3$  Sol in hot conc  $\text{H}_2\text{SO}_4$  Sol in conc  $\text{HCl} + \text{Aq}$  before the phosphide has been heated (Rose, Pogg 4 110)

$\text{Cu}_2\text{P}_2$  Easily sol in  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Granger, Bull Soc (3) 9 661)

$\text{CuP}_2$  Decomp by  $\text{HNO}_3$ , not readily sol in  $\text{HCl}$  Easily attacked by  $\text{Cl}_2$  or  $\text{Br}_2 + \text{Aq}$  (Granger, C R 1895, 120 924)

$\text{Cu}_4\text{P}_2$  (Granger, C N 1898, 77 229)  
Very sol in  $\text{HNO}_3$  and  $\text{Br}_2 + \text{Aq}$  Decomp by hot conc  $\text{H}_2\text{SO}_4$  (Rubénovitch, C R 1899, 129 338)

**Cupric zinc phosphide**,  $10\text{Cu}_3\text{P}_2$ ,  $\text{Zn}_3\text{P}_2(?)$   
(Hvoslef, A 100 99)

**Copper phosphoselenide**,  $\text{CuSe}$ ,  $\text{P Se}$   
Insol in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ , sol in  $\text{HNO}_3 + \text{Aq}$  Insol in cold alkalis, but decomp slowly when heated therewith (Hahn, J pr 93 436)  
 $2\text{CuSe}$ ,  $\text{P}_2\text{Se}_3$  Attacked only by fuming  $\text{HNO}_3$  (Hahn)  
 $2\text{CuSe}$ ,  $\text{P}_2\text{Se}_5$  Sol only in  $\text{HNO}_3 + \text{Aq}$  (Hahn)

**Copper phosphosulphide**,  $2\text{Cu}_3\text{S}$ ,  $\text{P}_2\text{S}$   
 $\text{Cu}_3\text{S}$ ,  $\text{P}_2\text{S}$  (Berzelius)  
 $2\text{CuS}$ ,  $\text{P}_2\text{S}_3$  (Berzelius)  
 $\text{CuS}$ ,  $\text{P}_2\text{S}$  Insol in  $\text{H}_2\text{O}$  and dil  $\text{HCl} + \text{Aq}$  Sol in conc  $\text{HCl} + \text{Aq}$ , from which it is precipitated by  $\text{H}_2\text{O}$  (Berzelius, A 46 252)  
 $8\text{CuS}$ ,  $\text{P}_2\text{S}_5$  (Berzelius)  
 $\text{Cu}_4\text{PS}_3$  Sol in conc  $\text{HNO}_3$  and in aqua regia Insol in  $\text{HCl}$  Not attacked by hot  $\text{H}_2\text{SO}_4$  or conc  $\text{NaOH} + \text{Aq}$  (Ferrand, A ch 1899, (7), 17 407)

**Cuprous selenide**,  $\text{Cu}_2\text{Se}$   
Ppt Sol in  $\text{HCl}$  and in  $\text{H}_2\text{SO}_4$   
Decomp by  $\text{HNO}_3$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Fonzez-Diacon, C R 1900, 131 1207)  
Sol in  $\text{KCN} + \text{Aq}$  (Heyn and Bauer, Metall 1903, 3 84)  
Min *Berzelianite*

**Cupric selenide**,  $\text{CuSe}$   
(Little, A 112 211)  
Ppt Sol in  $\text{HCl}$  and in  $\text{H}_2\text{SO}_4$  Decomp by  $\text{HNO}_3$  (Fonzez-Diacon, C R 1900, 131 1207)

**Cuprocupric selenide**,  $\text{Cu}_3\text{Se}_2$   
Min *Umangite* Sol in  $\text{HNO}_3$  (Klockmann, Zeit Kryst 1891 19, 270)

**Cuprous lead selenide**,  $3\text{Cu}_2\text{Se}$ ,  $\text{PbSe}$   
Min *Zorgite* Sol in cold conc  $\text{HNO}_3 + \text{Aq}$  with separation of  $\text{Se}$

**Cupric lead selenide**,  $\text{CuSe}$ ,  $\text{PbSe}$   
Sol in cold conc  $\text{HNO}_3$  with separation of  $\text{Se}$  (Karsten)  
 $\text{Cu}_3\text{Se}$ ,  $2\text{PbSe}$  As above  
 $\text{CuSe}$ ,  $4\text{PbSe}$  As above

**Cuprous silver selenide**,  $\text{Cu}_2\text{Se}$ ,  $\text{Ag}_2\text{Se}$   
Min *Eucarnite* Sol in hot  $\text{HNO}_3$  with decomp (Berzelius)

**Cuprous silicide**,  $\text{Cu}_4\text{Si}$   
Sol in warm dil or conc  $\text{HNO}_3$  Only sl sol in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HF}$  Sol in a mixture of  $\text{HNO}_3$  and  $\text{HF}$  Not attacked by solutions of alkalis (Vigouroux, C R 1906, 142 88)

$\text{Cu}_2\text{S}_3$  Sol in aqua regia and fused sodium potassium carbonate (de Chalmot, Am Ch J 1896, 18, 95)

$\text{Cu}_2\text{S}_1$  Decomp by water and moist air, and by acids and fused alkali (Vigouroux, C R 1896, 122 319)

### Cuprous sulphide, $\text{Cu}_2\text{S}$

More sol in  $\text{H}_2\text{O}$  than  $\text{Ag}_2\text{S}$ , but much less than PbS (Bodlander, Z phys Ch 1898 27, 64)

1 l  $\text{H}_2\text{O}$  dissolves  $3.1 \times 10^{-6}$  moles  $\text{Cu}_2\text{S}$  at  $18^\circ$  (Weigel, Z phys Ch 1907, 58 294)

Very slowly decomp by dil  $\text{H}_2\text{SO}_4$  in presence of oxygen (Thompson, Electrochem, Ind 1904 2, 225)

Decomp by conc  $\text{H}_2\text{SO}_4$  (Pickering, C N 1878, 37, 37)

Cold  $\text{HNO}_3$  + Aq dissolves out Cu and leaves CuS, hot  $\text{HNO}_3$  dissolves with separation of S. Sl sol in boiling conc HCl + Aq. Insol in  $(\text{NH}_4)_2\text{S}$  + Aq.

5N-HCl dissolves  $\text{Cu}_2\text{S}$  very slightly (0.0038 g Cu in  $7\frac{1}{2}$  hrs) but it is more sol in presence of Cl, when 0.672 g are dissolved in  $7\frac{1}{2}$  hours (Egl, Z anorg 1902, 30 46)

Sol with exclusion of air in  $\text{NH}_4\text{OH}$  + Aq (Malzac, Pat 1904)

Insol in acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

Min *Chalcocite* Completely sol in warm  $\text{HNO}_3$  with separation of S

### Cupric sulphide, $\text{CuS}$

Almost absolutely insol in  $\text{H}_2\text{O}$ , sol in 950,000 pts  $\text{H}_2\text{O}$ . When exposed to the air, dissolves in  $\text{H}_2\text{O}$  as  $\text{CuSO}_4$ . Easily sol in boiling  $\text{HNO}_3$  with separation of S. Difficultly sol in hot conc HCl + Aq. Insol in dil  $\text{H}_2\text{SO}_4$  + Aq (1.6) (Hoffmann, A 115 286)

Pptd by  $\text{H}_2\text{S}$  or  $(\text{NH}_4)_2\text{S}$  + Aq in presence of 100,000 pts  $\text{H}_2\text{O}$  (Pfaff), 200,000 pts  $\text{H}_2\text{O}$  (Lassaigne), 15,000 pts  $\text{H}_2\text{O}$  and 7500 pts HCl, but with 40,000 pts  $\text{H}_2\text{O}$  and 20,000 pts HCl no colour is visible (Reinsch)

1 l  $\text{H}_2\text{O}$  dissolves  $3.51 \times 10^{-6}$  moles  $\text{CuS}$  at  $18^\circ$  (Weigel, Z phys Ch 1907, 58 294)

Insol in  $\text{H}_2\text{SO}_3$  + Aq (Guerout, C R 1872, 75 1276)

Decomp by conc  $\text{H}_2\text{SO}_4$  (Kliche, J B 1890, 593)

Sol in  $(\text{NH}_4)_2\text{CO}_3$  + Aq (Berzelius) Sol in alkali bicarbonates + Aq

In sol in  $\text{NH}_4\text{NO}_3$  or  $\text{NH}_4\text{Cl}$  + Aq (Bicott) Insol in acidified conc alkali chlorides + Aq (Cushman, Am Ch J 1895, 17, 382)

Sol in  $\text{FeCl}_3$  + Aq with separation of S (Cumenge and Wimmer, Dingl 1883, 250 123)

Decomp by boiling  $\text{CuCl}_2$  + Aq in presence of HCl or NaCl (Raschig, Gm — K 5 1, 819)

Sol in  $\text{Fe}_2(\text{SO}_4)_3$  + Aq in presence of large excess of air (Thompson, Electrochem Ind 1904, 2, 228)

Insol in KOH, or  $\text{K}_2\text{S}$  + Aq, especially if boiling, appreciably sol in colourless and even more readily in hot yellow  $(\text{NH}_4)_2\text{S}$  + Aq

Sl sol in  $\text{Na}_2\text{S}$  + Aq, more easily in  $\text{NaSH}$  + Aq (Becker, Sill Am J (3) 33 199)

100 cc sat  $\text{Na}_2\text{S}$  + Aq (sp gr = 1.225) dissolve 0.0032 g  $\text{CuS}$  (Holland, Ann Chim Anal 1897, 2 243)

Sol in K polysulphides (3-64%) (Prost, Bull Soc Belg Chim 1897 103)

Appreciably sol in alkali polysulphides + Aq (Rossing, Z anal 1902, 41, 1)

Sol in considerable quantity in alkali sulpharsenates, sulphantimonates, and sulphostannates + Aq. Therefore when a mixed ppt of  $\text{CuS}$  and  $\text{As}_2\text{S}_3$ ,  $\text{Sb}_2\text{S}_3$ , or  $\text{SnS}$  is treated with  $\text{K}_2\text{S}$ , a portion of the  $\text{CuS}$  is dissolved (Wöhler, A 34 236)

Sol in alkali sulphovandates, or sulphotungstates + Aq (Storch, B 16 2015)

Sol in alkali sulphomolybdates + Aq (Debrav, C R 96 1616)

Insol in K thiocarbonate + Aq (Rosenbladt, Z anal 26 15)

Sol in KCN + Aq

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Insol in acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

Insol in Na xanthogenate (Ragg, Ch Z 1908, 32 677)

Solubility of  $\text{CuS}$  in sugar + Aq at  $t^\circ$   
g  $\text{CuS}$  per l of solution

$t^\circ$	1% sugar	30% sugar	50% sugar
17.5	0.5672	0.5632	0.9076
45	0.3659	0.7220	1.0549
75	1.1345	1.2033	1.2809

(Stolle, Z Ver Zuckerind 1900 50 331)

### Min *Covellic*

*Collodial* Aqueous solution is stable when it contains 5 g  $\text{CuS}$  in a litre, when it contains 4 or 5 times that amount it is decomposed in an hour

Solutions of salts of the following concentration cause a precipitate in the above solution. Salts of univalent elements—

### Salts of univalent elements—

$\text{K}_3\text{Fe}(\text{CN})_6$	1	62
$\text{K}_4\text{Fe}(\text{CN})_6$	1	127
$\text{Na}_2\text{S}_2\text{O}_3$	1	157
$\text{Na}_2\text{CO}_3$	1	200
$\text{Na}_2\text{HPO}_4$	1	252
$\text{Na}_2\text{SO}_4$	1	333
$\text{K}_2\text{Cr}_2\text{O}_7$	1	2083
KI	1	80
KBr	1	133
$\text{KClO}_3$	1	166

Salts of univalent elements—*Continued*

$\text{NaC}_2\text{H}_3\text{O}_2$	1	221
$(\text{NH}_4)_2\text{C}_2\text{O}_4$	1	255
$\text{NaCl}$	1	400
$\text{NaHCO}_3$	1	2500
$\text{K}_2\text{SO}_4$	1	117
$\text{K}_2\text{CrO}_4$	1	133
$\text{NaC}_7\text{H}_5\text{O}_2$	1	166
$\text{K}_2\text{S}_2\text{O}_6$	1	222
$\text{KCl}$	1	333
$\text{KNO}_3$	1	500

## Salts of bivalent metals—

$\text{BaS}_2\text{O}_6$	1	2242
$\text{Cd}(\text{NO}_3)_2$	1	3483
$\text{MgSO}_4$	1	6830
$\text{Ba}(\text{NO}_3)_2$	1	2677
$\text{BaCl}_2$	1	3921
$\text{Pb}(\text{ClO}_3)_2$	1	6988
$\text{CdSO}_4$	1	3442
$\text{MnSO}_4$	1	5518

## Salts of trivalent metals—

Ammonia alum	1	31,896
Chrome alum	1	58,889
$\text{Al}_2(\text{SO}_4)_3$	1	90,909

## Acids—

Succinic	1	100
Oxalic	1	162
$\text{HCl}$	1	733
$\text{H}_2\text{SO}_4$	1	208
Citric	1	20
Acetic	Not at all	
Tartaric	“ “	

(Spring and de Bock, Bull Soc (2) 58 165)

Copper polysulphide,  $\text{Cu}_2\text{S}_8$ *Amorphous* Ppt Decomp by boiling alcohol (Rossing, Z anorg 1900, 25 413) $\text{Cu}_2\text{S}_8$  *Amorphous* Ppt can be boiled with  $\text{H}_2\text{O}$  without decomposition (Rossing, Z anorg 1900, 25 4, 11) $\text{Cu}_2\text{S}_8$  Ppt, insol in alkali sulphides, decomp by conc  $\text{HNO}_3$  (Bodroux, C R 1900, 130 1398)

Could not be obtained (Rossing, Z anorg 1900, 25 414)

 $\text{Cu}_2\text{S}$  Ppt Decomp by  $\text{H}_2\text{O}$  Sol in alkali and barium polysulphides + Aq Decomp by colorless alkali sulphides + Aq (Rossing, Z anorg 1900, 25 407)Cuprous iron (ferric) sulphide,  $\text{Cu}_2\text{S}, \text{Fe}_2\text{S}_3$ Decomp by conc  $\text{HCl}$  + Aq Sol in boiling  $\text{HNO}_3$  + Aq of 1.2 sp gr (Schneider, J pr (2) 38 569)Min (*halcopyrite*) Insol in  $\text{HCl}$  + Aq When heated in a sealed tube with  $\text{H}_2\text{S}$  + Aq, a portion of it dissolves with difficulty and subsequent deposition of S (Senarmont, A ch (3) 32 168)Cuprocupric iron (ferric) sulphide,  $\text{Cu}_2\text{S}, \text{CuS}, \text{FeS}$ Min *Bornite* Sol in  $\text{HCl}$  + Aq with a residue of SCupric iron (ferric) sulphide,  $\text{CuS}, \text{Fe}_2\text{S}_3$ Min *Cubanite*Copper iron potassium sulphide,  $\text{K}_2\text{FeCu}_3\text{S}_4$ Sl attacked by cold dil  $\text{HCl}$  + Aq Decomp by warming (Schneider, Pogg 138 318)Copper iron sodium sulphide,  $\text{Na}_2\text{FeCu}_2\text{S}_4$ Sl attacked by cold dil, easily decomp by hot  $\text{HCl}$  + Aq (Schneider, Pogg 138 318)Cuprous lead sulphide,  $9\text{Cu}_2\text{S}, 2\text{PbS}$  $3\text{Cu}_2\text{S}, 2\text{PbS}$  $2\text{Cu}_2\text{S}, 2\text{PbS}$  Min *Cuprophumbite*

## Copper phosphorus sulphide

See Copper phosphosulphide

## Cupric platinum sulphide

See Sulphoplatinate, cupric

Cuprous potassium sulphide,  $4\text{Cu}_2\text{S}, \text{K}_2\text{S}$ 

(Ditte, C R 98 1429)

Cuprocupric potassium sulphide,  $3\text{Cu}_2\text{S}, 2\text{CuS}, \text{K}_2\text{S}$ Not decomp by very dil  $\text{HCl}$  + Aq, but easily by conc  $\text{HCl}$  + Aq on warming (Schneider, Pogg 138 311)Copper potassium polysulphide,  $\text{KCuS}_4$ Sl sol in cold  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$  Decomp by conc and dil  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  Sl sol in alcohol (Biltz and Herms, B 1907, 40 977) $2\text{CuS}_8, \text{K}_2\text{S}$  Decomp by  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4\text{SH}$  + Aq (Priwoznik, B 5 1291) $\text{K}_2\text{Cu}_2\text{S}_{10}$  Easily sol in  $\text{H}_2\text{O}$  1 g is sol in less than 5 cc  $\text{H}_2\text{O}$  Rapidly decomp by dil acids, slowly by conc acids Sl sol in alcohol (Biltz and Herms, B 1907, 40 983)Cupric rubidium polysulphide,  $\text{RbCuS}_4$ 

As K salt (Biltz and Herms, B 1907, 40 978)

 $\text{Rb}_2\text{Cu}_2\text{S}_{10}$  Easily sol in  $\text{H}_2\text{O}$  Decomp by acids Sl sol in alcohol (Biltz and Herms, B 1907, 40 985)Cuprous silver sulphide,  $\text{Cu}_2\text{S}, \text{Ag}_2\text{S}$ Min *Stromeyerite* Sol in  $\text{HNO}_3$  + Aq with separation of S $\text{Cu}_2\text{S}, 3\text{Ag}_2\text{S}$  Min *Jalpaite* As aboveCuprous sodium sulphide,  $\text{Na}_2\text{S}, \text{Cu}_2\text{S}$ 

(Bodlander, Z Elektrochem 1905, 11 181)

 $\text{Na}_2\text{S}, 2\text{Cu}_2\text{S}$  (Bodlander, Z Elektrochem 1905, 11 181)

**Cuprocupric sodium sulphide**,  $\text{Cu}_2\text{S}$ ,  $\text{CuS}$ ,  $\text{Na}_2\text{S}$

Scarcely decomp by cold dil  $\text{HCl} + \text{Aq}$ , conc  $\text{HCl} + \text{Aq}$  decomp easily on warming, without, however, dissolving all the  $\text{Cu}_2\text{S}$ . Completely decomp by warm  $\text{HNO}_3 + \text{Aq}$  (Schneider, Pogg 138 315)

**Copper zinc sulphide**,  $\text{CuS}$ ,  $3\text{ZnS}$

**Copper sulphophosphide**

See Copper phosphosulphide

**Cupric telluride**,  $\text{CuTe}$

$\text{Cu}_2\text{Te}_3$  Insol in  $\text{H}_2\text{O}$  (Parkmann, Sill Am J (2) 3 335)

$\text{Cu}_2\text{Te}$  (Brauner, M 1889 423)

**Croceocobaltic bromide**,

$\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{Br}$

Very sl sol in cold, easily in hot  $\text{H}_2\text{O}$  (Gibbs, Proc Am Acad 10 1)

— **chloraurate**,  $2\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{Cl}$ ,  $\text{AuCl}_3$   
Difficultly sol in  $\text{H}_2\text{O}$

— **chloride**,  $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{Cl}$

Very sl sol in cold easily in hot  $\text{H}_2\text{O}$ , but more sol than the sulphate (Gibbs)

— **chloroplatinate**,  $2\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{Cl}$ ,  $\text{PtCl}_4$

Can be recrystallised without decomp with difficulty (Gibbs and Genth, Sill Am J (2) 24 91)

— **chromate**,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]_2\text{CrO}_4$   
Sl sol in  $\text{H}_2\text{O}$  (Gibbs)

— **dichromate**,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]_2\text{Cr}_2\text{O}_7$   
Sl sol in  $\text{H}_2\text{O}$  (Gibbs)

— **periodide**,  $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{I}$ ,  $\text{I}_2$

Difficultly sol in cold  $\text{H}_2\text{O}$  and alcohol  
Decomp by hot  $\text{H}_2\text{O}$  (Gibbs)

— **nitrate**,  $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{NO}_3$

Sl sol in cold, easily sol in hot  $\text{H}_2\text{O}$  or dil acids. Much more sol than the sulphate (Gibbs)

Sol in about 400 pts cold  $\text{H}_2\text{O}$  (Jorgensen, Z anorg 5 163)

— **nitrite cobaltic nitrite**,  $3\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2$ ,  $\text{Co}(\text{NO}_2)_3$

Somewhat sol in  $\text{H}_2\text{O}$  (Jorgensen, Z anorg 5 178)

— **nitrite diamine cobaltic nitrite**,  $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2$ ,  $(\text{NO}_2)_2(\text{NH}_3)_2\text{Co}(\text{NO}_2)_2$

Nearly insol in cold, very sl sol in boiling  $\text{H}_2\text{O}$  (Jorgensen)

**Croceocobaltic phosphomolybdate**,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]_2\text{O}$ ,  $24\text{MoO}_3$ ,  $\text{P}_2\text{O}_5$

Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 3 317)

— **sulphate**,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]_2\text{SO}_4$

Very sl sol in cold or hot  $\text{H}_2\text{O}$  more easily in hot dil  $\text{H}_2\text{SO}_4 + \text{Aq}$

**Cuprammonium compounds**

See Copper compounds, ammonia

**Cuprotetrammonium tetraiodide**

See Cupric tetraiodide ammonia

**Cupric acid**

Known only in solution (Kruger, Pogg 62 445)

**Calcium cuprate**

Decomp by  $\text{H}_2\text{O}$  with evolution of oxygen (Kruger and Crum, A 55 213)

**Cyanhydric acid**,  $\text{HCN}$

Miscible with  $\text{H}_2\text{O}$ , alcohol, and ether with absorption of heat

Sp gr of  $\text{HCN} + \text{Aq}$

% HCN	Sp gr	% HCN	Sp gr
1 60	0 9979	4 0	0 9940
1 68	0 9978	4 6	0 9930
1 77	0 9975	5 0	0 9923
2 0	0 9974	5 3	0 9914
2 1	0 9973	5 8	0 9900
2 3	0 9970	6 4	0 9890
2 5	0 9967	7 3	0 9870
2 7	0 9964	8 0	0 9840
3 0	0 9958	9 1	0 9815
3 2	0 9952	10 6	0 9768
3 6	0 9945	16 0	0 9570

(Ure, Quar J Sci 13 321)

$2\text{HCN}$  mixed with  $3\text{H}_2\text{O}$  causes a diminution of temp of  $9.75^\circ$  (Bussy and Buignet, A ch (4) 3 231)

Miscible with volatile oils and other organic compounds

**Cyanhydric iodhydric acid**,  $\text{HI}$ ,  $\text{HCN}$

Easily sol in  $\text{H}_2\text{O}$  or alcohol, with rapid decomp. Sl sol in ether (Gal, A 138 38)

**Cyanides**

The alkali cyanides are easily sol in  $\text{H}_2\text{O}$ , those of the alkali-earths are less sol, while all others are insol with the exception of  $\text{Hg}(\text{CN})_2$ . All cyanides are sol in  $\text{KCN} + \text{Aq}$

**Ammonium cyanide**,  $\text{NH}_4\text{CN}$

Unstable, easily sol in  $\text{H}_2\text{O}$  and alcohol

**Ammonium cobaltic mercuric cyanide**

See Cobaltcyanide, ammonium mercuric

**Ammonium cuprous cyanide,  $\text{NH}_4\text{CN}$ ,  $\text{Cu}_2(\text{CN})_2$** 

Ppt Decomp by acids

+ $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , less sol in alcohol

Decomp by acids and alkalis (Treadwell and Girsfeld, Z anorg 1904, 39 90)

$2\text{NH}_4\text{CN}$ ,  $\text{Cu}_2(\text{CN})_2$  Sl sol in  $\text{H}_2\text{O}$ , but decomp by long boiling therewith Sol in  $\text{HCN} + \text{Aq}$  (Dufau, A 88 278)

**Ammonium cuprous cyanide ammonia,  $\text{NH}_4\text{CN}$ ,  $2\text{Cu}_2(\text{CN})_2$ ,  $\text{NH}_3$** 

Easily decomp (Treadwell and Girsfeld, Z anorg 1904, 39 90)

+ $2\text{H}_2\text{O}$  Insol in cold, decomp by boiling  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Fleurent, C R 1893, 116 191)

$\text{NH}_4\text{CN}$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $3\text{NH}_3$  Insol in cold, sl sol in boiling  $\text{H}_2\text{O}$  without decomp Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Fleurent, C R 1891, 113 1046)

$\text{NH}_4\text{CN}$ ,  $2\text{Cu}_2(\text{CN})_2$ ,  $2\text{NH}_3 + 2\text{H}_2\text{O}$  (Fleurent, B 25 498R)

**Ammonium gold (aurous) cyanide  $\text{NH}_4\text{CN}$ ,  $\text{AuCN}$** 

Easily sol in cold or warm  $\text{H}_2\text{O}$  or in alcohol Insol in ether

**Ammonium gold (auric) mercuric cyanide, basic,  $3\text{NH}_4\text{CN}$ ,  $2\text{Au}_2\text{O}$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{HgO}$  (Schmidt, Ch Z 1896, 20 633)****Ammonium mercuric silver cyanide, basic,  $\text{NH}_4\text{CN}$ ,  $2\text{Ag}_2\text{O}$ ,  $3\text{AgCN}$ ,  $4\text{Hg}(\text{OH})\text{CN} + \frac{1}{2}\text{H}_2\text{O}$** 

(Schmidt, Z anorg 1895, 9 431)

**Ammonium nickel cyanide,  $2\text{NH}_4\text{CN}$ ,  $\text{Ni}(\text{CN})_2$** 

Easily decomposed

**Ammonium tungsten cyanide**

See Tungstocyanide, ammonium

**Ammonium zinc cyanide,  $2\text{NH}_4\text{CN}$ ,  $\text{Zn}(\text{CN})_2$** 

Sol in  $\text{H}_2\text{O}$

**Ammonium cyanide mercuric nitrate silver cyanide basic,  $2\text{Hg}(\text{OH})\text{NO}_3$ ,  $3\text{NH}_4\text{CN}$ ,  $4\text{AgCN}$** 

(Schmidt, Z anorg 1895, 9 431)

**Arsenic tricyanide,  $\text{As}(\text{CN})_3$** 

Decomp by  $\text{H}_2\text{O}$  Not attacked by cold conc  $\text{H}_2\text{SO}_4$  Decomp on heating (Guenez, C R 1892, 114 1188)

**Barium cyanide,  $\text{Ba}(\text{CN})_2$** 

Rather sl sol in  $\text{H}_2\text{O}$ , more easily in  $\text{KCN} + \text{Aq}$  (Schulz, J pr 68 257)

10 pts  $\text{H}_2\text{O}$  dissolve 8 pts, and 10 pts 70% alcohol dissolve 18 pts  $\text{Ba}(\text{CN})_2$  at  $14^\circ$  (Joannis, A ch (5) 26 489)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

+ $2\text{H}_2\text{O}$  Very deliquescent  $\text{Ba}(\text{CN})_2$ ,  $\text{BaO}$  (Drechsel, J pr (2) 21 84)

**Barium cadmium cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Cd}(\text{CN})_2 + \text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$

Sl sol in alcohol (Loebe, Dissert, 1902)  $2\text{Ba}(\text{CN})_2$ ,  $3\text{Cd}(\text{CN})_2 + 10\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Weselsky, B 2 590)

**Barium cobaltous cobaltic cyanide**

See Cobaltocobaltcyanide, barium

**Barium cuprous cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$** 

Sol in  $\text{H}_2\text{O}$  without decomp (Traube, Z anorg 1894, 8 21)

+ $\text{H}_2\text{O}$  (Weselsky, B 2 590)

Could not be obtained (Grossmann, Z anorg 1905, 43 101)

+ $4\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1905, 43 101)

$2\text{Ba}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2 + 6\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1905, 43 105)

**Barium gold (aurous) cyanide,  $\text{Ba}(\text{CN})_2$ ,  $2\text{AuCN} + 2\text{H}_2\text{O}$** 

Sl sol in cold but easily sol in hot  $\text{H}_2\text{O}$

Sl sol in alcohol (Lindbom, Lund Univ Arsk 12 No 6)

**Barium iridium cyanide**

See Iridicyanide, barium

**Barium manganous cyanide,  $\text{Ba}(\text{CN})_2$ ,  $2\text{Mn}(\text{CN})_2$** 

Ppt (Descamps)

See also Manganocyanide and Manganicyanide, barium

**Barium mercuric cyanide,  $(\text{Ba}(\text{CN})_2)$ ,  $\text{Hg}(\text{CN})_2 + 3\text{H}_2\text{O}$** 

Very hygroscopic Very sol in  $\text{H}_2\text{O}$  (Grossmann, B 1904, 37 442)

**Barium mercuric cyanide iodide,  $\text{Ba}(\text{CN})_2$ ,  $\text{HgI}_2 + 6\text{H}_2\text{O}$** 

(Vurt, C R 1895, 121 499)

**Barium palladium cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Pd}(\text{CN})_2 + 4\text{H}_2\text{O}$** 

See Palladocyanide, barium

**Barium nickel cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Ni}(\text{CN})_2 + 3\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$ , decomp by acids with pptn of  $\text{Ni}(\text{CN})_2$  (Weselsky, B 2 590)

**Barium silver cyanide**,  $\text{Ba(CN)}_2$ ,  $2\text{AgCN} + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Weselsky, B 2 589)

**Barium zinc cyanide**,  $\text{Ba(CN)}_2$ ,  $\text{Zn(CN)}_2 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  \*

**Cadmium cyanide, basic**,  $\text{CdO}_2\text{H}_2$ ,  $2\text{Cd(CN)}_2 + 4\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$ , insol in alcohol (Loebe, Dissert, 1902)

**Cadmium cyanide**,  $\text{Cd(CN)}_2$

Sl sol in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  dissolve 1.7 pts  $\text{Cd(CN)}_2$  at  $15^\circ$  (Joannis)

Easily sol in acids, sol in  $\text{KCN} + \text{Aq}$  Sol in warm  $\text{NH}_4\text{OH} + \text{Aq}$ , but insol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Wittstein)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

**Cadmium calcium cyanide**,  $\text{Cd(CN)}_2$ ,  $4\text{Ca(CN)}_2 + 20\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  and in alcohol (Loebe, Dissert, 1902)

**Cadmium chromic cyanide**

See Chromicyanide, cadmium

**Cadmium cobaltic cyanide**

See Cobalticyanide, cadmium

**Cadmium cuprous cyanide**,  $2\text{Cd(CN)}_2$ ,  $\text{Cu}_2(\text{CN})_2$

Permanent Insol in  $\text{H}_2\text{O}$  Sl sol in cold, easily in warm  $\text{HCl} + \text{Aq}$  without decomp, except by long boiling Insol in  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4$  salts +  $\text{Aq}$  (Schuler)

**Cadmium cupric cyanide**,  $\text{Cd(CN)}_2$ ,  $\text{Cu(CN)}$

Very unstable

**Cadmium gold (aurous) cyanide**,  $\text{Cd(CN)}$ ,  $2\text{AuCN}$

Nearly insol in cold  $\text{H}_2\text{O}$  Sl sol in boiling  $\text{H}_2\text{O}$  Insol in alcohol (Landbom)

**Cadmium mercuric cyanide**,  $2\text{Cd(CN)}_2$ ,  $3\text{Hg(CN)}_2$

Permanent Readily sol in cold  $\text{H}_2\text{O}$  (Schuler)

**Cadmium mercuric cyanide mercuric iodide**,  $\text{Cd(CN)}_2$ ,  $\text{Hg(CN)}_2$ ,  $\text{HgI}_2 + 8\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Varet, Bull Soc (3) 5 8)

+  $7\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$  (Varet, C R 1890, 111, 679)

**Cadmium mercuric cyanide mercuric iodide**,  $\text{Cd(CN)}_2$ ,  $\text{Hg(CN)}_2$ ,  $\text{HgI}_2 + 8\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Varet, Bull Soc (3) 5 8)

+  $7\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$  (Varet, C R 1890, 111 679)

**Cadmium mercuric cyanide mercuric iodide ammonia**,  $\text{Cd(CN)}_2$ ,  $\text{Hg(CN)}_2$ ,  $\text{HgI}_2$ ,  $4\text{NH}_3$

Very easily decomp (Varet, Bull Soc (3) 6 22)

**Cadmium molybdenum cyanide**

See Molybdocyanide, cadmium

**Cadmium potassium cyanide**,  $\text{Cd(CN)}_2$ ,  $2\text{KCN}$

Sol in 3 pts cold, and 1 pt boiling  $\text{H}_2\text{O}$  Insol in absolute alcohol (Rammelsberg)

**Cadmium sodium cyanide**,  $\text{Na}_2\text{Cd}_2(\text{CN})_6$ ,  $+3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  and in alcohol (Loebe, Dissert, 1902)

**Cadmium strontium cyanide**,  $\text{Cd(CN)}_2$ ,  $2\text{Sr(CN)}_2 + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  and in alcohol (Loebe, Dissert 1902)

**Cadmium tungsten cyanide**,  $\text{Cd}_2\text{W(CN)}_8 + 8\text{H}_2\text{O}$

Nearly insol in  $\text{H}_2\text{O}$

Sl sol in dil  $\text{HCl}$  Sol in conc  $\text{NH}_4\text{OH} + \text{Aq}$

Insol in organic solvents (Olsson, Z anorg 1914, 88 68)

**Cadmium cyanide dihydrazine**,  $\text{Cd(CN)}_2$ ,  $(\text{N}_2\text{H}_4)_2$

Easily sol in dil acids (Franzen, Z anorg 1911, 70 152)

**Cæsium cuprous cyanide**,  $\text{CsCN}$ ,  $\text{CuCN} + 1\frac{1}{2}\text{H}_2\text{O}$

$\text{H}_2\text{O}$  separates  $\text{CuCN}$  (Grossmann, Z anorg 1905, 43 98)

$2\text{CsCN}$ ,  $\text{CuCN} + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1905, 43 95)

$2\text{CsCN}$ ,  $3\text{CuCN}$  Insol in, and not decomp by  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1905, 43 98)

**Cæsium tungsten cyanide**

See Tungstocyanide, cæsium

**Calcium cyanide**,  $\text{Ca(CN)}_2$

Sol in  $\text{H}_2\text{O}$ , but the solution is very unstable (Schulz)

$\text{Ca(CN)}_2$ ,  $3\text{CaO} + 15\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Joannis, A ch (5) 26 496)

**Calcium cuprous cyanide**,  $\text{Ca(CN)}_2$ ,  $\text{CuCN} + 4\text{H}_2\text{O}$

Easily decomp by  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1905, 43 106)

$\text{Ca(CN)}_2$ ,  $3\text{CuCN} + 8\text{H}_2\text{O}$  Immediately

decomp by  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1905, **43** 99)

**Calcium gold (aurous) cyanide**,  $\text{Ca}(\text{CN})_2$ ,  $2\text{AuCN} + 3\text{H}_2\text{O}$

Easily sol in hot or cold  $\text{H}_2\text{O}$  or in alcohol (Lindbom)

**Calcium manganous cyanide**,  $\text{Ca}(\text{CN})_2$ ,  $2\text{Mn}(\text{CN})_2$

Ppt (Descamps)

See also Manganocyanide, calcium

**Calcium mercuric cyanide**,  $\text{Ca}(\text{CN})_2$ ,  $2\text{Hg}(\text{CN})_2 + 8\text{H}_2\text{O}$

Very deliquescent (Grossmann, B 1904, **37** 4143)

$2\text{Ca}(\text{CN})_2$ ,  $3\text{Hg}(\text{CN})_2 + 6\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Grossmann, B 1904, **37** 4143)

**Calcium mercuric cyanide iodide**,  $\text{Ca}(\text{CN})_2$ ,  $\text{HgI}_2$ ,  $\text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$

(Varet, C R 1895, **121** 499)

**Calcium nickel cyanide**,  $\text{Ca}(\text{CN})_2$ ,  $\text{Ni}(\text{CN})_2 + \tau\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$

**Calcium tungsten cyanide**

See Tungstocyanide, calcium

**Calcium zinc cyanide**,  $(\text{Ca}(\text{CN})_2, \text{Zn}(\text{CN})_2 + 3\frac{1}{2}\text{H}_2\text{O})$

Sol in  $\text{H}_2\text{O}$  und in alcohol (Loebe, Dissert 1902)

**Cerous cyanide (?)**

Ppt Very easily decomp (Behringer, A **42** 139)

**Chromic cyanide, with MCN**

See Chromiocyanide, M

**Chromous potassium cyanide**

See Chromocyanide, potassium

**Cobaltous cyanide**,  $(\text{Co}(\text{CN})_2 + \text{H O})$

Insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , and  $\text{KCN} + \text{Aq}$ , also in  $(\text{NH}_4)_2\text{CO}_3$ , or  $\text{NH}_4\text{Cl}$  in  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4\text{Cl}$

**Cobaltous cyanide with 4MCN**

See Cobaltocyanide, M

**Cobaltic cyanide with 3MCN**

See Cobaltocyanide, M

**Cobalt gold (aurous) cyanide**,  $\text{Co}(\text{CN})_2$ ,  $2\text{AuCN}$

Insol in  $\text{H}_2\text{O}$  or cold  $\text{HCl} + \text{Aq}$

**Cobalt hydrazine cyanide**,  $(\text{N}_2\text{H}_4)_4\text{Co}(\text{CN})_6$   
Deliquescent (Franzen, Z anorg 1911, **70** 155)

**Cobaltous cyanide ammonia**,  $\text{Co}(\text{CN})_2$ ,  $2\text{NH}_3$

Unstable (Peters, B 1908, **41** 3178)

**Cuprous cyanide**,  $\text{Cu}_2(\text{CN})_2$

Insol in  $\text{H}_2\text{O}$  and dil acids Sol in  $\text{NH}_4\text{OH}$ ,  $(\text{NH}_4)_2\text{SO}_4$ , or  $\text{NH}_4$  succinate +  $\text{Aq}$ , and in hot  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  Sol in conc  $\text{HCl} + \text{Aq}$  Sol in  $\text{KCN} + \text{Aq}$

Easily sol in conc  $\text{NH}_4\text{SCN}$  or  $\text{KSCN} + \text{Aq}$  Sl sol in  $\text{NaSCN} + \text{Aq}$  (Grossmann, Z anorg 1903, **37** 408)

Sl sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, **20** 827)

Very sl sol in pyridine (Schroeder, Dissert 1902)

Mol weight determined in pyridine (Werner, Z anorg 1897, **15** 20)

**Cupric cyanide**,  $\text{Cu}(\text{CN})_2$

Easily decomp Insol in  $\text{H}_2\text{O}$

Sol in pyridine (Schroeder, Dissert 1901)

Insol in methyl acetate (Naumann, B 1909, **42** 3790)

**Cuprocupric cyanide**,  $\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2 + 5\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , but decomp by boiling Sol in cold conc  $\text{HCl} + \text{Aq}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$   $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , and in hot  $\text{NH}_4$  salts +  $\text{Aq}$  Easily sol in  $\text{KCN} + \text{Aq}$

+  $\text{H}_2\text{O}$  Ppt (Dufau)

+  $\text{Cu}(\text{CN})_2$ ,  $2\text{Cu}_2(\text{CN})_2 + \text{H O}$  Ppt

**Cuprous hydrazine cyanide**,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{N}_2\text{H}_5\text{CN}$

Insol in alcohol and  $\text{H}_2\text{O}$  (Ferratini, C C 1912, I 1281)

**Cupric iridium cyanide**

See Iridiocyanide, cupric

**Cuprous lithium cyanide**,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{LiCN} + \text{H O}$

Gradually decomp by  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1905, **43** 97)

**Cuprous magnesium cyanide**,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{Mg}(\text{CN})_2 + 11\text{H}_2\text{O}$

Decomp by  $\text{H O}$  (Grossmann, Z anorg 1905, **43** 103)

**Cuprous mercuric cyanide bromide**,  $\text{Cu}(\text{CN})_2$ ,  $2\text{Hg}(\text{CN})_2$ ,  $\text{HgBr}_2$

Sol in  $\text{H}_2\text{O}$  (Varet, C R 1890, **110** 148)

**Cupric molybdenum cyanide ammonia**

See Molybdocyanide ammonia, cupric



**Cuprous potassium cyanide,  $\text{Cu}(\text{CN})_2, 2\text{KCN}$** 

Sl sol in  $\text{H}_2\text{O}$ , with partial decomp. Decomp by acids, but not by alkalis

Decomp by boiling  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Fleurent, C R 1893, 116 191)

Sol without decomp in conc  $\text{KSCN}$  (Grossmann, Z anorg 1903, 37 407)

Sol without decomp in  $\text{KCN} + \text{Aq}$  (Treadwell and Girsewald, Z anorg 1904, 38 94)

$\text{Cu}_2(\text{CN})_2, \text{KCN} + \text{H}_2\text{O}$  Almost insol in cold  $\text{H}_2\text{O}$ . 100 cc  $\text{H}_2\text{O}$  dissolve 0.0594 g at  $15^\circ$ . Decomp by much hot  $\text{H}_2\text{O}$  with separation of  $\text{Cu}_2(\text{CN})_2$ . Sol in  $\text{KCN} + \text{Aq}$  or in  $\text{NH}_4\text{OH} + \text{Aq}$  (Treadwell and Girsewald, Z anorg 1904, 38 93)

$3\text{Cu}_2(\text{CN})_2, 4\text{KCN}$  Sol in  $\text{H}_2\text{O}$

$\text{Cu}_2(\text{CN})_2, 6\text{KCN}$  Sol in  $\text{H}_2\text{O}$

**Cuprous potassium cyanide ammonia,  $\text{Cu}_2(\text{CN})_2, \text{KCN}, \text{NH}_3$** 

(Treadwell and Girsewald, Z anorg 1904, 38 94)

**Cuprous potassium cyanide potassium sulphocyanide,  $\text{Cu}_2(\text{CN})_2, 4\text{KCN}, 2\text{KSCN}, \text{H}_2\text{O}$** 

Easily sol in cold  $\text{H}_2\text{O}$  (Itzig, B 1902, 35 108)

**Cupric potassium cyanide,  $\text{Cu}(\text{CN})_2, 2\text{KCN}$** 

Sol in  $\frac{3}{4}$  pt  $\text{H}_2\text{O}$  at  $15^\circ$  and  $\frac{1}{3}$  pt at  $100^\circ$  (Bugnet, J Pharm 1859, (3), 35 168)

**Cuprocupric potassium cyanide  $\text{Cu}_2(\text{CN})_2, \text{Cu}(\text{CN})_2, 2\text{KCN}$** 

(Straus, Z anorg 1895, 9 15)

**Cuprous rubidium cyanide,  $\text{Cu}(\text{CN})_2, 2\text{RbCN}$** 

Sl sol in  $\text{H}_2\text{O}$ . Pure  $\text{H}_2\text{O}$  separates  $\text{CuCN}$  (Grossmann, Z anorg 1905, 43 100)

$3\text{Cu}(\text{CN})_2, 4\text{RbCN}$  Sl sol in  $\text{H}_2\text{O}$ . Pure  $\text{H}_2\text{O}$  separates  $\text{CuCN}$  (Grossmann, Z anorg 1905, 43 98)

**Cuprous silver cyanide,  $\text{Cu}(\text{CN})_2, 2\text{AgCN}$** 

Ppt

$\text{Cu}(\text{CN})_2, 6\text{AgCN}$  Sol in excess of  $\text{Cu}(\text{CN})_2, \text{KCN} + \text{Aq}$  (Rummelsberg)

**Cuprous sodium cyanide,  $\text{Cu}(\text{CN})_2, 2\text{NaCN}$** 

(Treadwell, Z anorg 1894 8 21)

+  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$ . Sol in excess of  $\text{NaCN} + \text{Aq}$  (Grossmann, Z anorg 1905 43 96)

$\text{Cu}_2(\text{CN})_2, \text{NaCN} + 2\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1905, 43 96)

$\text{Cu}_2(\text{CN})_2, 4\text{NaCN} + 6\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  without decomp (Grossmann, Z anorg 1905, 43 96)

$\text{Cu}(\text{CN})_2, 6\text{NaCN} + 6\text{H}_2\text{O}$  Very sol in

$\text{H}_2\text{O}$  without decomp (Grossmann, Z anorg 1905, 43 96)

**Cuprous strontium cyanide,  $\text{Cu}_2(\text{CN})_2, \text{Sr}(\text{CN})_2 + 8\text{H}_2\text{O}$** 

$\text{H}_2\text{O}$  separates  $\text{Cu}_2(\text{CN})_2$  (Grossmann, Z anorg 1905, 43 103)

**Cuprous cyanide ammonia,  $\text{Cu}_2(\text{CN})_2, 2\text{NH}_3$** 

Nearly insol in cold  $\text{H}_2\text{O}$ . Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  in absence of oxygen. Insol in alcohol and ether. Decomp by hot  $\text{H}_2\text{O}$  and acids (Treadwell and Girsewald, Z anorg 1904, 39 87)

**Cuprocupric cyanide ammonia,  $\text{Cu}_2(\text{CN})_2, \text{Cu}(\text{CN})_2, 2\text{NH}_3$** 

(Malmberg, Arch Pharm 1898, 236 256) +  $\text{H}_2\text{O}$  Sl sol in cold, decomp by boiling  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Dufau, A 88 278)

$\text{Cu}(\text{CN})_2, \text{Cu}_2(\text{CN})_2, 3\text{NH}_3$  (Mills, Z Ch 1867 545)

Sl decomp by boiling  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  and can be recryst therefrom. Insol in alcohol and ether. Decomp by alkalis and acids (Treadwell and Girsewald, Z anorg 1904, 39 96)

$\text{Cu}(\text{CN})_2, \text{Cu}_2(\text{CN})_2, 4\text{NH}_3$  Insol in cold decomp by hot  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Treadwell and Girsewald, Z anorg 1904, 39 92)

$2\text{Cu}_2(\text{CN})_2, \text{Cu}(\text{CN})_2, 2\text{NH}_3$  Insol in  $\text{H}_2\text{O}$ , alcohol and ether. Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp by boiling acids and alkalis (Treadwell and Girsewald, Z anorg 1904, 39 92)

+  $\text{H}_2\text{O}$  (Monthier, J Pharm 11 257)

$\text{Cu}(\text{CN})_2, 2\text{Cu}(\text{CN})_2, 4\text{NH}_3$  (Hillen kamp, A 97 215)

$\text{Cu}(\text{CN})_2, 2\text{Cu}_2(\text{CN})_2, 6\text{NH}_3$  (Schiff and Beechi, A 134 33)

$2\text{Cu}(\text{CN})_2, \text{Cu}(\text{CN})_2, 2\text{NH}_3 + 3\text{H}_2\text{O}$

(Fleurent C R 114 1060)

$2\text{Cu}(\text{CN})_2, \text{Cu}(\text{CN})_2, 4\text{NH}_3 + \text{H}_2\text{O}$  Correct formula for  $\text{Cu}(\text{CN})_2, \text{Cu}(\text{CN})_2, 4\text{NH}_3$  (Bouveault, Bull Soc (3) 4 641)

**Cuprous cyanide ammonium sulphocyanide  $\text{Cu}(\text{CN})_2, 3\text{NH}_4\text{SCN}$** 

Decomp by  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1903, 37 409)

**Cupric cyanide hydrazine,  $\text{Cu}(\text{CN})_2(\text{NH}_2)_2$** 

Insol in  $\text{H}_2\text{O}$  and cold dil acids

Sol in warm dil acids (Franzen, Z anorg 1911, 70 154)

**Cuprous cyanide mercuric iodide,  $\text{Cu}_2(\text{CN})_2, \text{HgI}_2$** 

Sol in  $\text{H}_2\text{O}$  (Varet, Bull Soc (3) 4 484)

**Cuprous cyanide potassium sulphocyanide,**  $\text{Cu}_2(\text{CN})_2, 3\text{KSCN}$

Decomp by  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1903, 37 409)

**Gold (aurous) cyanide,  $\text{AuCN}$**

Insol in  $\text{H}_2\text{O}$ , alcohol, or ether Not attacked by dil, or conc acids, even boiling aqua regia

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , also in soluble cyanides  $+ \text{Aq}$

Slowly decomp by boiling  $\text{KOH} + \text{Aq}$ , also by  $(\text{NH}_4)_2\text{S} + \text{Aq}$

Sol in  $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$  (Bentel, Z anorg 1912, 78 152)

**Gold (auric) cyanide with  $\text{MCN}$**

See Auricyanide, M

**Gold (auroauric) mercuric cyanide auric mercuric chloride,  $4\text{AuCN}, \text{Au}(\text{CN})_3, 5\text{Hg}(\text{CN})_2, 7\text{AuCl}_3, 5\text{HgCl}_2$**   
(Schmidt, Ch Z 1896, 20 633)

**Gold (aurous) potassium cyanide,  $\text{AuCN}, \text{KCN}$**

Sol in 7 pts cold, and less than 0.5 pt boiling  $\text{H}_2\text{O}$  Sl sol in cold, and somewhat more sol in boiling alcohol Insol in ether (Himly, A 42 160)

Decomp by warm acids, even tartaric, and acetic acids

**Gold (aurous) sodium cyanide,  $\text{AuCN}, \text{NaCN}$**

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  Sl sol in alcohol (Lindbom)

**Gold (aurous) strontium cyanide,  $2\text{AuCN}, \text{Sr}(\text{CN})_2 + 3\text{H}_2\text{O}$**

As the Na salt

**Gold (aurous) zinc cyanide,  $2\text{AuCN}, \text{Zn}(\text{CN})_2$**

Nearly insol in hot or cold  $\text{H}_2\text{O}$

Insol in cold  $\text{HCl} + \text{Aq}$

**Gold (auric) cyanide auric mercuric chloride,  $\text{Au}(\text{CN})_3, \text{AuCl}_3, 2\text{HgCl}_2$**

(Schmidt, Ch Z 1896, 20 633)

**Gold (auroauric) cyanide aurous mercuric chloride,  $12\text{AuCN}, 3\text{Au}(\text{CN})_3, 4\text{AuCl}_3, 2\text{HgCl}_2$**

(Schmidt, Ch Z 1896, 20 633)

**Gold (auroauric) cyanide mercuric chloride  $15\text{AuCN}, 2\text{Au}(\text{CN})_3, 5\text{HgCl}_2$**

(Schmidt, Ch Z 1896, 20 633)

**Iridium cyanide,  $\text{Ir}(\text{CN})_3$**

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCN} + \text{Aq}$

**Iridium cyanide with  $\text{MCN}$**

See Iridicyanide, M

**Lanthanum cyanide,  $\text{La}(\text{CN})_3$**

Ppt (Frenichs and Smith, B 11 910, 1151)

**Lead cyanide,  $\text{Pb}(\text{CN})_2$**

Sl sol in cold, more in hot  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3 + \text{Aq}$ , and  $\text{KCN} + \text{Aq}$  Partially sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , and  $\text{NH}_4$  salts  $+ \text{Aq}$  Not pptd in presence of Na citrate

Above compound is  $2\text{PbO}, \text{Pb}(\text{CN})_2 + \text{H}_2\text{O}$  (Joannis, A ch (5) 26 204)

$2\text{PbO}, \text{Pb}(\text{CN})_2 + \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$

**Lead tungsten cyanide**

See Tungstocyanide, lead

**Lead zinc cyanide,  $\text{Pb}(\text{CN})_2, 2\text{Zn}(\text{CN})_2$**

Ppt (Rammelsberg)

**Lead cyanide chloride,  $2\text{Pb}(\text{CN})_2, \text{PbCl}_2$**

Insol in  $\text{H}_2\text{O}$  (Grissom and Thorp, Am Ch J 10 229)

**Lithium mercuric cyanide mercuric iodide,  $2\text{Li}(\text{CN})_3, \text{Hg}(\text{CN})_2, \text{HgI}_2 + 7\text{H}_2\text{O}$**

Deliquescent, sol in  $\text{H}_2\text{O}$  (Varet, C R 111 526)

**Magnesium cyanide,  $\text{Mg}(\text{CN})_2$**

Known only in aqueous solution which decomposes on evaporation (Schulz)

**Magnesium mercuric cyanide,  $2\text{Mg}(\text{CN})_2, 3\text{Hg}(\text{CN})_2 + 5\text{H}_2\text{O}$**

(Grossmann, B 1904, 37 4143)

**Magnesium mercuric cyanide mercuric bromide,  $\text{Mg}(\text{CN})_2, \text{Hg}(\text{CN})_2, \text{HgBr} + 8\text{H}_2\text{O}$**

Very sol in  $\text{H}_2\text{O}$  (Varet, Bull Soc (3) 7 170)

**Magnesium mercuric cyanide mercuric iodide,  $\text{Mg}(\text{CN})_2, \text{Hg}(\text{CN})_2, \text{HgI}_2 + 8\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  (Varet, Bull Soc (3) 7 170)

**Magnesium platinum cyanide**

See Platinocyanide, magnesium

**Magnesium tungsten cyanide**

See Tungstocyanide, magnesium

**Manganous and manganic cyanides**

See Manganocyanhydric, and Manganocyanhydric acids

**Manganous strontium cyanide,  $2\text{Mn}(\text{CN})_2, \text{Sr}(\text{CN})_2$**

Ppt (Descamps)

See also Manganocyanide, strontium

**Manganous tungsten cyanide**

See Tungstocyanide, manganous

**Manganic cyanide, with MCN**

See Manganicyanide, M

**Manganous cyanide with MCN**

See Manganocyanide, M

**Mercuric cyanide, basic,  $\text{Hg}(\text{CN})_2$ ,  $\text{HgO}$** Sl sol in cold, moderately sol in hot  $\text{H}_2\text{O}$   
Sol with decomp in  $\text{KOH}$ ,  $\text{KCN}$ , or  $\text{KCl} + \text{Aq}$  (Johnston)Decomp by  $\text{H}_2\text{O}$  over  $80^\circ$  (Holdermann, Arch Pharm 1906, 244 135)Cold  $\text{H}_2\text{O}$  dissolves about 1%, boiling  $\text{H}_2\text{O}$  about 5% (Borelli, Gazz ch it 1908, 38 (1), 361)11% dissolves in  $\text{H}_2\text{O}$  at ord temp (Richard, J Chm Phys (6) 18 555)At  $0^\circ$  1/100 mol dissolve in 1 l  $\text{H}_2\text{O}$ At  $25^\circ$  1/32 " " " " "At  $90^\circ$  1/10 " " " " "

(Borelli, Gazz ch it 1908, 38 (1), 361)

1000 cc cold  $\text{H}_2\text{O}$  dissolve 1.35g (Holdermann, Arch Pharm 1906, 244 135)Less sol in cold  $\text{H}_2\text{O}$  than  $\text{Hg}(\text{CN})_2$  (Pieverling, J B 1899, 783)

Somewhat sol in dil alcohol

Practically insol in alcohol, ether,  $\text{C}_2\text{H}_6$  and all organic solvents (Borelli, Gazz ch it 1908, 38, (1), 361)Sol in 110 pt alcohol of  $90^\circ$  Bé (Richard, J Chm Phys (6), 18 555) $3\text{Hg}(\text{CN})_2$ ,  $\text{HgO}$  (Joannis, A ch (5) 26 469)Moderately sol in  $\text{H}_2\text{O}$  (Barthe, J Pharm 1896, (6), 3 186)Very sol in hot, less sol in cold  $\text{H}_2\text{O}$  (Holdermann, Arch Pharm 1904, 242 32)Easily sol in  $\text{HCl}$  (Joannis A ch 1882, (5) 26 511) $\text{Hg}(\text{CN})_2$ ,  $3\text{HgO}$  More sol in  $\text{H}_2\text{O}$  than  $\text{Hg}(\text{CN})_2$ ,  $\text{HgO}$ **Mercuric cyanide,  $\text{Hg}(\text{CN})_2$** Moderately sol in  $\text{H}_2\text{O}$ 100 pts  $\text{Hg}(\text{CN})_2 + \text{Aq}$  sat at  $101.1^\circ$  contain 35 pts  $\text{Hg}(\text{CN})_2$ , or 100 pts  $\text{H}_2\text{O}$  dissolve 53.85 pts  $\text{Hg}(\text{CN})_2$  at  $101.1^\circ$  (Griffiths)Sol in 8 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Abl)Sol in 11 pts cold, and 2.5 pts boiling  $\text{H}_2\text{O}$  (Wittstein)8 g are sol in 100 g  $\text{H}_2\text{O}$  at  $-0.45^\circ$  (Guthrie, Phil Mag 1878, (5) 6 40)100 g  $\text{H}_2\text{O}$  dissolve 9.3 g at  $13.5^\circ$  (Gimofeyev, Dissert 1894)100 cc sat solution contain 9.3 g at  $20^\circ$  (Konowalow, J russ Soc 1898, (4) 30 367)Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 0.44$  mol l (Sherrill, Z phys Ch 1903, 43 735)1 l  $\text{H}_2\text{O}$  dissolves 0.3956 mol (Hofmann and Wagner, Z Elektrochem 1909, 15 444)100 g  $\text{H}_2\text{O}$  dissolve 12.5 g at  $15^\circ$  (Marsh and Struthers, Chem Soc 1905, 87 1879)100 g  $\text{H}_2\text{O}$  dissolve 11.27 g at  $25^\circ$  Sp gr of solution = 1.0813 (Herz and Anders, Z anorg 1907, 62 164) $\text{Hg}(\text{CN})_2 + \text{Aq}$  containing 7.23%  $\text{Hg}(\text{CN})_2$  has sp gr  $20^\circ/20^\circ = 1.0572$  $\text{Hg}(\text{CN})_2 + \text{Aq}$  containing 9.07%  $\text{Hg}(\text{CN})_2$  has sp gr  $20^\circ/20^\circ = 1.0743$ 

(Le Blanc and Rohland, Z phys Ch 1896, 19 282)

Sp gr at  $16^\circ/4^\circ$  of  $\text{Hg}(\text{CN})_2 + \text{Aq}$  containing 7.8921%  $\text{Hg}(\text{CN})_2 = 1.06376$ , containing 5.4037% = 1.04246, containing 7.5009% = 1.06049 (Schonrock, Z phys Ch 1893, 11 770)Not decomp by acids except hot conc  $\text{H}_2\text{SO}_4$ Sol without decomp in  $\text{HNO}_3 + \text{Aq}$  (Berzelius)1 l  $\text{NH}_4\text{OH} + \text{Aq}$  (5.2%  $\text{NH}_3$ ) dissolves 204.3 g at about  $25^\circ$  (Konowalow)

Solubility in bases

1 l  $\text{H}_2\text{O}$  containing 0.3286 mols  $\text{KOH}$  dissolves 0.5179 mols  $\text{Hg}(\text{CN})_2$ 1 l  $\text{H}_2\text{O}$  containing 0.2350 mols  $\text{NaOH}$  dissolves 0.4840 mols  $\text{Hg}(\text{CN})_2$ 1 l  $\text{H}_2\text{O}$  containing 0.4775 mols  $\text{NaOH}$  dissolves 0.5977 mols  $\text{Hg}(\text{CN})_2$ 1 l  $\text{H}_2\text{O}$  containing 0.9475 mols  $\text{NaOH}$  dissolves 0.79603 mols  $\text{Hg}(\text{CN})_2$ 1 l  $\text{H}_2\text{O}$  containing 0.970 mols  $\text{LiOH}$  dissolves 0.6543 mols  $\text{Hg}(\text{CN})_2$ 1 l  $\text{H}_2\text{O}$  containing 0.480 mols  $\text{LiOH}$  dissolves 0.5500 mols  $\text{Hg}(\text{CN})_2$ 1 l  $\text{H}_2\text{O}$  containing 0.243 mols  $\text{LiOH}$  dissolves 0.4840 mols  $\text{Hg}(\text{CN})_2$ 

(Hofmann and Wagner, Z Elektrochem 1909, 15 444)

Solubility in  $\text{KCN} + \text{Aq}$  at  $25^\circ$ 

Concentration of $\text{KCN}$ Mols per litre	Solubility of $\text{Hg}(\text{CN})_2$ Mols per litre
0.0493	0.4855
0.0985	0.5350
0.1970	0.627

(Sherrill, Z phys Ch 1903, 43 719)

Solubility in  $\text{Na}_2\text{CO}_3 + \text{Aq}$ 1 l  $\text{H}_2\text{O}$  containing 0.4923 mols  $\text{Na}_2\text{CO}_3$  dissolves 0.4956 mols  $\text{Hg}(\text{CN})_2$ 1 l  $\text{H}_2\text{O}$  containing 0.2443 mols  $\text{Na}_2\text{CO}_3$  dissolves 0.4464 mols  $\text{Hg}(\text{CN})_2$ 1 l  $\text{H}_2\text{O}$  containing 0.1250 mols  $\text{Na}_2\text{CO}_3$  dissolves 0.4147 mols  $\text{Hg}(\text{CN})_2$ 1 l  $\text{H}_2\text{O}$  containing 0.0000 mols  $\text{Na}_2\text{CO}_3$  dissolves 0.3952 mols  $\text{Hg}(\text{CN})_2$ 

(Hofmann and Wagner, Z Elektrochem, 1909, 15 444)

Solubility in  $\text{KNO}_3 + \text{Aq}$  at  $25^\circ$

1 l  $\text{H}_2\text{O}$  containing 0.9574 mols  $\text{KNO}_3$   
dissolves 0.5383 mols  $\text{Hg}(\text{CN})_2$   
1 l  $\text{H}_2\text{O}$  containing 0.4614 mols  $\text{KNO}_3$   
dissolves 0.4619 mols  $\text{Hg}(\text{CN})_2$   
1 l  $\text{H}_2\text{O}$  containing 0.0000 mols  $\text{KNO}_3$  dis-  
solves 0.3956 mols  $\text{Hg}(\text{CN})_2$   
(Hofmann and Wagner, Z Elektrochem 1909,  
15 444)

Insol in liquid  $\text{CO}_2$  (Buchner, Z phys  
Ch 1906, 54 674)

Very easily sol in liquid  $\text{NH}_3$  (Franklin,  
Am Ch J 1898, 20 829)

Solubility of  $\text{Hg}(\text{CN})_2$  in ethyl alcohol at  $t^\circ$

$t^\circ$	% $\text{HgCl}_2$
0	8.3
10	8.8
20	9.25
30	9.8
40	10.3

(Timofeev, Dissert 1894)

Solubility of  $\text{Hg}(\text{CN})_2$  in methyl alcohol at  $t^\circ$   
 $\text{Hg}(\text{CN})_2 = g$   $\text{Hg}(\text{CN})_2$  in 100 g of the  
solution

$t^\circ$	$\text{Hg}(\text{CN})_2$
0.0	26.10
14.7	29.17
23.4	32.01
27.4	31.77
31.7	32.53
38.1	33.29
44.5	34.05

(Dukelski, Z anorg 1907, 53 337)

100 pts methyl alcohol dissolve 44.2 pts  
 $\text{Hg}(\text{CN})_2$  at  $19.5^\circ$ , 100 pts ethyl alcohol  
dissolve 2.09 pts at  $19.5^\circ$  (de Bruyn, Z  
phys Ch 1892, 10 784)

Sol in 2.5 pts methyl alcohol at  $14^\circ$ , in  
20 pts ethyl alcohol at  $15^\circ$  (Marsh, Chem  
Soc 1905, 87 1878)

Solubility of  $\text{Hg}(\text{CN})_2$  in methyl alcohol +  
 $\text{Aq}$  at  $25^\circ$

$P = g$  alcohol in 100 g alcohol +  $\text{Aq}$   
 $\text{Hg}(\text{CN})_2 = \text{millimols}$   $\text{Hg}(\text{CN})_2$  in 10 cc of  
the solution

P	$\text{Hg}(\text{CN})_2$	Sp gr
0	4.34	1.0813
10.60	4.37	1.0642
30.77	4.94	1.0484
37.21	5.40	1.0430
47.06	6.49	1.0426
64.00	8.13	1.0441
78.05	9.75	1.0484
100	13.60	1.0762

(Herz and Anders, Z anorg 1907, 52 165)

Solubility of  $\text{Hg}(\text{CN})_2$  in ethyl alcohol +  $\text{Aq}$   
at  $25^\circ$

$P = g$  alcohol in 100 g alcohol +  $\text{Aq}$   
 $\text{Hg}(\text{CN})_2 = \text{millimols}$   $\text{Hg}(\text{CN})_2$  in 10 cc of  
the solution

P	$\text{Hg}(\text{CN})_2$	Sp gr
0	4.34	1.0813
20.18	3.47	1.0339
40.69	3.58	1.0006
70.01	3.80	0.9419
100	3.25	0.8552

(Herz and Anders, l c)

Solubility of  $\text{Hg}(\text{CN})_2$  in mixtures of methyl  
and ethyl alcohol at  $25^\circ$

$P = \%$  methyl alcohol in the solvent  
 $\text{Hg}(\text{CN})_2 = g$   $\text{Hg}(\text{CN})_2$  in 10 ccm. of the  
solution

$S_{25^\circ/4^\circ} = \text{Sp gr}$  of the sat solution

P	$\text{Hg}(\text{CN})_2$	$S_{25^\circ/4^\circ}$
0	0.819	0.8552
4.37	0.902	0.8618
10.4	1.01	0.8707
41.02	1.67	0.9267
80.69	2.82	1.024
84.77	2.96	1.034
91.25	3.09	1.052
100	3.43	1.076

(Herz and Kuhn, Z anorg 1903, 58 166)

100 g propyl alcohol dissolve 3.79 g  
 $\text{Hg}(\text{CN})_2$  at  $13.5^\circ$  (Timofeev, Dissert  
1894)

Solubility in mixtures of propyl and methyl  
alcohol at  $25^\circ$

$P = \%$  propyl alcohol in the solvent  
 $G = g$   $\text{Hg}(\text{CN})_2$  in 10 ccm. of the solution  
 $S = \text{Sp gr}$  of the sat solution

P	C	$S_{25^\circ/4^\circ}$
0	3.43	1.0760
11.11	2.952	1.0327
23.8	2.448	0.9891
65.2	1.048	0.8800
91.8	0.504	0.8376
93.97	0.423	0.8335
96.6	0.398	0.8322
100	0.344	0.8283

(Herz and Kuhn, Z anorg 1908, 60 158)

Solubility in mixtures of propyl and ethyl alcohol at 25°

P = % propyl alcohol in the solvent

G = g  $\text{Hg}(\text{CN})_2$  in 10 cc of the solution

S = Sp gr of the sat solution

P	G	S 25°/4°
0	0.819	0.8552
8.1	0.790	0.8549
17.85	0.730	0.8527
56.6	0.521	0.8386
88.6	0.387	0.8311
91.2	0.384	0.8306
95.2	0.364	0.8293
100	0.344	0.8283

(Herz and Kuhn, l c)

Sp gr at 16°/4° of  $\text{Hg}(\text{CN})_2$  + alcohol, containing 8.2206%  $\text{Hg}(\text{CN})_2$  = 0.85273, containing 5.8652% = 0.8348 +

Sp gr of 16°/4° of  $\text{Hg}(\text{CN})_2$  + pyridine containing 29.6018%  $\text{Hg}(\text{CN})_2$  = 1.28155, containing 23.2275% = 1.20198

(Schonrock, Z phys Ch 1893, 11 771)

1 l ether dissolves 0.01 mol at 25° (Sherrill, Z phys Ch 1903, 43 735)

Easily sol in acetone (Krug and M'Elroy, J Anal Ch 6 84)

100 g glycerol dissolve 27 g  $\text{Hg}(\text{CN})_2$  at 15.5° (Ossendowski, Pharm J 1907, 79 575)

Nearly insol in  $\text{C}_6\text{H}_6$  (Sherrill, Z phys Ch 1903, 43 735)

Sol in methyl acetate (Naumann, B 1909, 42 3790)

100 g boiling methyl acetate dissolve 3.2 g (Steiner, Dissert, 1906)

Solubility of  $\text{Hg}(\text{CN})_2$  in ethyl acetate + Aq at 25°

P = g ethyl acetate in 100 g ethyl acetate + Aq

$\text{Hg}(\text{CN})_2$  = millimols  $\text{Hg}(\text{CN})_2$  in 10 cc of the solution

P	$\text{Hg}(\text{CN})_2$	Sp gr
0	4.34	1.0810
4.39	4.295	1.0797
96.76	1.056	1.9374
100	0.714	0.9097

(Herz and Anders, Z anorg 1907, 52 165)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Solubility in organic solvents at 18-20°

100 g tetrachlormethane dissolve 0.001 g  $\text{Hg}(\text{CN})_2$

100 g bromoform dissolve 0.005 g  $\text{Hg}(\text{CN})_2$

100 g ethyl bromide dissolve 0.013 g  $\text{Hg}(\text{CN})_2$

100 g ethylene dibromide dissolve 0.001 g  $\text{Hg}(\text{CN})_2$

(Sule, Z anorg 1900, 25 401)

100 g acetonitrile dissolve 9.58 g  $\text{Hg}(\text{CN})_2$  at 18° (Naumann and Schier, B 1914 47 249)

Solubility in benzonitrile at 18° = 1.0 g in 100 g (Naumann, B 1914, 47 1370)

Sl sol in ethyl amine (Shinn, J I ys Chem 1907, 11 538)

Very sol in liquid methyl amine (G bs, J Am Chem Soc 1906, 28 1419)

Sol in paratoluidine (Werner, Z anorg 1897, 15 7)

Mol weight determined in pyridine and benzonitrile (Werner, Z anorg 1897, 15 20 and 32)

100 g pyridine dissolve 64.8 g  $\text{Hg}(\text{CN})_2$  at 18° (Schroeder, Z anorg 1905, 44 1)

#### Solubility in pyridine

Mols per 100 $\text{Hg}(\text{CN})_2$	Temp of Solidification	Mols per 100 $\text{Hg}(\text{CN})_2$	Temp of Solidification
7.1	9	22.9	45
8.7	11	23.7	46
10.1	12.3	25.3	53
10.4	12.2	26.0	54
11.3	13	26.6	56
12.9	13.5	27.5	68
13.8	14.5	27.7	70
15.8	16.5	29.0	86
15.9	20.5	32.0	111
17.3	22.5	33.8	122
18.4	28.5	34.4	125
19.3	32	38.3	141
20.6	38		
22.3	42		

(Staronka, Anz Ak Wiss Krakau, 1910 372)

#### Solubility in quinoline

Mols per 100 $\text{Hg}(\text{CN})_2$	Temp of Solidification	Mols per 100 $\text{Hg}(\text{CN})_2$	Temp of Solidification
4.2	45°	13.2	13
6.0	54	17.4	16
8.2	89(61)	22.5	18
9.2	99(61)	27.1	19

(Staronka, l c)

#### Solubility in aniline

Mols per 100 $\text{Hg}(\text{CN})_2$	Temp of Solidification	Mols per 100 $\text{Hg}(\text{CN})_2$	Temp of Solidification
3.7		14.2	77° ?
4.9	26° (?)	18.2	83° ?
5.7	30.5(?)	19.7	84° ?
7.7	35° (?)	23.4	88° ?
9.2	38.5(?)		

(Staronka, l c)

**Mercuric nickel cyanide ammonia**,  $2\text{Hg}(\text{CN})_2 \cdot 4\text{Ni}(\text{CN})_2 \cdot 5\text{NH}_3 + 2\text{H}_2\text{O}$

(Papiermeister, Dissert 1898)

$5\text{Hg}(\text{CN})_2 \cdot 18\text{Ni}(\text{CN})_2 \cdot 8\text{NH}_3 + 15\text{H}_2\text{O}$  (Papiermeister, Dissert 1898)

**Mercuric potassium cyanide,  $\text{Hg}(\text{CN})_2, 2\text{KCN}$** 

Sol in 4 4 pts cold  $\text{H}_2\text{O}$ , sl sol in alcohol, decomp by acids

100 g  $\text{H}_2\text{O}$  dissolve 22.7 g (Fronmüller, B 1878, 11 92)

Abundantly sol in liquid  $\text{NH}_3$  (Franklin, Z phys Ch 1909, 69 295)

**Mercuric silver cyanide, basic,  $\text{Hg}(\text{CN})_2, \text{HgO}, 7\text{AgCN}$** 

Ppt (Bloxam, B 16 2669)

**Mercuric silver cyanide mercuric sulphate,  $\text{Hg}(\text{CN})_2, 2\text{AgCN}, \text{HgSO}_4 + \text{H}_2\text{O}$** **Mercuric sodium cyanide,  $\text{Hg}(\text{CN})_2, \text{NaCN} + 1\frac{1}{2}\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Grossmann, B 1904, 37 4141)

**Mercuric strontium cyanide,  $\text{Hg}(\text{CN})_2, \text{Sr}(\text{CN})_2 + 5\text{H}_2\text{O}$** 

Very hygroscopic. Sol in  $\text{H}_2\text{O}$  (Grossmann, B 1904, 37 4142)

**Mercuric strontium cyanide iodide,  $\text{Sr}(\text{CN})_2, \text{HgI}_2, \text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$** 

(Varet, C R 1895, 121 499)

**Mercuric thallium cyanide,  $\text{Hg}(\text{CN})_2, 2\text{TlCN}$** 

Easily sol in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  dissolve 7.9 pts at  $1^\circ$ , and 10.3 pts at  $10^\circ$  (Fronmüller, B 11 92)

**Mercuric zinc cyanide,  $4\text{Zn}(\text{CN})_2, \text{Hg}(\text{CN})_2$** 

Insol in  $\text{H}_2\text{O}$  (Dunstan, Chem Soc 6 666)

**Mercuric zinc cyanide mercuric bromide ammonia,  $\text{Hg}(\text{CN})_2, \text{Zn}(\text{CN})_2, \text{HgBr}_2, 4\text{NH}_3$** 

Decomp by  $\text{H}_2\text{O}$  Sl sol in cold  $\text{NH}_4\text{OH} + \text{Aq}$  (Varet, C R 1889, 109 810)

**Mercuric cyanide ammonia,  $\text{Hg}(\text{CN})_2, \text{NH}_3$** 

Very sol in  $\text{H}_2\text{O}$   $\text{NH}_4\text{OH} + \text{Aq}$  and alcohol (Varet, C R 1889, 109 903)

Sl sol in  $\text{H}_2\text{O}$  (Schmidt, B 1894, 27 232)

$\text{SiH}_4(\text{CN})_2 + 2\text{NH}_3 + 1\frac{1}{2}\text{H}_2\text{O}$  easily decomp (Varet Bull Soc (5) 6 221)

**Mercuric cyanide bromide,  $\text{Hg}(\text{CN})_2, \text{HgBr}_2$** 

Very sl sol even in boiling  $\text{H}_2\text{O}$  (Prussia, Gazz ch it 1898, 28, (2), 114)

**Mercuric cyanide barium bromide,  $2\text{Hg}(\text{CN})_2, \text{BaBr}_2 + 6\text{H}_2\text{O}$** 

Easily sol especially in hot  $\text{H}_2\text{O}$  and alcohol (Varet, C R 1895, 121 398)

**Mercuric cyanide cadmium bromide,  $\text{Hg}(\text{CN})_2, \text{CdBr}_2 + 3\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$  (Varet, Bull Soc (3) 5 8)

$2\text{Hg}(\text{CN})_2, \text{CdBr}_2 + 4.5\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$  (Varet, C R 1890, 111 680)

**Mercuric cyanide cadmium bromide ammonia  $2\text{Hg}(\text{CN})_2, \text{CdBr}_2, 4\text{NH}_3 + 2\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$

Sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Varet, C R 1891, 112 535)

**Mercuric cyanide calcium bromide,  $2\text{Hg}(\text{CN})_2, \text{CaBr}_2 + 5\text{H}_2\text{O}$** 

Sol in 1 pt cold, and 0.25 pt boiling  $\text{H}_2\text{O}$ , also in 2 pts cold, and 1 pt boiling 90% alcohol (Custer)  $+ 7\text{H}_2\text{O}$  (Varet, C R 1895, 121 399)

**Mercuric cyanide cupric bromide ammonia,  $2\text{Hg}(\text{CN})_2, \text{CuBr}_2, 4\text{NH}_3$** 

Decomp by  $\text{H}_2\text{O}$ , sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Varet, Bull Soc (3) 6 221)

**Mercuric cyanide lithium bromide,  $2\text{Hg}(\text{CN})_2, 2\text{LiBr} + 7\text{H}_2\text{O}$** 

Deliquescent (Varet, C R 111 526)

**Mercuric cyanide magnesium bromide**

See Magnesium mercuric cyanide mercuric bromide

$\text{Hg}(\text{CN})_2, 2\text{KBr}$  Very sol in  $\text{H}_2\text{O}$  (Harth, Z anorg 1897, 14 351)

**Mercuric cyanide potassium bromide,  $\text{Hg}(\text{CN})_2, \text{KBr} + 2\text{H}_2\text{O}$** 

Sol in 13.34 pts  $\text{H}_2\text{O}$  at  $18^\circ$ , and less than 1 pt boiling  $\text{H}_2\text{O}$  (Brett)

Sol without decomp in hot dil  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$  (Brett)

Contains  $1\frac{1}{2}\text{H}_2\text{O}$  (Berthelot, A ch (5) 29 226)

**Mercuric cyanide sodium bromide,  $\text{Hg}(\text{CN})_2, \text{NaBr} + 1\frac{1}{2}\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  and alcohol

**Mercuric cyanide strontium bromide,  $2\text{Hg}(\text{CN})_2, \text{SrBr}_2 + 6\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  and in alcohol (Varet, C R 1895, 121 399)

**Mercuric cyanide zinc bromide,  $\text{HgBr}_2, \text{Hg}(\text{CN})_2, \text{Zn}(\text{CN})_2 + 8\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$  (Varet, Bull Soc (3) 5 8)

**Mercuric cyanide zinc bromide ammonia,  $\text{HgBr}_2, \text{Hg}(\text{CN})_2, \text{Zn}(\text{CN})_2, 4\text{NH}_3$** 

As the corresponding chloride (Varet)

**Mercuric cyanide chloride**,  $\text{Hg}(\text{CN})_2$ ,  $\text{HgCl}_2$   
Sol in  $\text{H}_2\text{O}$  Decomp by alcohol, which  
dissolves out  $\text{HgCl}_2$

**Mercuric cyanide ammonium chloride**,  
 $\text{Hg}(\text{CN})_2$ ,  $\text{NH}_4\text{Cl}$   
Sol in  $\text{H}_2\text{O}$  and alcohol (Poggiale)  
 $\text{Hg}(\text{CN})_2$ ,  $4\text{NH}_4\text{Cl}$

**Mercuric cyanide barium chloride**,  $2\text{Hg}(\text{CN})_2$ ,  
 $\text{BaCl}_2 + 4\text{H}_2\text{O}$   
Efflorescent Easily sol in  $\text{H}_2\text{O}$  and alcohol  
 $+6\text{H}_2\text{O}$  (Dexter)

**Mercuric cyanide barium chloride ammonia**,  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{BaCl}_2$ ,  $4\text{NH}_3$   
Decomp by  $\text{H}_2\text{O}$  Sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
(Varet, Bull Soc (3) 6 221)

**Mercuric cyanide cadmium chloride**,  
 $\text{Hg}(\text{CN})_2$ ,  $\text{CdCl}_2 + 2\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$  (Varet,  
Bull Soc (3) 5 8)

**Mercuric cyanide calcium chloride**,  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{CaCl}_2 + 6\text{H}_2\text{O}$   
Efflorescent Very sol in  $\text{H}_2\text{O}$  (Varet,  
C R 1895, 121 349)

**Mercuric cyanide cerium chloride**,  $3\text{Hg}(\text{CN})_2$ ,  
 $\text{CeCl}_3 + 8\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  (Ahlén, Bull Soc (2)  
27 365)

**Mercuric cyanide cobaltous chloride**,  
 $\text{Hg}(\text{CN})_2$ ,  $2\text{CoCl}_2 + 4\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Poggiale)  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{CoCl}_2 + 7\text{H}_2\text{O}$  (Dexter)

**Mercuric cyanide cupric chloride**,  $\text{Hg}(\text{CN})_2$ ,  
 $\text{CuCl}_2 + 6\text{H}_2\text{O}$   
Efflorescent  
Sol in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$  (Varet,  
C R 1888, 107 1002)

$2\text{Hg}(\text{CN})_2$ ,  $\text{CuCl}_2 + 6\text{H}_2\text{O}$  Efflorescent  
Very sol in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$   
(Varet, C R 1888, 107 1002)

**Mercuric cyanide cupric chloride ammonia**,  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{CuCl}_2$ ,  $4\text{NH}_3$   
Decomp by  $\text{H}_2\text{O}$  Sl sol in cold  $\text{NH}_4\text{OH}$   
 $+ \text{Aq}$  (Varet, Bull Soc (3) 6 221)

**Mercuric cyanide didymium chloride**,  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{DyCl}_3 + 8\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  (Ahlen)

**Mercuric cyanide erbium chloride**,  $3\text{Hg}(\text{CN})_2$ ,  
 $\text{ErCl}_3 + 8\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  (Ahlen)

**Mercuric cyanide hydrazine chloride**,  
 $\text{Hg}(\text{CN})_2$ ,  $\text{N}_2\text{H}_4$ ,  $\text{HCl}$   
Very sol in  $\text{H}_2\text{O}$

Nearly insol in alcohol and ether (Fe-  
ratini, Gazz ch it 1912, 42 (1), 154)

**Mercuric cyanide ferric chloride**,  $2\text{Hg}(\text{CN})$   
 $\text{FeCl}_3 + 3\frac{1}{2}\text{H}_2\text{O}$   
(Dexter)

**Mercuric cyanide lanthanum chloride**,  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{LaCl}_3 + 8\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  (Ahlén)

**Mercuric cyanide magnesium chloride**,  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{MgCl}_2 + 2\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  and dil alcohol (Po-  
ggiale)

**Mercuric cyanide manganous chloride**,  
 $\text{Hg}(\text{CN})_2$ ,  $\text{MnCl}_2 + 3\text{H}_2\text{O}$   
Efflorescent Very sol in  $\text{H}_2\text{O}$  (Poggiale)

**Mercuric cyanide nickel chloride**,  $\text{Hg}(\text{CN})$ ,  
 $\text{NiCl}_2 + 6\text{H}_2\text{O}$   
Deliquescent Sol in  $\text{H}_2\text{O}$  (Poggiale)  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{NiCl}_2 + 7\text{H}_2\text{O}$  (Dexter)

**Mercuric cyanide chloride nickel chlori-**  
**oxychloride**,  $11\text{Hg}(\text{CN})_2$ ,  $8\text{HgCl}_2$ ,  $2\text{NiCl}_2$ ,  
 $8\text{Ni}(\text{OH})\text{Cl} + 76\text{H}_2\text{O}$   
(Papiermeister, Dissert 1898)

**Mercuric cyanide potassium chloride**,  
 $\text{Hg}(\text{CN})_2$ ,  $\text{KCl} + \text{H}_2\text{O}$   
Sol in 675 pts  $\text{H}_2\text{O}$  at  $18^\circ$  (Bret)  
Sol in alcohol

**Mercuric cyanide sodium chloride**,  $\text{Hg}(\text{CN})$ ,  
 $\text{NaCl}$   
Easily sol especially in hot  $\text{H}_2\text{O}$ , insol in  
alcohol (Poggiale)

**Mercuric cyanide strontium chloride**,  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{SrCl}_2 + 6\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  and dil alcohol (Va-  
t, C R 1895, 121 349)

**Mercuric cyanide yttrium chloride**,  $3\text{Hg}(\text{CN})_2$ ,  
 $\text{YCl}_3 + 8\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  (Ahlen, Bull Soc (2)  
27 365)

**Mercuric cyanide zinc chloride**,  $2\text{Hg}(\text{CN})_2$ ,  
 $\text{ZnCl}_2 + 6\text{H}_2\text{O}$   
Efflorescent Sol in  $\text{H}_2\text{O}$  (Kane)  
 $\text{HgCl}_2$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{CN})_2 + 7\text{H}_2\text{O}$  ef-  
florescent Very sol in  $\text{H}_2\text{O}$  (Varet, Bull  
Soc (3) 5 8)

**Mercuric cyanide zinc chloride ammonia**,  
 $\text{HgCl}_2$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{ZnCl}_2$ ,  $4\text{NH}_3$   
Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
(Varet, Bull Soc (3) 6 221)  
 $\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{CN})_2$ ,  $\text{HgCl}_2$ ,  $6\text{NH}_3$  (Varet,  
C R 106 1080)

**Mercuric cyanide potassium chromate***See Chromate mercuric cyanide, potassium***Mercuric cyanide potassium ferrocyanide,**  
 $3\text{Hg}(\text{CN})_2, \text{K}_4\text{Fe}(\text{CN})_6 + 4\text{H}_2\text{O}$ Readily sol in  $\text{H}_2\text{O}$ **Mercuric cyanide hydrazine,  $\text{Hg}(\text{CN})_2,$**   
 $\text{N}_2\text{H}_4$ Very sol in  $\text{H}_2\text{O}$  with partial decomp (Hofmann and Marburg, A 1899, 305 215)  
 $\text{Hg}(\text{CN})_2, \text{N}_2\text{H}_4$  Ppt (Franzen, Z anorg 1911, 70 154)**Mercuric cyanide potassium hydroxide,**  
 $\text{Hg}(\text{CN})_2, \text{KOH}$ (Hofmann and Wagner, B 1908, 41 321)  
 $+1\frac{1}{2}\text{H}_2\text{O}$  (Hofmann and Wagner, B 1908, 41 1630)  
 $2\text{Hg}(\text{CN})_2, \text{KOH} + \text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$   
(Hofmann and Wagner, B 1908, 41 320)**Mercuric cyanide sodium hydroxide,**  
 $\text{Hg}(\text{CN})_2, \text{NaOH} + 1\frac{1}{2}\text{H}_2\text{O}$  or  $\text{H}_2\text{O}$ 

(Hofmann and Wagner, B 1908, 41 1631)

**Mercuric cyanide barium iodide,  $2\text{Hg}(\text{CN})_2,$**   
 $\text{BaI}_2 + 4\text{H}_2\text{O}$ Slowly deliquescent Sol in 16.5 pts cold, and 0.4 pt boiling  $\text{H}_2\text{O}$  Sol in 22.5 pts cold, and 1.6 pts hot 90% alcohol Solution is decomp on boiling (Custer)**Mercuric cyanide cadmium iodide,  $\text{Hg}(\text{CN})_2,$**   
 $\text{Cd}(\text{CN})_2, \text{HgI}_2 + 8\text{H}_2\text{O}$ *See Cadmium mercuric cyanide mercuric iodide***Mercuric cyanide caesium iodide,  $\text{Hg}(\text{CN})_2,$**   
 $\text{CsI}$ Recryst from  $\text{H}_2\text{O}$  without decomp  
Decomp by acids (Mathewson and Wells, Am Ch J 1903, 30 433)**Mercuric cyanide calcium iodide,  $2\text{Hg}(\text{CN})_2,$**   
 $\text{CaI}_2 + 6\text{H}_2\text{O}$ Sl efflorescent More sol in  $\text{H}_2\text{O}$  than corresponding Sr comp (Custer)**Mercuric cyanide lithium iodide,  $\text{Hg}(\text{CN})_2,$**   
 $2\text{Li}(\text{CN})_2, \text{HgI}_2 + 7\text{H}_2\text{O}$ *See Cyanide, lithium mercuric mercuric iodide***Mercuric cyanide magnesium iodide,**  
 $\text{Hg}(\text{CN})_2, \text{Mg}(\text{CN})_2, \text{HgI}_2 + 8\text{H}_2\text{O}$ *See Cyanide, magnesium mercuric mercuric iodide***Mercuric cyanide potassium iodide,  $\text{Hg}(\text{CN})_2,$**   
 $\text{KI}$ Sol in 16 pts cold, and less hot  $\text{H}_2\text{O}$  Sol in 96 pts cold alcohol of  $34^\circ$  Baumé (Caillet) Sl sol in ether Decomp by acids  
 $3\text{Hg}(\text{CN})_2, 2\text{KI} + \frac{1}{2}\text{H}_2\text{O}$  (Berthelot)**Mercuric cyanide sodium iodide,  $\text{Hg}(\text{CN})_2,$**   
 $\text{NaI} + 2\text{H}_2\text{O}$ Sol in  $4\frac{1}{2}$  pts  $\text{H}_2\text{O}$  at  $18^\circ$ , and  $\frac{9}{7}$  pt boiling  $\text{H}_2\text{O}$ Sol in 2 pts boiling, and  $6\frac{1}{2}$  pts cold 90% alcohol (Custer)**Mercuric cyanide strontium iodide,**  
 $2\text{Hg}(\text{CN})_2, \text{SrI}_2 + 6\text{H}_2\text{O}$ Sol in 7 pts  $\text{H}_2\text{O}$  at  $18^\circ$ , and  $\frac{1}{2}$  pt at b-pt  
Sol in 4 pts 90% alcohol at  $18^\circ$ , and  $\frac{1}{2}$  pt at b-pt (Custer)**Mercuric cyanide zinc iodide,  $2\text{Hg}(\text{CN})_2,$**   
 $\text{ZnI}_2 + 6\text{H}_2\text{O}$ Efflorescent, sol in  $\text{H}_2\text{O}$ **Mercuric cyanide iodide potassium cyanide,**  
 $\text{HgI}_2, \text{Hg}(\text{CN})_2, 2\text{KCN}$ 

Easily decomp by dil acids (Rupp Apoth Ztg, 23 374)

**Mercuric cyanide cadmium nitrate,**  
 $2\text{Hg}(\text{CN})_2, \text{Cd}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$ Decomp by  $\text{H}_2\text{O}$ , not by alcohol (Nylander, J B 1859 271)**Mercuric cyanide cobalt nitrate,  $2\text{Hg}(\text{CN})_2,$**   
 $\text{Co}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$ Decomp by  $\text{H}_2\text{O}$ , not by alcohol (Nylander)**Mercuric cyanide copper nitrate,  $\text{Hg}(\text{CN})_2,$**   
 $\text{Cu}(\text{NO}_3)_2 + 5\text{H}_2\text{O}$ Decomp by  $\text{H}_2\text{O}$ , not by alcohol (Nylander)**Mercuric cyanide ferrous nitrate,  $2\text{Hg}(\text{CN})_2,$**   
 $\text{Fe}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$ Decomp by  $\text{H}_2\text{O}$ , not by alcohol (Nylander)**Mercuric cyanide manganous nitrate,**  
 $\text{Hg}(\text{CN})_2, \text{Mn}(\text{NO}_3)_2 + 5\text{H}_2\text{O}$ Decomp by  $\text{H}_2\text{O}$ , not by alcohol (Nylander) $2\text{Hg}(\text{CN})_2, \text{Mn}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$  As above**Mercuric cyanide nickel nitrate,  $2\text{Hg}(\text{CN})_2,$**   
 $\text{Ni}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$ Decomp by  $\text{H}_2\text{O}$  not by alcohol (Nylander)**Mercuric cyanide silver nitrate,  $2\text{Hg}(\text{CN})_2,$**   
 $\text{AgNO}_3 + 2\text{H}_2\text{O}$ Sl sol in cold, more readily in hot  $\text{H}_2\text{O}$   
Sol with decomp in  $\text{HNO}_3 + \text{Aq}$   
As sol in alcohol as in  $\text{H}_2\text{O}$ **Mercuric cyanide zinc nitrate,  $2\text{Hg}(\text{CN})_2,$**   
 $\text{Zn}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  with decomp Not decomp by alcohol (Nylander, J B 1859 271)



**Mercuric cyanide nitrate silver cyanide, basic,**  
 $\text{Hg}(\text{N}_2\text{O}_2)\text{CN}$ ,  $10\text{AgCN}$ ,  $\text{Hg}(\text{OH})\text{NO}_2$   
 (Schmidt, Z anorg 1895, 9 431)

**Mercuric cyanide potassium selenocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{KSeCN}$

Sl sol in cold, much more easily sol in hot  $\text{H}_2\text{O}$  or alcohol. Traces dissolve in ether (Cameron and Davy, C N 44 63)

**Mercuric cyanide nickel sulphate,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{NiSO}_4 \cdot 9\text{H}_2\text{O}$   
 (Papiermeister, Dissert 1898)

**Mercuric cyanide ammonium sulphocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{NH}_4\text{SCN}$   
 Easily sol in hot  $\text{H}_2\text{O}$  (Cleve, Bull Soc (2) 23 71)

**Mercuric cyanide barium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Ba}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$   
 Permanent Sol in hot  $\text{H}_2\text{O}$  (Cleve)

**Mercuric cyanide cadmium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Cd}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$   
 Permanent Sol in hot  $\text{H}_2\text{O}$  (Cleve)

**Mercuric cyanide calcium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Ca}(\text{SCN})_2 \cdot 8\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Cleve)

**Mercuric cyanide cerium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{Ce}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$   
 Easily sol in hot  $\text{H}_2\text{O}$  (Jolin)

**Mercuric cyanide didymium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{Dy}(\text{SCN})_3 \cdot 6\text{H}_2\text{O}$   
 Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  (Cleve)

**Mercuric cyanide erbium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $2\text{Er}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$   
 Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  (Cleve)

**Mercuric cyanide lanthanum sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $1\text{La}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$   
 Very sol in  $\text{H}_2\text{O}$  (Cleve)

**Mercuric cyanide magnesium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Mg}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$   
 Permanent. Easily sol in hot  $\text{H}_2\text{O}$  (Cleve)

**Mercuric cyanide potassium sulphocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{KSCN}$   
 Permanent. Easily sol in hot  $\text{H}_2\text{O}$  (Cleve)  
 $+2\text{H}_2\text{O}$  (Philp, Z Ch 1867 552)

**Mercuric cyanide rubidium sulphocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{Rb}(\text{SCN})$   
 Sol in hot  $\text{H}_2\text{O}$  without decomp (Grossmann, B 1904, 37 1259)

**Mercuric cyanide samarium sulphocyanide**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{Sm}(\text{SCN})_2 \cdot 12\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  (Cleve)

**Mercuric cyanide sodium sulphocyanide**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{NaSCN} \cdot 2\text{H}_2\text{O}$   
 Efflorescent Sol in  $\text{H}_2\text{O}$  (Cleve, Bu Soc (2) 23 71)

**Mercuric cyanide strontium sulphocyanide**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Sr}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$   
 Efflorescent (Cleve)

**Mercuric cyanide yttrium sulphocyanide**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{Y}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$   
 Sl sol in warm, much less in cold  $\text{H}_2\text{O}$  (Cleve)

**Mercuric cyanide zinc sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$   
 Sl sol in  $\text{H}_2\text{O}$  (Cleve)

**Mercuric cyanide zinc sulphocyanide ammonia,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{SCN})_2$ ,  $3\text{NH}_3$   
 Not efflorescent. Decomp by  $\text{H}_2\text{O}$

**Mercuric cyanide potassium thiosulphate,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{K}_2\text{S}_2\text{O}_3$   
 Permanent Sol in  $\text{H}_2\text{O}$  (Kessler)  
 $+ \text{H}_2\text{O}$  (Fock and Kluss, B 24 1355)

**Molybdenum hydroxyl potassium cyanide,**  
 $\text{K}_3\text{Mo}(\text{OH})_2(\text{CN})_5$   
 (Rosenheim and Koss, Z anorg 1906, 1 155)  
 $\text{K}_3\text{Mo}(\text{OH})_2(\text{CN})_5$ , Very sol in  $\text{H}_2\text{O}$  (Rosenheim and Koss)

**Molybdenum cyanide with MCN**  
 See Molybdocyanide M

**Molybdenyl potassium cyanide,**  
 $\text{MoO}_2(\text{CN})_2$ ,  $2\text{KCN}$   
 Very sol in  $\text{H}_2\text{O}$ . Aqueous solution is stable in presence of alkalis.  
 Insol in alcohol (Pouchard, C R 18 4, 118 805)  
 $\text{MoO}(\text{CN})_2$ ,  $2\text{KCN}$  Sol in  $\text{H}_2\text{O}$ . Insol in alcohol (Hofmann, Z anorg 1896, 2 287)  
 $+ \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Hofmann)  
 $+ 4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Hofmann)

**Nickel cyanide,**  $\text{Ni}(\text{CN})_4 \cdot 2\text{H}_2\text{O}$   
 Insol in  $\text{H}_2\text{O}$ . Insol in conc  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{HNO}_3 + \text{Ag}$  but decomp by heating the solid with Sol in  $\text{NH}_4\text{OH}$ , warm  $(\text{NH}_4)_2\text{CO}_3$ , or  $\text{NH}_4$  succinate +  $\text{Ag}$ , also in  $\text{KCN} + \text{aq}$ . Sl sol in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Ag}$  (Wittstein)  
 Insol in methyl acetate (Naumann B 1909, 42 3790)

+3H<sub>2</sub>O, +3½H<sub>2</sub>O, +3¼ H<sub>2</sub>O, +4¼H<sub>2</sub>O, and +5¼H<sub>2</sub>O (Papiermeister, Dissert 1898)

+4H<sub>2</sub>O (Hofmann and Hochtlen, B 1903, 36 1149)

**Nickel potassium cyanide**, Ni(CN)<sub>2</sub>, 2KCN + H<sub>2</sub>O

Sol in H<sub>2</sub>O Decomp by acids with residue of insol Ni(CN)<sub>2</sub>

+½H<sub>2</sub>O (Rammelsberg)

**Nickel sodium cyanide**, Ni(CN)<sub>2</sub>, 2NaCN + 3H<sub>2</sub>O

Sol in H<sub>2</sub>O, decomp by acids with residue of Ni(CN)<sub>2</sub>

**Nickel strontium cyanide**, Ni(CN)<sub>2</sub>, Sr(CN)<sub>2</sub> + xH<sub>2</sub>O

Sol in H<sub>2</sub>O (Handl, J B 1859 273)

**Nickel cyanide ammonia**, Ni(CN)<sub>2</sub>, NH<sub>3</sub> + ½H<sub>2</sub>O

Scarcely attacked by H<sub>2</sub>O or dil acids

Sol in conc H<sub>2</sub>SO<sub>4</sub> Sol in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq, conc NH<sub>4</sub>OH + Aq (NH<sub>4</sub>)<sub>2</sub>C<sub>2</sub>O<sub>4</sub> + Aq, (NH<sub>4</sub>)<sub>2</sub>S + Aq, and KCN + Aq Decomp by boiling with NaOH or KOH (Bernoulli and Grether, Ch Z 1901, 25 436)

**Nickel cyanide trihydrazine**, Ni(CN)<sub>2</sub>, (N<sub>2</sub>H<sub>4</sub>)<sub>3</sub>

Ppt (Franzen, Z anorg 1911, 70 155)

**Osmium cyanide**, Os(CN) (?)

Insol in H<sub>2</sub>O, not attacked by acids

See also Osmocyanhydric acid

**Osmium potassium cyanide**

See Osmocyanide, potassium

**Palladous cyanide**, Pd(CN)

Insol in H<sub>2</sub>O Insol in dil acids Sol in KCN or NH<sub>4</sub>OH + Aq, also in conc HCN + Aq

**Platinous cyanide**, Pt(CN)<sub>2</sub>

Insol in H<sub>2</sub>O, alkalis, or acids Sol in KCN + Aq When freshly pptd, sol in NH<sub>4</sub>OH + Aq

**Platinous cyanide with MCN**

See Platinocyanide, M

**Potassium cyanide**, KCN

Deliquescent Very sol in H<sub>2</sub>O

100 pts KCN + Aq, sat at b-pt 103.3°, contain 55 pts KCN, i e 100 pts H<sub>2</sub>O dissolve 122.2 pts KCN at 103.3° (Griffiths)

KCN + Aq containing 3.25% KCN has sp gr = 1.0154, 6.5% KCN, 1.0316 (Kohlrausch, W Ann 1879 1)

KCN + Aq containing 9.64% KCN has sp gr 20°/20° = 1.0514

KCN + Aq containing 14.42% KCN has sp gr 20°/20° = 1.0768 (Le Blanc and Rohland, Z phy ch 1896, 19 278)

Moderately sol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 829)

Almost insol in absolute alcohol

Sol in 80 pts 95% alcohol when boiling, and easily sol in 35% alcohol (Geiger, A 1 50)

100 pts absolute methyl alcohol dissolve 4.91 pts at 19.5°, 100 pts absolute ethyl alcohol dissolve 0.87 pt at 19.5° (de Bruyn, Z phys Ch 10 783)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3601)

100 g glycerol dissolve 32 g KCN at 15.5° (Ossendowski, Pharm J 1907, 79 575)

Sol in CS<sub>2</sub> when pure (Loughlin, J B 1875 234)

Wholly insol in CS<sub>2</sub> (Moldenhauer, Z anal 16 199)

Sl sol in benzonitrile (Naumann, B 1914, 47 1369)

**Potassium chromium tetroxide pentacyanide**, K<sub>3</sub>[(CrO<sub>4</sub>)<sub>2</sub>(CN)<sub>5</sub>] + 5H<sub>2</sub>O

Very hygroscopic

Sol in H<sub>2</sub>O (Riesenfeld, B 1908, 41 3548)

**Potassium chromium tetroxide dicyanide ammonia**, K<sub>2</sub>[CrO<sub>4</sub>(CN) NH<sub>3</sub>] + 5H<sub>2</sub>O

Hygroscopic in the air

Easily sol in H<sub>2</sub>O and in NH<sub>4</sub>OH + Aq (Riesenfeld, B 1908, 41 3545)

**Potassium rhodium cyanide**

See Rhodocyanide, potassium

**Potassium ruthenium cyanide**

See Ruthenocyanide, potassium

**Potassium silver cyanide**, KCN, AgCN

Sol in 4.7 pts H<sub>2</sub>O at 15°, 4 pts at 20°, and in much less at higher temp Sol in 25 pts 85% alcohol (Baup, A ch (3) 53 464)

**Potassium silver sodium cyanide**, 2KCN, NaCN, 3AgCN

Sol in 4.4 pts H<sub>2</sub>O at 15°, and 22 pts 85% alcohol at 17° (Baup)

**Potassium tungsten cyanide**

See Tungstocyanide, potassium

**Potassium uranyl cyanide**,

(UO<sub>2</sub>)(CN)<sub>2</sub>, 2KCN

Ppt Sol in H<sub>2</sub>O Sl sol in presence of large excess of KCN (Alox A ch 1901 (7) 24 417)

**Potassium vanadium cyanide**, K<sub>3</sub>V(CN)

Readily sol in H<sub>2</sub>O, decomp slowly in neutral aq solution, rapidly in acid aq solution,

insol in alcohol (Locke, Am Ch J 1898, 20 601)

$K_4V(CN)_6 + 3H_2O$  Sol in  $H_2O$

Insol in alcohol and ether (Petersen, Z anorg 1904, 38 345)

**Potassium zinc cyanide**,  $2KCN$ ,  $Zn(CN)_2$

100 pts  $H_2O$  dissolve 11 pts at  $20^\circ$  (Sharwood, Eng Min J 1904, 77 845)

**Potassium cyanide molybdenum dioxide**,  $4KCN$ ,  $MoO_3 + 5H_2O$

Sol in  $H_2O$  Insol in alcohol (Hofmann, Z anorg 1896, 12 287)

+  $6H_2O$  "Potassium dioxotetracyanomolybdate"

Very sol in  $H_2O$  (Winkler, Dissert 1909)

+  $8H_2O$  (Rosenheim, Kohn and Garfunkel, Z anorg 1910, 65 174)

+  $10H_2O$  Decomp by conc  $HCl$ ,  $HNO_3$  and  $H_2SO_4$

Not acted upon by cold dil acids (v der Heide and Hofmann, Z anorg 1896, 12 285)

$5KCN$ ,  $MoO_3 + 8H_2O$  Sol in  $H_2O$  Insol in alcohol (Kalscher, Dissert 1902)

**Potassium cyanide molybdenum dioxide hydroxylamine**,  $4KCN$ ,  $MoO_3$ ,  $NH_2OH + H_2O$

Sol in  $H_2O$

Decomp by dil acids (v der Heide and Hofmann, Z anorg 1896, 12 282)

**Potassium cyanide molybdenum sulphide**,  $6KCN$ ,  $Mo_2S_3 + 5H_2O$

Easily sol in  $H_2O$  Decomp by dil acids (Hofmann, Z anorg 1896, 12 289)

Very sol in  $H_2O$  Slowly decomp in the cold by dil mineral acids (v der Heide and Hofmann, Z anorg 1896, 12 289)

**Potassium cyanide molybdenum sulphocyanide**,  $2KCN$ ,  $MoS_2(CN)_2$

(Péchar, C R 1894, 118, 806)

$5KCN$ ,  $Mo_3S_4(CN)_3 + 7H_2O$  Sol in  $H_2O$  Stable toward dil acids and alkalies (Hofmann, Z anorg 1896, 12 289)

**Potassium cyanide molybdenum sulphonyl cyanide**,  $4KCN$ ,  $Mo_2SO(CN)_2 + 4H_2O$

Sol in  $H_2O$  Stable toward dil acids (Hofmann, Z anorg 1896, 12 289)

**Potassium cyanide nitrite**,  $KCN$ ,  $KNO_2 + \frac{1}{2}H_2O$

Sol in  $H_2O$ , decomp slowly by  $H_2O$ , explosive (Hofmann, Z anorg 1895, 10 260-261)

**Potassium cyanide sulphur dioxide**,  $KCN$ ,  $SO_2 + H_2O$

Much more sol in hot than cold  $H_2O$  (Étard, C R 88 649)

$KCN$ ,  $HCN$ ,  $2SO_2 + 3H_2O$  Very sl so in cold  $H_2O$ , decomp by hot  $H_2O$  (Étard)

**Rubidium tungsten cyanide**

See Tungstocyanide, rubidium

**Rhodium cyanide**,  $Rh(CN)_3$

Ppt Not decomp by acids Sol in  $KCN + Aq$  (Martius, A 117 361)

**Rhodium cyanide with 3KCN**

See Rhodicyanide, potassium

**Ruthenium cyanide with 4MCN**

See Ruthenocyanide, M

**Silver cyanide**,  $AgCN$

Sl sol in  $H_2O$

$2.2 + 10^{-4}$  g sol in 1 liter of  $H_2O$  at  $19.96^\circ$  (Böttger, Z phys ch 1903, 46 603)

1 l solution in  $H_2O$  contains 0.000043  $AgCN$  at  $17.5^\circ$  (Abegg and Cox, Z phy Ch 1903, 46 11)

Solubility in  $H_2O$  at  $25^\circ = 2.22 + 10$  mol per l (Lucas, Z anorg 1904, 41 198)

Insol in dil acids Decomp by conc acids Not sol to any extent in  $HCN + A$

Freshly pptd  $AgCN$  is not dissolved by cold dil  $HNO_3$ , but is attacked by very d  $HNO_3$  on boiling From dry  $AgCN$  is dissolved 5% by boiling 1 hour with 1%  $HNO_3 + Aq$  Conc  $HNO_3$  dissolves more (Brunc B 1901, 34 1605)

Sol in  $NH_4OH + Aq$  Sol in boiln  $KCl$ ,  $NaCl$ ,  $CaCl_2$ ,  $BaCl_2$ , or  $MgCl_2 + Aq$ , b very slowly sol therein at ord temp Sol  $Na_2S_2O_3$ ,  $K_4Fe(CN)_6$ ,  $(NH_4)_2CO_3$ ,  $(NH_4)_2SCN$ ,  $NH_4NO_3$ , and  $NH_4$  succinate +  $Aq$ , and large amt of hot  $NH_4Cl + Aq$  (Wittstem

Sol in  $KCN$ ,  $NaCN$ ,  $Ba(CN)_2$ ,  $Ca(CN)$  or  $Sr(CN)_2 + Aq$  Insol in  $KOH$ , or  $NaOH + Aq$  Sol in conc boiling  $AgNO_3 + A$  (Wohler)

Sol in 431.7 pts 5%  $NH_4OH + Aq$  (c gr 0.998) at  $12^\circ$ , in 184.5 pts 10%  $NH_4OH$   $Aq$  (sp gr 0.96) at  $18^\circ$  (Longi, Gazz, c it 13 87)

Sl sol in  $Na$  citrate +  $Aq$

Sol in  $Hg(NO_3)_2 + Aq$

1 l of a 3-N solution of  $AgNO_3$  dissolv 3 1.216 g  $AgCN$  at  $25^\circ$  (Hellwig, Z anorg 1900, 25 177)

Very sol in  $(NH_4)_2S_2O_3 + Aq$  (Rosenheim and Steinhäuser, Z anorg 1900, 105)

Moderately sol in liq  $NH_3$  (Frankl, Am Ch J 1898 20 829)

Sl sol in liq  $HF$  (Franklin, Z anorg 1905, 46 2)

Abundantly sol in quinoline at  $60^\circ$  (Var, C R 1893, 116 60)

Sl sol in ethyl amine (Shinn, J ph Chem 1907, 11 538)

Insol in methyl acetate (Bezold, Dissert 1906, Naumann, B 1909, 42 3790), etl 1

acetate (Hamers, Dissert 1906, Naumann, B 1910, 43 314)

**Silver hydrogen cyanide**,  $\text{AgCN}$ ,  $\text{HCN}$   
(Euler, B 1903, 36 1859)

**Silver sodium cyanide**,  $\text{AgCN}$ ,  $\text{NaCN}$

Sol in 5 pts  $\text{H}_2\text{O}$  at  $20^\circ$  and in much less hot  $\text{H}_2\text{O}$  Sol in 24 pts 85% alcohol at  $20^\circ$  (Baup, A ch (3) 53 468)

**Silver thallous cyanide**,  $\text{AgCN}$ ,  $\text{TlCN}$

Easily sol in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  dissolve 4.7 pts at  $0^\circ$ , and 7.4 pts at  $16^\circ$  (Fronmuller, B 11 92)

**Silver tungsten cyanide**

See Tungstocyanide, silver

**Silver cyanide ammonia**,  $\text{AgCN}$ ,  $\text{NH}_3$

Efflorescent Decomp on air  
Very sol in ammonia at  $-10^\circ$  (Joannis, C R 1894, 118 1151)

**Silver cyanide hydrazine**,  $\text{AgCN}$ ,  $\text{N}_2\text{H}_4$

Decomp in the air  
Decomp by  $\text{H}_2\text{O}$  (Franzen, Z anorg 1911, 70 153)

**Silver cyanide nitrate**,  $2\text{AgCN}$ ,  $\text{AgNO}_3$

Decomp by  $\text{H}_2\text{O}$

**Sodium cyanide**,  $\text{NaCN}$

Sol in  $\text{H}_2\text{O}$  and 75% alcohol  
+  $\frac{1}{2}\text{H}_2\text{O}$ , and  $2\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$ , sl sol in alcohol (Joannis, A ch (5) 26 484)

**Sodium tungsten cyanide**

See Tungstocyanide, sodium

**Sodium zinc cyanide**,  $\text{NaCN}$ ,  $\text{Zn}(\text{CN})_2 + 2\frac{1}{2}\text{H}_2\text{O}$

Much more sol in  $\text{H}_2\text{O}$  than the corresponding K Zn salt (Rammelsberg)  
+  $8\text{H}_2\text{O}$  (Loebe, Dissert 1902)

**Sodium cyanide molybdenum dioxide**,  $4\text{NaCN}$ ,  $\text{MoO}_2 + 6\text{H}_2\text{O}$

(Winkler, Dissert 1909)  
+  $14\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Rosenheim, Garfunkel and Kohn, Z anorg 1910, 65 174)

**Sodium cyanide molybdenum dioxide hydroxylamine**,  $4\text{NaCN}$ ,  $\text{MoO}_2$ ,  $\text{NH}_2\text{OH} + \text{H}_2\text{O}$

As K comp (Winkler, Dissert 1909)

**Strontium cyanide**,  $\text{Sr}(\text{CN})_2 + 4\text{H}_2\text{O}$

Very unstable, very deliquescent, and sol in  $\text{H}_2\text{O}$  (Joannis, A ch (5) 26 496)

**Strontium tungsten cyanide**

See Tungstocyanide, strontium

**Strontium zinc cyanide**,  $2\text{Sr}(\text{CN})_2$ ,  $3\text{Zn}(\text{CN})_2 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  and alcohol (Loebe, Dissert 1902)

**Thallous cyanide**,  $\text{TlCN}$

100 pts  $\text{H}_2\text{O}$  dissolve 16.8 pts at  $28.5^\circ$  (Fronmuller, B 6 1178)

**Thallothallic cyanide**,  $\text{Tl}_2(\text{CN})_4 = \text{TlCN}$ ,  $\text{Tl}(\text{CN})_3$

Easily sol in  $\text{H}_2\text{O}$   
100 pts  $\text{H}_2\text{O}$  dissolve 27.3 pts at  $30^\circ$ , 15.3 pts at  $12^\circ$ , 9.7 pts at  $0^\circ$  (Fronmuller, B 11 92)

**Thallous tungsten cyanide**

See Tungstocyanide, thallous

**Thallous zinc cyanide**,  $2\text{TlCN}$ ,  $\text{Zn}(\text{CN})_2$

Easily sol in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  dissolve 8.7 pts at  $0^\circ$ , 15.2 pts at  $14^\circ$ , and 29.6 pts at  $31^\circ$  (Fronmuller, B 11 92)

**Tungsten cyanide with MCN**

See Tungstocyanide, M

**Zinc cyanide**,  $\text{Zn}(\text{CN})_2$

Insol in  $\text{H}_2\text{O}$  and alcohol Sol in alkalies  
Easily sol in  $\text{KCN} + \text{Aq}$  Sol in hot  $\text{NH}_4$  salts +  $\text{Aq}$  (Wittstein)

Easily sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Gore)  
Sol in  $\text{KOH} + \text{Aq}$  Solution is when less than 1 mol  $\text{Zn}(\text{CN})_2$  to 2  $\text{KOH}$  is present When proportion  $\text{ZnO}_2\text{H}_2$  soon separates

Sol in dil  $\text{KCN} + \text{Aq}$  (Sharwood, J Am Chem Soc 1903, 25 587)

Sl sol in conc Zn salts +  $\text{Aq}$  1 l conc  $\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  dissolves 4 g, and 1 l conc  $\text{ZnSO}_4 + \text{Aq}$  dissolves 2 g  $\text{Zn}(\text{CN})_2$   
Insol in  $\text{HCN} + \text{Aq}$  Easily sol in dil acids (Joannis)

Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 830)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

**Zinc cyanide ammonia**,  $\text{Zn}(\text{CN})_2$ ,  $2\text{NH}_3$

Decomp on air (Varet, C R 105 1070)  
+  $\text{H}_2\text{O}$  Decomp on air Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Varet)

**Zinc cyanide dihydrazine**,  $\text{Zn}(\text{CN})_2$ ,  $2\text{N}_2\text{H}_4$

Decomp by  $\text{H}_2\text{O}$  (Franzen, Z anorg 1911, 70 153)

**Cyanogen**,  $\text{CN}$

$\text{H}_2\text{O}$  absorbs  $4\frac{1}{2}$  vols  $\text{CN}$  gas at  $20^\circ$  Alcohol absorbs 23 vols, and ether 5 vols at the same temperature (Gay-Lussac)

The solution gradually decomposes, but this is prevented by traces of acids

0.221 mol litre are dissolved in  $H_2O$  at  $0^\circ$  (Naumann, Z Electrochem 1910, 16 177)

Oil of turpentine absorbs 5 vols (Gay-Lussac) Absorbed by many essential oils

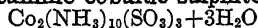
Very sol in  $CuCl_2 + Aq$   
Absorbed with decomp by  $NH_4OH + Aq$  and other alkaline liquids

Absorbed by aniline (Jacquemain, C R 100 1006)

### Cyclotriborene, $B_3H_3$

Insol in  $H_2O$  (Ramsay and Hatfield, Proc Chem Soc 1901, 17 152)

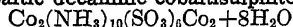
### Decamine cobaltic sulphite,



Sol in  $H_2O$  (Vortmann and Magdeburg, B 22 2636)

### Decamine cobaltisulphurous acid

#### Cobaltic decamine cobaltisulphite,



Ppt (Vortmann and Magdeburg, B 22 2635)

#### Sodium decamine cobaltisulphite,



Sol in  $H_2O$  (Vortmann and Magdeburg, B 22 2635)

### Diamide, $N_2H_4$

See Hydrazine

### Diamine chromium sulphocyanhydric acid, $Cr(NH_3)_{12}(SCN)_3, HSCN + H_2O$

Sol in  $H_2O$  (Nordenskiöld, Z anorg 1 130)

### Diamine chromium diaquo sulphocyanide, $Cr(NH_3)_2(SCN)_3 + 2H_2O$

Sol in  $H_2O$  from which it is pptd by con  $HCl + Aq$  (Nordenskiöld, Z anorg 1 137)

### Ammonium diamine chromium sulphocyanide, $Cr(NH_3)_3(SCN)_3, NH_4SCN$

(Reinecke's salt) Quite easily sol in  $H_2O$ , less in alcohol, and insol in benzene. Slowly decomp by boiling  $H_2O$  or dil acids (Nordenskiöld, Z anorg 1 130)

+  $H_2O$  Insol in absolute ether (Christensen, J pr (2) 45 218)

### Ammonium diamine chromium sulphocyanide iodide, $Cr(NH_3)_2(SCN)_3, NH_4SCN, I$

### Barium ———, $[Cr(NH_3)_3(SCN)_3]_2, Ba(SCN)_2$

Sol in  $H_2O$  and alcohol (N)

### Cadmium diamine chromium sulphocyanide, $Cd(SCN)_2, [Cr(NH_3)_2(SCN)_3]_2 + H_2O$

Nearly insol in cold, sl sol in hot  $H_2O$   
Sl sol in boiling alcohol (Christensen, J pr (2) 45 371)

### Cupric ———, $Cu(SCN)_2, [Cr(NH_3)_2(SCN)_3]_2$

Insol in  $H_2O$  or dil acids (Reinecke, A 126 116)

### Ferric ———, $[Cr(NH_3)_2(SCN)_3]^1 Fe(SCN)_3 (N)$

### Luteocobaltic ———, $Co(NH_3)_6(SCN)_3[Cr(NH_3)_2(SCN)_3]_3$

As good as insol in cold  $H_2O$  Sl sol in hot  $H_2O$  and alcohol (Christensen, J pr (2) 45 370)

### Mercuric ———, $[Cr(NH_3)_2(SCN)_3] Hg(SCN)_2$

Insol in  $H_2O$  (N)

Insol in  $H_2O$  and dil acids (Reinecke)

### Potassium ———, $Cr(NH_3)_2(SCN)_3 KSCN$

Properties as the  $NH_4$  salt (N)

$Cr(NH_3)_2(SCN)_3, KSCN, I$  As the  $NH_4$  salt (N)

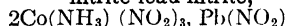
### Sodium ———, $NaSCN, Cr(NH_3)_2(SCN)_3$

Sol in  $H_2O$ , alcohol, and ether (Reinecke)

### Diamine cobaltic nitrite ammonium nitrite, $Co(NH_3)_2(NO_2)_3, NH_4NO_2$

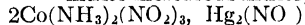
Sol in  $H_2O$  (Frdmann)

### ——— nitrite lead nitrite,



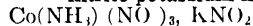
Sol in hot  $H_2O$  with partial decomp

### ——— nitrite mercurous nitrite,



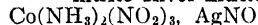
Ppt Not sol in hot  $H_2O$  without decomp

### ——— nitrite potassium nitrite,



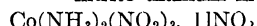
Sol in  $H_2O$  (Frdmann, J pr 97 35)

### ——— nitrite silver nitrite,

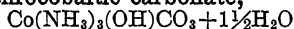


Ppt Crystallises out of hot  $H_2O$  (Erdmann)

### ——— nitrite thallium nitrite,



Crystallises out of hot  $H_2O$  without decomp

**Dichroco-baltic carbonate,**

Sol in  $\text{H}_2\text{O}$  (Vortmann, B 15 1901)

**Dichroco-baltic chloride,  $\text{Co}(\text{NH}_3)_3\text{Cl}_3 + \text{H}_2\text{O}$** 

Quite sol in cold  $\text{H}_2\text{O}$ , dil acids, conc  $\text{H}_2\text{SO}_4$ , or dil alcohol

From solution in conc  $\text{H}_2\text{SO}_4$ , the salt is precipitated by much  $\text{HCl} + \text{Aq}$  Composition is  $\text{Co}(\text{NH}_3)_3(\text{OH}_2)\text{Cl}_3$  (Jorgensen, Z anorg 5 189)

**— nitrate,  $\text{Co}(\text{NH}_3)_3(\text{NO}_3)_3 + 4\text{H}_2\text{O}$** 

Deliquescent Sol in  $\text{H}_2\text{O}$  More sol in dil  $\text{HNO}_3 + \text{Aq}$  than praseocobaltic nitrate (Vortmann, B 15 1897)

*Anhydrous* Insol in  $\text{H}_2\text{O}$  as such, but converted into above salt thereby (Jorgensen, Z anorg 5 186)

**— nitrite,  $\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3$** 

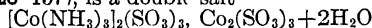
Difficultly sol in cold, but rather easily sol in hot  $\text{H}_2\text{O}$

**— sulphate,  $[\text{Co}(\text{NH}_3)_3]_2(\text{SO}_4)_3 + 6\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  (Vortmann, B 15 1900)

**— sulphite,  $[\text{Co}(\text{NH}_3)_3]_2(\text{SO}_3)_3 + \text{H}_2\text{O}$** 

Nearly insol in cold, slowly decomp by hot  $\text{H}_2\text{O}$  Decomp by acids or  $\text{KOH} + \text{Aq}$  Insol in cold, sol in warm  $\text{NH}_4\text{OH} + \text{Aq}$  (Kunzel, J pr (1) 72 209) According to Geuther (A 128 157), is a double salt—

**Didymium,  $\text{D}_1$** 

Slowly decomp by  $\text{H}_2\text{O}$  Insol in cold conc  $\text{H}_2\text{SO}_4$  Sol in dil acids

Compound of two elements, neodymium and praseodymium (v Welsbach, W A B 92 317)

**Didymium bromide,  $\text{D}_1\text{Br}_3 + 6\text{H}_2\text{O}$** 

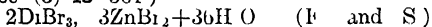
Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Cleve)

**Didymium nickel bromide,  $2\text{D}_1\text{Br}_3 \cdot 3\text{NiBr} + 18\text{H}_2\text{O}$** 

Deliquescent Very sol in  $\text{H}_2\text{O}$  (Frerichs and Smith, A 191 342)

**Didymium zinc bromide,  $\text{D}_1\text{Br}_3 \cdot 3\text{ZnBr}_2 + 12\text{H}_2\text{O}$** 

Extremely deliquescent (Cleve, Bull Soc (3) 43 361)

**Didymium chloride,  $\text{D}_1\text{Cl}_3$** 

*Anhydrous* Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol (Marignac)

+  $6\text{H}_2\text{O}$  Deliquescent Easily sol in  $\text{H}_2\text{O}$  and alcohol (Marignac)

**Didymium mercuric chloride,  $2\text{D}_1\text{Cl}_3, 9\text{HgCl}_2 + 24\text{H}_2\text{O}$** 

More sol in  $\text{H}_2\text{O}$  than the corresponding La salt (Marignac)

$\text{D}_1\text{Cl}_3, 4\text{HgCl}_2 + 11\text{H}_2\text{O}$  Not deliquescent Easily sol in  $\text{H}_2\text{O}$

**Didymium stannic chloride**

See Chlorostannate, didymium

**Didymium fluoride,  $\text{D}_1\text{F}_3 + \frac{1}{2}\text{H}_2\text{O}$** 

Precipitate (Cleve)

**Didymium hydrogen fluoride,  $2\text{D}_1\text{F}_3, 3\text{HF}$** 

Precipitate (Smith)

Does not exist (Cleve)

**Didymium potassium fluoride,  $\text{D}_1\text{F}_3, \text{KF} + \text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Brauner, B 15 114)

+  $\frac{1}{2}\text{H}_2\text{O}$  As above (B)

$2\text{D}_1\text{F}_3, 3\text{KF} + \text{H}_2\text{O}$  As above (B)

**Didymium hydroxide,  $\text{D}_1_2\text{O}_5\text{H}_6$** 

Insol in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ , but is sl sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rose)

See also  $\text{D}_1_2\text{O}_3$

**Didymium penthydroxide,  $\text{D}_1\text{O}_4\text{H}_3 = \text{D}_1_2\text{O}_5, 3\text{H}_2\text{O}$** 

Precipitate (Brauner, B 15 113)

**Didymium zinc iodide,  $2\text{D}_1\text{I}_3, 3\text{ZnI}_2 + 24\text{H}_2\text{O}$** 

Very deliquescent (Frerichs and Smith)

**Didymium oxide,  $\text{D}_1_2\text{O}_3$** 

With  $\text{H}_2\text{O}$  slowly forms  $\text{D}_1_2\text{O}_5\text{H}_6$

Sol in conc, or dil mineral acids (Marignac), and in acetic acid (Heimann) Sol in ammonium salts +  $\text{Aq}$

Slightly more slowly sol in conc  $\text{NH}_4\text{NO}_3 + \text{Aq}$  than  $\text{La}_2\text{O}_3$  (Damour and Deville)

A solution of  $\text{NH}_4\text{NO}_3$  in  $\text{H}_2\text{O}$  that can dissolve 29 mols  $\text{I}_2\text{O}_5$  dissolves 1 mol  $\text{D}_1_2\text{O}_3$  (Brauner, B 15 114)

Insol in acetone (Naumann, B 1904, 37 4329)

**Didymium peroxide,  $\text{D}_1_4\text{O}_7$** 

Sol in acids with decomp (Frerichs, B 7 799)

Not obtained by Cleve (B 11 910)

The contradictory statements concerning the composition of  $\text{D}_1$  peroxide are owing to the fact that praseodidymium is the only one of the constituents of  $\text{D}_1$  which easily forms a peroxide (v Welsbach)

**Didymium pentoxide,  $\text{D}_1_2\text{O}_5$** 

Sol in dil  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  in the cold without evolution of gas, but gas is evolved if treated with conc acids Insol in  $\text{HF} + \text{Aq}$  Sl sol in cold  $\text{NH}_4\text{NO}_3 + \text{Aq} = \text{D}_1_4\text{O}_9$  (Cleve)

**Didymium oxybromide,  $\text{D}_1\text{OBr}$** 

(Frerichs and Smith)

**Didymium oxychloride,  $\text{D}_1\text{OCl}$** 

*Anhydrous* Insol in  $\text{H}_2\text{O}$  (Smith)  
 $+3\text{H}_2\text{O}$  Sol in cold dil  $\text{HNO}_3 + \text{Aq}$   
 (Marignac) Sl sol in  $\text{HCl} + \text{Aq}$  (Hermann)

**Didymium oxysulphide,  $\text{D}_1\text{O}_2\text{S}$** 

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  without  
 residue (Marignac)

**Didymium sulphide,  $\text{D}_1\text{S}_2$** 

Insol in  $\text{H}_2\text{O}$  Decomp by dil acids  
 (Marignac, A ch (3) 38 159)  
 Insol in acetone (Naumann, B 1904,  
 37 4329)

**Disulphuric acid,  $\text{H}_2\text{S}_2\text{O}_7$** 

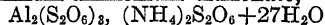
See Disulphuric acid

**Dithionic acid (Hyposulphuric acid),**

Known only in aqueous solution, which is  
 stable only when dil Can be evaporated in  
 vacuo until sp gr = 1.347, but decomp upon  
 further evaporation (Welter and Gay-  
 Lussac, A ch 10 312)

**Dithionates**All dithionates are sol in  $\text{H}_2\text{O}$ **Aluminum dithionate,  $\text{Al}_2(\text{S}_2\text{O}_6)_3 + 18\text{H}_2\text{O}$** 

Extremely deliquescent Easily sol in  $\text{H}_2\text{O}$   
 or absolute alcohol (Kluss, A 246 218)

**Aluminum ammonium dithionate,**

Sl deliquescent Sol in  $\text{H}_2\text{O}$  (Kluss, A  
 246 303)

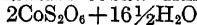
**Ammonium dithionate,  $(\text{NH}_4)_2\text{S}_2\text{O}_6$** 

Very sol in  $\text{H}_2\text{O}$  Sol in 0.79 pt  $\text{H}_2\text{O}$  at  
 $16^\circ$ , with reduction of temp Not decomp  
 on boiling Insol in absolute alcohol (Heeren,  
 Pogg 7 172)

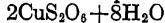
Contains  $\frac{1}{2}\text{H}_2\text{O}$  Sol in 0.56 pt  $\text{H}_2\text{O}$  at  
 $19^\circ$  (Kluss, A 246 194)

**Ammonium cadmium dithionate,**

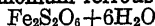
Sol in  $\text{H}_2\text{O}$  (Kluss, A 246 298)

**Ammonium cobalt dithionate,  $9(\text{NH}_4)_2\text{S}_2\text{O}_6,$** 

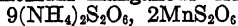
Sol in  $\text{H}_2\text{O}$  (Kluss)

**Ammonium cupric dithionate,  $(\text{NH}_4)_2\text{S}_2\text{O}_6,$** 

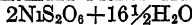
Sol in  $\text{H}_2\text{O}$

**Ammonium ferrous dithionate,  $3(\text{NH}_4)_2\text{S}_2\text{O}_6,$** 

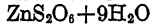
Sol in  $\text{H}_2\text{O}$  (Kluss, A 246 300)  
 $9(\text{NH}_4)_2\text{S}_2\text{O}_6, 2\text{Fe}_2\text{S}_2\text{O}_6 + 16\frac{1}{2}\text{H}_2\text{O}$  Sol  
 in  $\text{H}_2\text{O}$  (Kluss)

**Ammonium manganous dithionate,**

Sol in  $\text{H}_2\text{O}$  (Kluss, A 246 301)

**Ammonium nickel dithionate,  $9(\text{NH}_4)_2\text{S}_2\text{O}_6,$** 

Sol in  $\text{H}_2\text{O}$  (Kluss)

**Ammonium zinc dithionate,  $5(\text{NH}_4)_2\text{S}_2\text{O}_6,$** 

Easily sol in  $\text{H}_2\text{O}$  (Kluss, A 246 296)  
 $9(\text{NH}_4)_2\text{S}_2\text{O}_6, 2\text{ZnS}_2\text{O}_6 + 16\frac{1}{2}\text{H}_2\text{O}$  Easily  
 sol in  $\text{H}_2\text{O}$  (Kluss)

**Ammonium dithionate chloride,  $(\text{NH}_4)_2\text{S}_2\text{O}_6,$** 

Sol in  $\text{H}_2\text{O}$  (Fock and Kluss, B 24  
 3017)

**Barium dithionate,  $\text{BaS}_2\text{O}_6 + 2\text{H}_2\text{O}$** 

Not efflorescent Sol in 7.17 pts  $\text{H}_2\text{O}$  at  
 $8^\circ$ , 4.04 pts at  $18^\circ$ , and 1.1 pts  $\text{H}_2\text{O}$  at  $100^\circ$   
 Insol in alcohol (Gay-Lussac, Heeren)  
 Sol in 0.994 pt  $\text{H}_2\text{O}$  at  $102^\circ$ , the boiling-  
 point of the sat solution (Baker, Bull  
 Soc (2) 44 166)

Insol in methyl acetate (Naumann, B  
 1909, 42 3790)  
 $+4\text{H}_2\text{O}$  Very efflorescent (Heeren)

**Barium magnesium dithionate,  $\text{BaMg}(\text{S}_2\text{O}_6)_2$** 

Sol in  $\text{H}_2\text{O}$  (Schiff, A 118 97)

**Barium rubidium dithionate,  $\text{BaRb}_4(\text{S}_2\text{O}_6)_3$** 

Sol in  $\text{H}_2\text{O}$  Solubility is diminished by  
 presence of excess of  $\text{Rb}_2\text{SO}_4$ , but increased by  
 $\text{BaS}_2\text{O}_6$  (Bodlander, Chem Ztg 14 1140)

**Barium sodium dithionate,  $\text{BaNa}_4(\text{S}_2\text{O}_6)_3 +$** 

Sol in  $\text{H}_2\text{O}$  Decomp by recrystallisation  
 (Kraut, A 118 95)  
 $+6\text{H}_2\text{O}$  (Schiff)

**Barium dithionate chloride,  $\text{Ba}_2\text{S}_2\text{O}_6, \text{BaCl}_2 +$** 

(Fock and Kluss, B 23 3001)

**Bismuth dithionate, basic,  $\text{Bi}_2\text{O}_3, \text{S}_2\text{O}_6 +$** 

Efflorescent Insol in  $\text{H}_2\text{O}$ , but decomp  
 thereby into the following salt Easily sol  
 in dil acids, especially  $\text{HCl} + \text{Aq}$  (Kluss, A  
 246 183)

$4\text{Bi}_2\text{O}_3, 3\text{S}_2\text{O}_6 + 5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol  
 in dil acids (Kluss)

**Cadmium dithionate**

Deliquescent in moist air, very sol in  $H_2O$  (Heeren, Pogg 7 183)

**Cadmium dithionate ammonia**,  $CdS_2O_6 \cdot 4NH_3$ 

Decomp by alcohol, sol in  $NH_4OH + Aq$ , but decomp on heating (Rammelsberg, Pogg 58 298)

**Cæsium dithionate**,  $Cs_2S_2O_6$ 

Easily sol in  $H_2O$  (Chabrié, C R 1901, 133 297)

**Calcium dithionate**,  $CaS_2O_6 \cdot 4H_2O$ 

Sol in 2 46 pts  $H_2O$  at  $19^\circ$ , 0 8 pt. at  $100^\circ$  Insol in alcohol (Heeren, Pogg 7 178)  
 Insol in acetone (Naumann, B 1904, 37 4329)

**Cerous dithionate**,  $Ce_2(S_2O_6)_3 + 24H_2O$ 

Very sol in  $H_2O$  (John)  
 +3, and  $5H_2O$  (Wyruboff)

**Chromic dithionate**,  $Cr_2(S_2O_6)_3 + 18H_2O$ 

Sol in  $H_2O$  and alcohol (Kluss, A 246 189)  
 $3Cr_2O_3 \cdot 4S_2O_6 + 24H_2O$  Easily sol in  $H_2O$  or alcohol Insol in ether (Kluss)

**Cobaltous dithionate**,  $CoS_2O_6 \cdot 6H_2O$ 

Not deliquescent Very sol in  $H_2O$  (Heeren)  
 + $8H_2O$  Sol in 0 49 pt  $H_2O$  at  $19^\circ$  Sol in absolute alcohol (Kluss, A 246 203)

**Cupric dithionate basic**,  $4CuO \cdot S_2O_6 + 4H_2O$ 

Very sl sol in  $H_2O$  (Heeren, Pogg 7 18)  
 Insol in  $H_2O$ , easily sol in dil acids (Kluss, A 246 208)  
 + $3H_2O$  Insol in  $H_2O$  and  $NaC_2H_3O_2 + Aq$ , sol in traces in conc  $CuS_2O_6 + Aq$  Easily sol in dil acids, even  $HC_2H_3O_2$ , or  $H_2S_2O_6 + Aq$  (Kluss)

**Cupric dithionate**,  $CuS_2O_6 + 4H_2O$ 

Not efflorescent Very sol in  $H_2O$  Insol in alcohol (Heeren)  
 + $5H_2O$  (Efflorescent Sol in 0 64 pt  $H_2O$  at  $18.5^\circ$  (Kluss, A 246 204)

**Cupric dithionate ammonia**,  $CuS_2O_6 \cdot 4NH_3$ 

Difficultly sol in cold  $H_2O$ , moderately sol in  $H_2O$  at  $40^\circ$  Decomp by much  $H_2O$  or by heating the solution above  $60^\circ$  Decomp by  $HCl + Aq$  (Heeren)  
 Can be recryst from  $NH_4OH + Aq$   
 Sol in liquid  $NH_3$  (Horn, Am Ch J 1908, 39 213)  
 $CuS_2O_6 \cdot 9NH_3$  Decomp at ord temp in the air  
 Insol in liquid  $NH_3$  (Horn, Am Ch J 1908, 39 213)

**Dydium dithionate**,  $Dy_2(S_2O_6)_3 + 24H_2O$ 

Extremely sol in  $H_2O$  (Cleve)

**Erbium dithionate**,  $Er_2(S_2O_6)_3 + 18H_2O$ 

Very sol in  $H_2O$  or alcohol, insol in ether (Hoglund)

**Glucinum dithionate, basic**,  $5GfO \cdot 2S_2O_6 + 14H_2O$ 

Easily sol in  $H_2O$  and absolute alcohol (Kluss, A 246 196)

**Iron (ferrous) dithionate**,  $FeS_2O_6 + 5H_2O$ 

Very sol in  $H_2O$  Insol in alcohol Decomp in aqueous solution into  $FeSO_4$  by boiling (Heeren, Pogg 7 181)  
 + $7H_2O$  Sol in 0 59 pt  $H_2O$  at  $18.5^\circ$  (Kluss, A 246 198)

**Iron (ferric) dithionate, basic**,  $8Fe_2O_3 \cdot S_2O_6 + 20H_2O$ 

Insol in  $H_2O$  or alcohol Very sl sol in  $H_2S_2O_6 + Aq$ , easily sol in  $HCl + Aq$  (Heeren)  
 Contains  $14H_2O$  (Kluss, A 246 200)  
 $3Fe_2O_3 \cdot S_2O_6 + 8H_2O$  Insol in  $H_2O$  Easily sol in acids (Kluss, A 246 201)

**Lanthanum dithionate**,  $La_2(S_2O_6)_3 + 16H_2O$ , and  $24H_2O$ 

Sol in  $H_2O$  (Cleve)

**Lead dithionate, basic**,  $2PbO \cdot S_2O_6 + 2H_2O$ 

Very difficultly sol in  $H_2O$  (Heeren, Pogg 7 171)  
 $10PbO \cdot S_2O_6 + 2H_2O$  Sl sol in  $H_2O$  (Heeren)

**Lead dithionate**,  $PbS_2O_6 + 4H_2O$ 

Easily sol in  $H_2O$  (Heern)  
 Sol in 0 869 pt  $H_2O$  at  $20.5^\circ$  (Baker, C N 36 203)

**Lead strontium dithionate**,  $(Pb, Sr)S_2O_6 + 4H_2O$ 

(Rammelsberg)

**Lithium dithionate**,  $Li_2S_2O_6 + 2H_2O$ 

Sl deliquescent, and easily sol in  $H_2O$  Insol in alcohol (Rammelsberg)

**Magnesium dithionate**,  $MgS_2O_6 + 6H_2O$ 

Sol in 0 85 pt  $H_2O$  at  $13^\circ$  Solution can be boiled without decomp (Heeren, Pogg 7 179)  
 Sol in 0 692 pt  $H_2O$  at  $17^\circ$  (Baker, C N 36 203)

**Manganous dithionate**,  $MnS_2O_6 + 3H_2O$ 

Sol in  $H_2O$  (Kraut, A 118 98)  
 + $6H_2O$  Efflorescent Sol in  $H_2O$  (Magnac, J B 1855 380)



**Mercurous dithionate,  $\text{Hg}_2\text{S}_2\text{O}_6$** 

Sl sol in cold, decomp by hot  $\text{H}_2\text{O}$   
(Rammelsberg)

**Mercuric dithionate, basic,  $5\text{HgO}$ ,  $2\text{S}_2\text{O}_6$** 

Sl sol in cold, decomp by hot  $\text{H}_2\text{O}$   
Easily sol in  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg,  
Pogg 59 472)

**Mercuric dithionate,  $\text{HgS}_2\text{O}_6 + 6\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  or on standing (Kluss,  
A 246 216)

**Nickel dithionate,  $\text{NiS}_2\text{O}_6 + 6\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Topsoe)  
Sol in 0.897 pt  $\text{H}_2\text{O}$  at  $12^\circ$  (Baker, C N  
36 203)

**Nickel dithionate ammonia,  $\text{NiS}_2\text{O}_6$ ,  $6\text{NH}_3$** 

Can be recryst from warm  $\text{NH}_4\text{OH} + \text{Aq}$   
Decomp by  $\text{H}_2\text{O}$  (Rammelsberg, Pogg  
58 295)

**Nickel dithionate hydrazine,  $\text{NiS}_2\text{O}_6$ ,  
 $3\text{N}_2\text{H}_4$** 

Unstable  
Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Franzen, Z anorg  
1908, 60 267)

**Potassium dithionate,  $\text{K}_2\text{S}_2\text{O}_6$** 

Not deliquescent Sol in 16.5 pts  $\text{H}_2\text{O}$  at  
 $16^\circ$ , and 1.58 pts at  $100^\circ$  Insol in alcohol  
(Heeren)

Sol in 2.65 pts  $\text{H}_2\text{O}$  at  $16^\circ$  (Dumas)  
Sol in 16.5 pts  $\text{H}_2\text{O}$  at  $16^\circ$ , in 1.58 pts  
boiling  $\text{H}_2\text{O}$   
Insol in alcohol (Heeren, Pogg 1826, 7  
72)

**Praseodymium dithionate,  $\text{Pr}_2(\text{S}_2\text{O}_6)_3 + 12\text{H}_2\text{O}$** 

Deliquescent, very sol in  $\text{H}_2\text{O}$  (von  
Schule, Z anorg 1898, 18 361)

**Rubidium dithionate,  $\text{Rb}_2\text{S}_2\text{O}_6$** 

Sol in  $\text{H}_2\text{O}$  (Topsoe and Christiansen)

**Ruthenium dithionate,  $\text{RuS}_2\text{O}_6$** 

Ppt from aq sol by alcohol (Antony,  
Gazz ch it 1898, 28 139-142)

**Silver dithionate,  $\text{Ag}_2\text{S}_2\text{O}_6 + 2\text{H}_2\text{O}$** 

Sol in 2 pts  $\text{H}_2\text{O}$  at  $16^\circ$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
(Heeren, Pogg 7 191)

**Silver sodium dithionate,  $\text{AgS}_2\text{O}_6$ ,  $\text{Na}_2\text{S}_2\text{O}_6$   
 $+ 4\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Kraut, A 118 96)

**Silver dithionate ammonia,  $\text{Ag}_2\text{S}_2\text{O}_6$ ,  $4\text{NH}_3$** 

Sol in  $\text{H}_2\text{O}$  without decomp (Rammels-  
berg, Pogg 58 298)

**Sodium dithionate,  $\text{Na}_2\text{S}_2\text{O}_6 + 2\text{H}_2\text{O}$** 

Sol in 2.1 pts  $\text{H}_2\text{O}$  at  $16^\circ$ , and in 1.1 pts  
boiling  $\text{H}_2\text{O}$  Insol in alcohol

Fuming  $\text{HCl} + \text{Aq}$  precipitates the salt  
from aqueous solution (Heeren, Pogg 7  
76)  
 $+ 6\text{H}_2\text{O}$  (Kraut, A 117 97)

**Strontium dithionate,  $\text{SrS}_2\text{O}_6 + 4\text{H}_2\text{O}$** 

Sol in 4.5 pts  $\text{H}_2\text{O}$  at  $16^\circ$ , 1.5 pts boiling  
 $\text{H}_2\text{O}$  Insol in alcohol (Heeren, Pogg 7  
177)

**Thallous dithionate,  $\text{Tl}_2\text{S}_2\text{O}_6$** 

Very easily sol in  $\text{H}_2\text{O}$  (Werther)

**Thallous dithionate sulphate,  $3\text{Tl}_2\text{S}_2\text{O}_6$   
 $\text{Tl}_2\text{SO}_4$** 

Sol in  $\text{H}_2\text{O}$  (Wyrouboff, Ann Phys  
Beibl 8 802)

**Thorium dithionate,  $\text{Th}(\text{S}_2\text{O}_6)_2 + 4\text{H}_2\text{O}$  (?)**

Very unstable (Kluss, A 246 188)

**Tin (stannous) dithionate,  $\text{SnS}_2\text{O}_6$** 

Known only in solution  
 $8\text{SnO}$ ,  $\text{S}_2\text{O}_6 + 9\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol  
in dil acids, even dithionic acid +  $\text{Aq}$  (Kluss  
A 246 186)

**Uranous dithionate,  $6\text{UO}_2$ ,  $\text{S}_2\text{O}_6 + 10\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , sol in warm  $\text{HCl} + \text{Aq}$   
(Kluss, A 246 191)

$7\text{UO}_2$ ,  $\text{S}_2\text{O}_6 + 8\text{H}_2\text{O}$  As above  
 $8\text{UO}_2$ ,  $\text{S}_2\text{O}_6 + 21\text{H}_2\text{O}$  As above

**Vanadyl dithionate,  $(\text{VO})_2\text{S}_2\text{O}_6$** 

Sol in  $\text{H}_2\text{O}$  (Bevan, C N 38 294)

**Yttrium dithionate,  $\text{Y}_2(\text{S}_2\text{O}_6)_3 + 18\text{H}_2\text{O}$** 

Not deliquescent Easily sol in  $\text{H}_2\text{O}$ , but  
difficultly sol in alcohol Insol in ether  
(Cleve, Bull Soc (2) 21 344)

**Zinc dithionate,  $\text{ZnS}_2\text{O}_6 + 6\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$ , decomp on boiling  
(Heeren, Pogg 7 183)

**Zinc dithionate ammonia,  $\text{ZnS}_2\text{O}_6$ ,  $4\text{NH}_3$** 

Decomp with  $\text{H}_2\text{O}$ , sol in warm, less sol  
in cold  $\text{NH}_4\text{OH} + \text{Aq}$  (Rammelsberg, Pogg  
58 297)

$+ \text{H}_2\text{O}$  Ppt (Ephraim, B 1915, 48  
640)

**Dysprosium, Dy**

(Lecoq de Boisbaudran, C R 102 1005)

**Dysprosium chloride,  $\text{DyCl}_3 + 6\text{H}_2\text{O}$** 

Deliquescent, sol in  $\text{H}_2\text{O}$  (Urban, C R  
1908, 146 129)

**Europium****Europium chloride,  $\text{EuCl}_2$** 

Sol in  $\text{H}_2\text{O}$  Stable in very dil aqueous solution, but decomp when the solution is concentrated at  $100^\circ$  (Urban, C R 1911, 153 1157)

**Erbium, Er**

Decomposes  $\text{H}_2\text{O}$  (Hoglund)

The so-called element "erbium" can be further decomp into simple substances (Kruss, Z anorg 3 353)

**Erbium bromide,  $\text{ErBr}_3 + 9\text{H}_2\text{O}$** 

Very deliquescent

**Erbium chloride,  $\text{ErCl}_3 + 6\text{H}_2\text{O}$** 

Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol (Hoglund)

**Erbium mercuric chloride,  $\text{ErCl}_3, 5\text{HgCl}_2 + x\text{H}_2\text{O}$** 

Deliquescent (Cleve)

**Erbium fluoride,  $\text{ErF}_3$** 

Insol in  $\text{H}_2\text{O}$  Verv sl sol in  $\text{HF} + \text{Aq}$  (Hoglund, Bull Soc (2) 18 193)

**Erbium hydroxide,  $\text{Er}_2\text{O}(\text{OH})_4$** 

Insol in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$   
Easily sol in acids Decomp ammonium salts by boiling therewith

**Erbium iodide,  $\text{ErI}_3$** 

Very deliquescent Very sol in  $\text{H}_2\text{O}$  and alcohol Insol in ether (Hoglund)

**Erbium oxide,  $\text{Er}_2\text{O}_3$** 

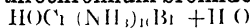
Difficultly but completely sol in warm  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HCl} + \text{Aq}$  Decomp  $\text{NH}_4$  salts by boiling therewith

**Erbium peroxide,  $\text{Er}_2\text{O}_5$** 

Preecipitate (Cleve, Bull Soc (2) 43 53)

**Erbium sulphide**

Decomp in moist air and with acids

**Erythrochromium bromide,**

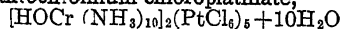
Very easily sol in  $\text{H}_2\text{O}$  Insol in  $\text{HBr} + \text{Aq}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Jorgensen, J pr (2) 25 598)

**— bromide, basic,  $\text{HO}(\text{Cr}_2(\text{NH}_3)_{10}(\text{OH})\text{Br})_4 + \text{H}_2\text{O}$** 

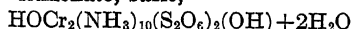
Very sol in  $\text{H}_2\text{O}$  (Jorgensen)

**— chloriodide,  $\text{HO}(\text{Cr}_2(\text{NH}_3)_{10}\text{ClI})_4 + \text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  and in alcohol (Jorgensen)

**Erythrochromium chloroplatinate,**

Nearly insol in  $\text{H}_2\text{O}$  (Jorgensen)

**— dithionate, basic,**

Insol in  $\text{H}_2\text{O}$  Easily sol in very dil  $\text{HNO}_3$ ,  $\text{HBr}$ ,  $\text{HCl} + \text{Aq}$  Sol in conc  $\text{NH}_4\text{Cl} + \text{Aq}$  (Jorgensen)

**— nitrate,  $\text{HO}(\text{Cr}_2(\text{NH}_3)_{10}(\text{NO}_3)_5 + \text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  Insol in dil  $\text{HNO}_3 + \text{Aq}$  Sol in conc  $\text{HNO}_3$  with decomp Very sol in dil  $\text{NH}_4\text{OH} + \text{Aq}$  Insol in alcohol (Jorgensen)

**— nitrate, basic,  $\text{HO}(\text{Cr}_2(\text{NH}_3)_{10}(\text{NO}_3)_4\text{OH} + 3\frac{1}{2}\text{H}_2\text{O}$** 

Sol in cold  $\text{H}_2\text{O}$  (Jorgensen)

**— sulphate,  $[\text{HO}(\text{Cr}_2(\text{NH}_3)_{10})_2(\text{SO}_4)_5$** 

Nearly insol in  $\text{H}_2\text{O}$  (Jorgensen)

**Tetraferriammonium,  $\text{Fe}_2\text{N}$** 

See Iron nitride

**Ferric acid****Barium ferrate,  $\text{BaFeO}_4 + \text{H}_2\text{O}$** 

Ppt Can be boiled for some time with  $\text{H}_2\text{O}$  without decomp Decomp by mineral acids Sol in dil acetic acid (Fremy, A ch (3) 12 373)

Insol in  $\text{H}_2\text{O}$ , not readily acted upon by acids when dry (Roscn, J Am Chem Soc 1895, 17 766)

Ppt Easily decomp by acids (Moeser, Arch Pharm 1895, 233 526)

Insol in acetone (Naumann, B 1904, 37 429)

**Calcium ferrate,  $\text{CaFe}_2\text{O}_4$** 

Sol in  $\text{H}_2\text{O}$  (Rosell, J Am Chem Soc 1895 17 760-69)

**Potassium ferrate,  $\text{K}_2\text{FeO}_4$** 

Very deliquescent Easily sol in cold  $\text{H}_2\text{O}$  with evolution of much heat Decomp by standing or warming Decomp by acids or alkalis (Fremy, A ch (3) 12 569)

Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Moeser, Arch Pharm 1895, 233 526)

Quickly decomp by potassium carbonate or carbonate, sugar, or albumin without separation of  $\text{Fe}_2\text{O}_3$ , by alcohol with separation of  $\text{Fe}_2\text{O}_3$ , Potassium oxalate, acetate, formate, and benzoate, also citrate decomp much more slowly Insol in conc  $\text{KOH} + \text{Aq}$  (Wickham, A 33 41)

**Sodium ferrate,  $\text{Na}_2\text{FeO}_4$** 

Sol in  $\text{H}_2\text{O}$  and in conc  $\text{NaOH} + \text{Aq}$  (Fremy, l c)

**Strontium ferrate,  $\text{SrFeO}_4$** 

Sl sol in  $\text{H}_2\text{O}$  by which it is decomp  
Decomp by acids  
Sol in aqueous solutions of Na and K salts with partial decomp  
Insol in sat  $\text{SrBr}_2 + \text{Aq}$ , alcohol and ether (Eidmann, B 1903, 36, 2290)

**Ferricomolybdic acid**

**Ammonium ferricomolybdate,  $3(\text{NH}_4)_2\text{O} \cdot \text{Fe}_2\text{O}_3 \cdot 12\text{MoO}_3 + 19\text{H}_2\text{O}$**   
Ppt (Hall, J Am Chem Soc 1907, 29 697)

**Ferricyanhydric acid,**

$\text{H}_3\text{Fe}(\text{CN})_3$ , (or  $\text{H}_2\text{Fe}_2(\text{CN})_{12}$ )  
Easily sol in  $\text{H}_2\text{O}$  or alcohol Solution decomposes slowly by standing, more rapidly by heating Insol in ether

**Ferricyanides**

The alkali, and alkaline-earth ferricyanides are sol in  $\text{H}_2\text{O}$ , the others are insol The ferricyanides of metals, the oxides of which are sol in  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ , are themselves sol in those reagents

**Ammonium ferricyanide,  $(\text{NH}_4)_3\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$**

Permanent Readily sol in  $\text{H}_2\text{O}$  (and alcohol?)

**Ammonium ferrous ferricyanide,  $\text{NH}_4\text{FeFe}(\text{CN})_6 + 1\frac{1}{2}\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  and not pptd by alcohol from aqueous solution More stable than the corresponding K salt

**Ammonium lead ferricyanide,  $\text{NH}_4\text{PbFe}(\text{CN})_6 + 3\text{H}_2\text{O}$**

**Ammonium potassium ferricyanide,  $(\text{NH}_4)_2\text{KFe}(\text{CN})_6$**

Sol in  $\text{H}_2\text{O}$  (Schaller, Bull Soc (2) 1 275)

**Barium ferricyanide,  $\text{Ba}_3[\text{Fe}(\text{CN})_6]_2 + 20\text{H}_2\text{O}$**

Easily sol in  $\text{H}_2\text{O}$ , insol in alcohol (Schuler, W A B 77 692)

**Barium potassium ferricyanide,  $\text{BaKFe}(\text{CN})_6 + 3\text{H}_2\text{O}$**

Permanent Easily sol in  $\text{H}_2\text{O}$ , less in alcohol

**Barium ferricyanide bromide,  $\text{Ba}_3[\text{Fe}(\text{CN})_6] \cdot 2\text{BaBr}_2 + 20\text{H}_2\text{O}$**

Easily sol in  $\text{H}_2\text{O}$  Boiling alcohol does not dissolve out  $\text{BaBr}_2$  (Rammelsberg, J pr (2) 39 463)

**Bismuth ferricyanide,  $\text{Bi}_3[\text{Fe}(\text{CN})_6]_3$**

Insol in  $\text{H}_2\text{O}$ , but decomp by boil therewith (Muir, Chem Soc 32 40)

**Cadmium ferricyanide ammonia,**

$\text{Cd}_3[\text{Fe}(\text{CN})_6]_2 \cdot 6\text{NH}_3 + 3\text{H}_2\text{O}$   
Effloresces to form—  
 $\text{Cd}_3[\text{Fe}(\text{CN})_6]_2 \cdot 4\text{NH}_3 + 2\text{H}_2\text{O}$  Insol  
 $\text{H}_2\text{O}$  (Wyrouboff, A hc (5) 10 413)

**Calcium ferricyanide,  $\text{Ca}_3[\text{Fe}(\text{CN})_6]_2 + 1$  or  $12\text{H}_2\text{O}$**

Deliquescent Sol in  $\text{H}_2\text{O}$  and dil alcohol

**Calcium potassium ferricyanide,**

$\text{CaKFe}(\text{CN})_6$   
Sol in  $\text{H}_2\text{O}$

**Cerous ferricyanide,  $\text{CeFe}(\text{CN})_6 + 4\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$ , easily decomp (John)

**Chromic ferricyanide (?)**

Ppt

**Cobaltous ferricyanide,  $\text{Co}_3[\text{Fe}(\text{CN})_6]_2$**

Insol in  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Cobaltous ferricyanide ammonia,**

$\text{Co}_3[\text{Fe}(\text{CN})_6]_2 \cdot 4\text{NH}_3 + 6\text{H}_2\text{O}$

**Cobaltic ferricyanide ammonia**

See Luteo,- purpureo,- etc cobaltic ferricyanide

**Cuprous ferricyanide,  $(\text{Cu}_2)_3[\text{Fe}(\text{CN})_6]$**

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , insol in  $\text{NH}_4$  salts  
 $\text{Aq}$  (Wittstein)

**Cupric ferricyanide,  $\text{Cu}_3[\text{Fe}(\text{CN})_6]_2$**

Insol in  $\text{H}_2\text{O}$  or  $\text{NH}_4$  salts +  $\text{Aq}$  Sol in  $\text{NH}_4\text{OH}$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Wittstein)  
Insol in  $\text{HCl} + \text{Aq}$

**Iron (ferrous) ferricyanide,  $\text{Fe}_3[\text{Fe}(\text{CN})_6]_2 \cdot x\text{H}_2\text{O}$**

(Turnbull's blue) Properties as ferri ferrocyanide (Prussian blue), with which it is perhaps identical (Gintl, Z anal 21 110)

**Iron (ferrosoferric) ferricyanide,**

$\text{Fe}_{13}(\text{CN})_{35} = \text{Fe}^{+4}_4\text{Fe}^{+3}_9[\text{Fe}(\text{CN})_6]_5$   
(Prussian green) Insol in  $\text{H}_2\text{O}$  or conc  $\text{HCl} + \text{Aq}$ , but slowly decomp by boiling therewith  
 $\text{Fe}_3(\text{CN})_9 + 4\text{H}_2\text{O} = \text{Fe}^{+3}_3\text{Fe}^{+2}_3[\text{Fe}(\text{CN})_6]_4 + 12\text{H}_2\text{O}$  Properties as above (Reynolds, Chem Soc 54 767)

**Iron (ferrous) potassium ferricyanide,**

$\text{KFe}_2(\text{CN})_6 = \text{KFeFe}(\text{CN})_6 + 4$ , or  $3\text{H}_2\text{O}$   
(Soluble Prussian blue) Sol in  $\text{H}_2\text{O}$ , but insol in salts +  $\text{Aq}$  or alcohol

Salt of the same composition, called "Williamson's blue," is insol in  $H_2O$

**Lead ferricyanide, basic**,  $Pb_3[Fe(CN)_6]_2$ ,  
 $3PbO_2H_2 + 11H_2O$   
(Schuler)

**Lead ferricyanide**,  $Pb_3[Fe(CN)_6]_2 + 16H_2O$   
Sl sol in  $H_2O$ , more sol in hot, than cold  
 $H_2O$ , but decomp on boiling (Gmelin)  
 $+4H_2O$  Easily sol in  $H_2O$ , sl sol in  
alcohol (Schuler, W A B 77 692)

**Lead potassium ferricyanide**,  $PbKFe(CN)_6$   
 $+3H_2O$   
Sol in 4.75 pts  $H_2O$  at  $16^\circ$ , and the solu-  
tion decomp on standing (Schuler)  
 $+1\frac{1}{2}H_2O$  Efflorescent Much more sol  
in  $H_2O$  than the Pb salt Insol in alcohol  
(Wyrouboff)

**Lead ferricyanide nitrate**,  $Pb_3[Fe(CN)_6]_2$ ,  
 $Pb(NO_3)_2 + 12H_2O$   
Sol in 13.31 pts  $H_2O$  at  $16^\circ$  (Schuler)  
 $+11H_2O$  (Joannis, A ch (5) 26 528)

**Magnesium ferricyanide**,  $Mg_3[Fe(CN)_6]_2$   
Sol in  $H_2O$

**Magnesium potassium ferricyanide**,  
 $MgKFe(CN)_6$   
(Reindel, J pr 103 166)

**Manganous ferricyanide**,  $Mn_3[Fe(CN)_6]_2$   
Insol in  $H_2O$ , acids,  $NH_4OH$ , or  $NH_4$  salts  
 $+Aq$

**Mercurous ferricyanide**,  $Hg_2Fe(CN)_6$   
Ppt (Fernekes, J Am Chem Soc 1906, 28 604)

**Mercuric ferricyanide**,  $Hg_2[Fe(CN)_6]_2$   
Very sol in  $H_2O$  Solution quickly decomp  
(Fernekes, J Am Chem Soc 1906, 28 603)

**Nickel ferricyanide ammonia**,  $Ni_3[Fe(CN)_6]_2$ ,  
 $4NH_3 + H_2O$   
Sol in  $Ni_4OH + Aq$  (Reynoso, A ch (3)  
30 254)

**Nickel ferricyanide**,  $Ni_3[Fe(CN)_6]_2(?)$   
Ppt Insol in  $HCl + Aq$

**Potassium ferricyanide**,  $K_3Fe(CN)_6$ , (or  
 $K_4Fe_2(CN)_{12}$ )  
Permanent Easily sol in  $H_2O$

100 pts  $H_2O$  dissolve pts  $K_3Fe(CN)_6$  at  $t^\circ$

$t^\circ$	Pts salt	t	Pts salt	t	Pts salt
4 4	33 0	15 6	40 8	100	77 5
10	36 6	37 8	58 8	104 4	82 6

(Wallace, Chem Soc 7 80)

100 pts  $H_2O$  at  $13^\circ$  dissolve 38 pts, and the  
solution has sp gr = 1.630 (Schiff, A 113  
350)

1 l sat solution in  $H_2O$  at  $25^\circ$  contains  
385.5 g  $K_3Fe(CN)_6$  (Grube, Z Electrochem  
1914, 20 342)

Sp gr of  $K_3Fe(CN)_6 + Aq$  at  $13^\circ$

% salt	Sp gr	% salt	Sp gr	% salt	Sp gr
1	1.0051	11	1.0595	21	1.1202
2	1.0103	12	1.0653	22	1.1266
3	1.0155	13	1.0712	23	1.1331
4	1.0208	14	1.0771	24	1.1396
5	1.0261	15	1.0831	25	1.1462
6	1.0315	16	1.0891	26	1.1529
7	1.0370	17	1.0952	27	1.1596
8	1.0426	18	1.1014	28	1.1664
9	1.0482	19	1.1076	29	1.1732
10	1.0538	20	1.1039	30	1.1802

(Schiff)

Sp gr of  $K_3Fe(CN)_6 + Aq$  at  $25^\circ$

Concentration of $K_3Fe(CN)_6$ $+Aq$	Sp gr
1—normal	1.0574
$\frac{1}{2}$ —"	1.0289
$\frac{1}{4}$ —"	1.0143
$\frac{1}{8}$ —"	1.0092

(Wagner, Z phys Ch 1890, 5 37)

Sat  $K_3Fe(CN)_6 + Aq$  boils at  $104.4^\circ$   
(Wallace)

1 l sat solution at  $25^\circ$  of  $K_3Fe(CN)_6 +$   
 $K_4Fe(CN)_6$  contains 338.1 g  $K_3Fe(CN)_6$  and  
79.02 g  $K_4Fe(CN)_6$  (Grube)

Solubility of  $K_3Fe(CN)_6 + K_4Fe(CN)_6$  in  
 $KOH + Aq$  at  $25^\circ$

KOH Normality	g per l	
	$K_3Fe(CN)_6$	$K_4Fe(CN)_6$
0.4687	309	66.64
0.9628	275.3	55.19
1.949	200.8	35.95

(Grube)

Solubility in  $KOH + Aq$  at  $25^\circ$

KOH Normality	g $K_3Fe(CN)_6$ per l
0.4687	342.7
0.9628	302.3
1.949	215.1

(Grube, Z Electrochem, 1914, 20 342)

Insol in liquid  $NH_3$  (Franklin, Am Ch  
J 1898, 20 828)

Insol in absolute alcohol, and only sl sol in dil alcohol

Sol in acetone (Naumann, B 1904, **37** 4328)

Insol in methyl acetate (Naumann, B 1909, **42** 3790), ethyl acetate (Naumann, B 1910, **43** 314)

Insol in benzonitrile (Naumann, B 1914, **47** 1370)

**Potassium sodium ferricyanide,**  
 $\text{KNa}_2\text{Fe}(\text{CN})_6$

Sol in  $\text{H}_2\text{O}$

K NaFe(CN)<sub>6</sub> Sol in  $\text{H}_2\text{O}$

$\text{K}_3\text{Na}_3[\text{Fe}(\text{CN})_6]_2$  Sol in  $\text{H}_2\text{O}$   
+  $3\text{H}_2\text{O}$

**Potassium ferricyanide iodide,**  $\text{K}_3\text{Fe}(\text{CN})_6$ ,  
KI

Very unstable

**Silver ferricyanide,**  $\text{Ag}_3\text{Fe}(\text{CN})_6$

1 l  $\text{H}_2\text{O}$  dissolves 0.00066 g  $\text{Ag}_3\text{Fe}(\text{CN})_6$  at  $20^\circ$  (Whitby, Z anorg 1910, **67** 108)

Sol in  $\text{NH}_4\text{OH}$ , and hot  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , but insol in  $\text{NH}_4$  salts + Aq

Insol in  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$  (Wackenroder, A **41** 317)

**Silver ferricyanide ammonia,**  $2\text{Ag}_3\text{Fe}(\text{CN})_6$ ,  
 $3\text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Gintl)

$2\text{Ag}_3\text{Fe}(\text{CN})_6$ ,  $5\text{NH}_3$  (Carlo, Gazz ch it 1910, **40** (2) 477)

**Sodium ferricyanide,**  $\text{Na}_3\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$

Deliquescent Sol in 53 pts cold, and 15 pts boiling  $\text{H}_2\text{O}$  Insol in alcohol, but not pptd thereby from aqueous solution (Bette)

**Ferrinitrososulphydic acid**

See Ferroheptanitrososulphydic acid

**Ferrocyanhydric acid,**  $\text{H}_4\text{Fe}(\text{CN})_6$

Sol in  $\text{H}_2\text{O}$  and alcohol

100 pts  $\text{H}_2\text{O}$  dissolve 15 pts acid at  $14^\circ$  (Joannis, A ch (5) **26** 514)

Insol in ether, and much less sol in ethyl alcohol than in alcohol Insol in conc  $\text{HCl} + \text{Aq}$

**Ferrocyanides**

The ferrocyanides of the alkali and alkali-earth metals are sol in  $\text{H}_2\text{O}$ , the others are insol, but sol in alkalis + Aq in case the base is sol therein

**Aluminum ferrocyanide,**  $\text{Al}_4[\text{Fe}(\text{CN})_6]_3 + 17\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$

Sl sol in  $\text{HCl} + \text{Aq}$  with partial decomp (Wyruboff, A ch (5) **8** 446)

**Ammonium ferrocyanide,**  $(\text{NH}_4)_4\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , insol in alcohol

+  $\text{H}_2\text{O}$  (Berzelius)

**Ammonium cadmium ferrocyanide ammonia**  
 $(\text{NH}_4)_2\text{Cd}_2[\text{Fe}(\text{CN})_6]_2, 2\text{NH}_3 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Wyruboff, A ch (5) **10** 413)

**Ammonium calcium ferrocyanide,**  
 $(\text{NH}_4)_2\text{CaFe}(\text{CN})_6$

Sl sol in  $\text{H}_2\text{O}$  (Kunheim and Zimmer man, Dingl **252** 478)

100 g sat solution in  $\text{H}_2\text{O}$  contain 0.25% at  $16^\circ$  (Brown, J phys Ch 1898, **2** 51)

**Ammonium cuprous ferro cyanide,**  
 $(\text{NH}_4)_2\text{Cu}_2\text{Fe}(\text{CN})_6$

Insol in  $\text{H}_2\text{O}$  and alcohol

Decomp in the air (Messner, Z anorg 1895, **8** 382)

**Ammonium cupric ferrocyanide,**  
 $(\text{NH}_4)_2\text{CuFe}(\text{CN})_6$

Ppt

+  $\text{H}_2\text{O}$  Very unstable Insol in  $\text{H}_2\text{O}$  decomp by boiling  $\text{H}_2\text{O}$  (Messner, Z anorg 1895, **8** 384)

**Ammonium lithium ferrocyanide,**  
 $(\text{NH}_4)_2\text{Li}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Wyruboff, A ch (4) **21** 270)

**Ammonium magnesium ferrocyanide,**  
 $(\text{NH}_4)_2\text{MgFe}(\text{CN})_6$

1 l sat solution at  $17^\circ$  contains 2.18 g  $(\text{NH}_4)_2\text{MgFe}(\text{CN})_6$  (Robins in Chem Soc 1900 **95**)

**Ammonium manganous ferrocyanide,**  
 $(\text{NH}_4)_2\text{MnFe}(\text{CN})_6$

Ppt (Blum, Z anal **30** 281)

**Ammonium potassium ferrocyanide,**  
 $\text{NH}_4\text{K}_3\text{Fe}(\text{CN})_6 + 5\text{H}_2\text{O}$

Insol in cold, more easily in hot  $\text{H}_2\text{O}$  Insol in alcohol

$(\text{NH}_4)_2\text{KFe}(\text{CN})_6 + 3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

**Ammonium potassium ferrocyanide ammonium chloride,**  $(\text{NH}_4)_4\text{KFe}(\text{CN})_6$   
 $2\text{NH}_4\text{Cl}$

Sol in  $\text{H}_2\text{O}$  (Etard, J pr (2) **31** 150)

**Ammonium ferrocyanide bromide,**  
 $(\text{NH}_4)_4\text{Fe}(\text{CN})_6, 2\text{NH}_4\text{Br}$

Permanent Very sol in  $\text{H}_2\text{O}$

**Ammonium ferrocyanide chloride,**  
 $(\text{NH}_4)_4\text{Fe}(\text{CN})_6, 2\text{NH}_4\text{Cl} + 3\text{H}_2\text{O}$

Permanent Very sol in  $\text{H}_2\text{O}$ , but less so than  $\text{NH}_4\text{Cl}$  (Bunsen)

**Antimony ferrocyanide**,  $\text{Sb}_4[\text{Fe}(\text{CN})_6]_3 + 25\text{H}_2\text{O}$

Ppt (Atterberg)

**Barium ferrocyanide**,  $\text{Ba}_2\text{Fe}(\text{CN})_6 + 6\text{H}_2\text{O}$

Permanent Sl sol in  $\text{H}_2\text{O}$

Sol in 584 pts cold, and 116 pts boiling  $\text{H}_2\text{O}$  (Duflos, 1832), sol in 1800 pts cold  $\text{H}_2\text{O}$  (Porrett, 1814), sol in 1920 pts cold, and about 100 pts boiling  $\text{H}_2\text{O}$  (Thomson), sol in 2000 pts cold, and 100 pts boiling  $\text{H}_2\text{O}$  (Ure's Diet)

Sol in 1000 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and 100 pts at  $75^\circ$  (Wyruboff, A ch (4) 16 292)

Sol in  $\text{HNO}_3$ ,  $\text{HCl}$ , or conc  $\text{H}_2\text{SO}_4 + \text{Aq}$

**Barium cupric ferrocyanide**,  $\text{BaCuFe}(\text{CN})_6$

Insol in  $\text{H}_2\text{O}$  (Messner, Z anorg 1895, 8 389)

**Barium potassium ferrocyanide**,

$\text{BaK}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$

Sol in 38 pts cold, and 9 5 pts boiling  $\text{H}_2\text{O}$  (Duflos, 1832), in 36 4 pts  $\text{H}_2\text{O}$  at  $14^\circ$ , and 11 9 pts at b-pt (Mosander)

Not more sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  than in  $\text{H}_2\text{O}$   
Sol in dil, insol in conc  $\text{HCl} + \text{Aq}$  (Rose)  
+  $5\text{H}_2\text{O}$  Sol in 300 pts  $\text{H}_2\text{O}$  at ord temp (Wyruboff)

**Bismuth ferrocyanide**,  $\text{Bi}_2\text{Fe}(\text{CN})_6 + 5\text{H}_2\text{O}$  (?)

Sl sol in pure  $\text{H}_2\text{O}$  (Wyruboff)

$\text{Bi}_4[\text{Fe}(\text{CN})_6]_3$  Ppt (Muir, Chem Soc 31 657)

**Bismuth potassium ferrocyanide**,

$\text{BiKFe}(\text{CN})_6 + 7\text{H}_2\text{O}$ , or  $4\text{H}_2\text{O}$

Ppt

**Cadmium potassium ferrocyanide**,

$\text{CdK}_2\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$

Formula given by Wyruboff is  $\text{Cd}_5\text{K}_6[\text{Fe}(\text{CN})_6]_4 + 11\text{H}_2\text{O}$  (?)

**Calcium ferrocyanide**,  $\text{Ca}_{12}\text{Fe}(\text{CN})_6 + 12\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Sol in 0 66 pt  $\text{H}_2\text{O}$  at  $90^\circ$  and not pptd by cooling, and is apparently less sol in warm than cold  $\text{H}_2\text{O}$  (Wyruboff, A ch (4) 16 280)

**Calcium cuprous ferrocyanide**,

$\text{CaCu}_2\text{Fe}(\text{CN})_6$  (Messner, Z anorg 1894, 8 387)

**Calcium cupric ferrocyanide**,  $\text{CaCuFe}(\text{CN})_6$

Insol in  $\text{H}_2\text{O}$  (Messner, Z anorg 1895 8 388)

**Calcium potassium ferrocyanide**,

$\text{CaK}_2\text{Fe}(\text{CN})_6$

Sl sol in  $\text{H}_2\text{O}$  (Kunheim and Zimmerman, Dingl 252 478)

+  $3\text{H}_2\text{O}$  Sol in 795 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and 145 pts at b-pt, with decomp in the latter case

Sol in dil, insol in conc  $\text{HCl} + \text{Aq}$  Sol in  $\text{HNO}_3$  of 1 2 sp gr (Mosander)

Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$

**Calcium sodium ferrocyanide**,

$\text{CaNa}_6[\text{Fe}(\text{CN})_6]_2$

Sol in  $\text{H}_2\text{O}$

**Calcium strontium ferrocyanide**,

$\text{CaSrFe}(\text{CN})_6 + 10\text{H}_2\text{O}$

Efflorescent Sol in about 3 pts  $\text{H}_2\text{O}$  (Wyruboff, A ch (4) 21 278)

**Cerium ferrocyanide**,  $\text{Ce}_4[\text{Fe}(\text{CN})_6]_3 + 30\text{H}_2\text{O}$

Ppt (Wyruboff)

**Cerium potassium ferrocyanide**,

$\text{CeKFe}(\text{CN})_6 + 3\text{H}_2\text{O}$

Ppt (John)

+  $4\text{H}_2\text{O}$  (Wyruboff)

**Chromic ferrocyanide**,  $\text{Cr}_2[\text{Fe}(\text{CN})_6]_3 + 20\text{H}_2\text{O}$

Ppt

**Cobaltous ferrocyanide**,  $\text{Co}_2\text{Fe}(\text{CN})_6 + 7\text{H}_2\text{O}$

Wholly insol in  $\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{SO}_4$  with decomp Insol in  $\text{HCl} + \text{Aq}$  Sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$  Sol in  $\text{KCN} + \text{Aq}$

**Cobaltous ferrocyanide ammonia**,

$\text{Co}_2\text{Fe}(\text{CN})_6 \cdot 8\text{NH}_3 + 10\text{H}_2\text{O}$

Ppt Decomp on standing (Curda, Z Ch 1869 369)

$\text{Co}_2\text{Fe}(\text{CN})_6 \cdot 12\text{NH}_3 + 9\text{H}_2\text{O}$  As above (Curda)

**Cobaltous potassium ferrocyanide**,

$\text{CoK}_2\text{Fe}(\text{CN})_6$

Ppt (Wyruboff)

$\text{Co}_6\text{K}_5[\text{Fe}(\text{CN})_6]_4$  (?) Ppt Insol only in presence of an excess of  $\text{K}_4\text{Fe}(\text{CN})_6$  (Wyruboff)

**Columbium potassium ferrocyanide**,

$\text{Cb}_{16}\text{K}[\text{Fe}(\text{CN})_6]_2 + 67\text{H}_2\text{O}$  (?)

Sol in  $\text{H}_2\text{O}$  (Wyruboff)

$\text{Cb}_{12}\text{K}_2\text{Fe}(\text{CN})_6 + 39\text{H}_2\text{O}$  (?) Sol in  $\text{H}_2\text{O}$  (W)

$(\text{CbO})_4\text{K}_9[\text{Fe}(\text{CN})_6]_6 + 10\text{H}_2\text{O}$  (?) Ppt (Atterberg)

**Cuprous ferrocyanide**,  $\text{Cu}_2\text{Fe}(\text{CN})_6$

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , insol in  $\text{NH}_4\text{Cl} + \text{Aq}$

**Cupric ferrocyanide, basic**,  $\text{CuFe}(\text{OH})_4(\text{CN})_4$   
Ppt (Bong, Bull Soc 23 231)

**Cupric ferrocyanide**,  $\text{Cu}_2\text{Fe}(\text{CN})_6 + 7\text{H}_2\text{O}$   
Insol in  $\text{H}_2\text{O}$  or acids Insol in  $\text{NH}_4$   
salts + Aq Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in  
 $(\text{NH}_4)_2\text{C}_2\text{O}_4 + \text{Aq}$  and in  $\text{KCN} + \text{Aq}$   
Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J  
1898, 20 827)  
+  $10\text{H}_2\text{O}$  Sol in excess of  $\text{K}_4\text{Fe}(\text{CN})_6 +$   
Aq, especially if hot (Wyruboff)

**Cupric ferrocyanide ammonia (cupram-  
monium ferrocyanide)**,  $\text{Cu}_2\text{Fe}(\text{CN})_6$ ,  
 $4\text{NH}_3 + \text{H}_2\text{O}$   
Insol in  $\text{H}_2\text{O}$  or alcohol Sol in  $\text{NH}_4\text{OH} +$   
Aq (Bunsen)  
 $\text{Cu}_2\text{Fe}(\text{CN})_6$ ,  $8\text{NH}_3 + \text{H}_2\text{O}$

**Cuprous magnesium ferrocyanide**,  
 $\text{Cu}_2\text{MgFe}(\text{CN})_6$   
Very unstable Decomp in air  
Insol in  $\text{H}_2\text{O}$  (Messner, Z anorg 1895,  
8 385)

**Cupric magnesium ferrocyanide**,  
 $\text{CuMgFe}(\text{CN})_6$   
Insol in  $\text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}$   
Very unstable (Messner, Z anorg 1895, 8  
387)

**Cuprous potassium ferrocyanide**,  
 $\text{Cu}_2\text{K}_2\text{Fe}(\text{CN})_6$   
Insol in  $\text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}$   
Decomp by acids Insol in alcohol (Mess-  
ner, Z anorg 1895, 8 378)  
+  $1\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , alcohol, or ether  
Decomp by acids Sol in  $\text{KCN} + \text{Aq}$   
 $\text{K}_2\text{Cu}_2\text{Fe}(\text{CN})_6 + 4\text{H}_2\text{O}$   
+  $5\text{H}_2\text{O}$  (Wofor)  
+  $6\text{H}_2\text{O}$  (Wyruboff)

**Cupric potassium ferrocyanide**,  $\text{K}_2\text{CuFe}(\text{CN})_6$   
+  $\text{H}_2\text{O}$   
Insol in cold sl decomp by boiling  $\text{H}_2\text{O}$   
 $\text{K}_2\text{Cu}_2[\text{Fe}(\text{CN})_6]_2 + 12\text{H}_2\text{O}$  Ppt

**Cuprous sodium ferrocyanide**,  
 $\text{Cu}_2\text{Na}_2\text{Fe}(\text{CN})_6$   
Decomp by boiling  $\text{H}_2\text{O}$ , insol in alcohol,  
insol in  $\text{H}_2\text{O}$ , decomp by acids (Messner,  
Z anorg 1895, 8 373)

**Cupric sodium ferrocyanide**,  
 $\text{CuNa}_2\text{Fe}(\text{CN})_6$   
Insol in cold  $\text{H}_2\text{O}$  Decomp by boiling  
 $\text{H}_2\text{O}$  (Moissan, Z anorg 1895, 8 376)

**Cupric strontium ferrocyanide**,  
 $\text{CuSrFe}(\text{CN})_6$   
Insol in  $\text{H}_2\text{O}$  (Messner, Z anorg 1895,  
8 389)

**Didymium potassium ferrocyanide**,  
 $\text{D}_2\text{KFe}(\text{CN})_6 + 4\text{H}_2\text{O}$   
Ppt (Cleve)  
+  $2\text{H}_2\text{O}$  (Wyruboff)

**Erbium potassium ferrocyanide**,  $\text{ErKFe}(\text{CN})_6$   
+  $x\text{H}_2\text{O}$   
(Hoglund)

**Gallium ferrocyanide**  
Sol in boiling  $\text{HCl} + \text{Aq}$  (de Boisbau an,  
C R 99 526)

**Glucinum ferrocyanide**,  $\text{Gl}_2\text{Fe}(\text{CN})_6$ ,  $4\text{Gl}_2\text{H}_2$   
+  $7\text{H}_2\text{O}$  (?)  
Sol in  $\text{H}_2\text{O}$  (Atterberg)

**Iron (ferric) ferrocyanide**,  $\text{Fe}_7(\text{CN})_{11} =$   
 $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3 + x\text{H}_2\text{O}$   
(Prussian blue) Insol in  $\text{H}_2\text{O}$ , al hol,  
ether, or oils Decomp slowly by b ling  
 $\text{H}_2\text{O}$  Insol in dil mineral acids S in  
conc  $\text{HCl} + \text{Aq}$ , and conc  $\text{H}_2\text{SO}_4$  witho de-  
comp Sol in  $\text{H}_2\text{C}_2\text{O}_4$  or  $\text{NH}_4$  tartrate Aq  
Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp by N OH,  
or  $\text{KOH} + \text{Aq}$  Not pptd in presence of tar-  
trates or citrates

**Iron (ferrous) potassium ferrocyanide**  
 $\text{FeK}_2\text{Fe}(\text{CN})_6$   
Insol in  $\text{H}_2\text{O}$  Decomp on air

**Iron (ferric) potassium ferrocyanide**  
 $\text{FeKFe}(\text{CN})_6$   
Is probably ferrous potassium ferricy anide,  
which see

**Iron (ferric) ferrocyanide ammonia**,  
 $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$ ,  $6\text{NH}_3 + 9\text{H}_2\text{O}$   
Insol in  $\text{NH}_4$  tartrate + Aq

**Lanthanum potassium ferrocyanide**,  
 $\text{LaKFe}(\text{CN})_6 + 4\text{H}_2\text{O}$   
Ppt

**Lead ferrocyanide**,  $\text{Pb}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$   
Insol in  $\text{H}_2\text{O}$ , acids, or  $\text{NH}_4\text{OH} + \text{Aq}$   
(Wyruboff, A ch (5) 8 480)  
Sl sol in conc  $\text{H}_2\text{SO}_4$ , from whic it is  
pptd by  $\text{H}_2\text{O}$  (Berzelius)  
Sol in hot  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4$  succinat + Aq,  
insol in other  $\text{NH}_4$  salts + Aq (Witts in)  
Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Brett)  
Not pptd in presence of Na citrate  
(Spiller)

**Lithium ferrocyanide**,  $\text{Li}_4\text{Fe}(\text{CN})_6 + 9\text{H}_2\text{O}$   
Deliquescent Very sol in  $\text{H}_2\text{O}$

**Lithium potassium ferrocyanide**,  
 $\text{Li}_2\text{K}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  Sol in 15 pts  $\text{H}_2\text{O}$  at  
ord temp (Wyruboff, A ch (4) 2 274)

**Magnesium ferrocyanide**,  $\text{Mg}_2\text{Fe}(\text{CN})_6 + 6\text{H}_2\text{O}$

Sol in 3 pts cold  $\text{H}_2\text{O}$  (Bette, A 22 148)

**Magnesium potassium ferrocyanide**,  $\text{MgK}_2\text{Fe}(\text{CN})_6$

Sol in 1575 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and 238 pts at  $100^\circ$  Solution is decomp by boiling (Storer's Dict)

1 l sat solution at  $17^\circ$  contains 1.95 g  $\text{MgK}_2\text{Fe}(\text{CN})_6$  (Robinson, Chem Soc 1909, 75 1353)

**Manganous ferrocyanide**,  $\text{Mn}_2\text{Fe}(\text{CN})_6 + 7\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  Insol in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$

**Manganic ferrocyanide**,  $\text{Mn}_2\text{Fe}_3(\text{CN})_{12}$

Insol in  $\text{H}_2\text{O}$  Easily decomp in the air Sol in  $\text{HCl}$  (Straus, Z anorg 1895, 9 8)

**Manganous potassium ferrocyanide**,  $\text{MnK}_2\text{Fe}(\text{CN})_6$

Ppt (Berzelius)  
5 $\text{Mn}_2\text{Fe}(\text{CN})_6$ , 4 $\text{K}_4\text{Fe}(\text{CN})_6 + 4\text{H}_2\text{O} (?)$   
Ppt Sol in dil  $\text{HCl} + \text{Aq}$  (Wyruboff)

**Mercuric potassium ferrocyanide**,  $\text{K}_2\text{HgFe}(\text{CN})_6$

Insol in  $\text{H}_2\text{O}$  Appreciably sol in  $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$  (Fernekes, J Am Chem Soc 1906 28 87)

**Molybdenum ferrocyanide**,  $\text{Mo}_4\text{Fe}(\text{CN})_6 + 20\text{H}_2\text{O} (?)$

Very sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Wyruboff)  
 $\text{Mo}_2\text{Fe}(\text{CN})_6 + 8\text{H}_2\text{O} (?)$  (W)  
 $+ 14\text{H}_2\text{O} (?)$  Very sol in  $\text{H}_2\text{O}$ , insol in alcohol (W)

**Molybdenum potassium ferrocyanide**,

$\text{K}_4\text{Mo}_8[\text{Fe}(\text{CN})_6]_2 + 40\text{H}_2\text{O} (?)$   
(Wyruboff)  
 $\text{K}_2(\text{MoO}_4)_3[\text{Fe}(\text{CN})_6]_2$ , 2 $\text{MoO}_3 + 20\text{H}_2\text{O} (?)$  (Atterberg)  
 $\text{K}_2\text{Mo}_2[\text{Fe}(\text{CN})_6]_2$ , 2 $\text{MoO}_3 + 12\text{H}_2\text{O} (?)$  (Atterberg)

**Nickel ferrocyanide**,  $\text{Ni}_2\text{Fe}(\text{CN})_6 + 11\text{H}_2\text{O}$ , or  $14\text{H}_2\text{O}$

Ppt Insol in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , insol in  $\text{NH}_4$  salts +  $\text{Aq}$  Sol in  $\text{KCN} + \text{Aq}$

**Nickel ferrocyanide ammonia**,  $\text{Ni}_2\text{Fe}(\text{CN})_6$ ,  $4\text{NH}_3 + \text{H}_2\text{O}$

Completely insol in  $\text{H}_2\text{O}$  and not attacked thereby, sol in  $\text{NH}_4\text{OH} + \text{Aq}$  to form—

$\text{Ni}_2\text{Fe}(\text{CN})_6$ , 10 $\text{NH}_3 + 4\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$  (Reynoso, A ch (3) 30 252)

$\text{Ni}_2\text{Fe}(\text{CN})_6$ , 2 $\text{NH}_3 + 4$ , and 9 $\text{H}_2\text{O}$  Hygro-

scopic Easily decomp (Gintl, J B 1868 304)

$\text{Ni}_2\text{Fe}(\text{CN})_6$ , 8 $\text{NH}_3 + 4\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (G)

$\text{Ni}_2\text{Fe}(\text{CN})_6$ , 12 $\text{NH}_3 + 9\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , but less so than the above compounds (G)

**Nickel potassium ferrocyanide**,  $\text{NiK}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$

Ppt (Wyruboff)

**Osmium ferrocyanide**,  $\text{Os}_2\text{Fe}(\text{CN})_6$

Ppt (Martius, A 117 368)

**Potassium ferrocyanide**,  $\text{K}_4\text{Fe}(\text{CN})_6$

Permanent Easily sol in cold, and more easily in hot  $\text{H}_2\text{O}$

Sol in 4.23 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , or 100 pts  $\text{H}_2\text{O}$  dissolve 23.6 pts salt at  $15^\circ$  (Schiff, A 113 350)

100 pts  $\text{H}_2\text{O}$  dissolve 27.8 pts at  $12^\circ$ , 65.8 pts at  $37^\circ$ , 87.6 pts at  $65^\circ$ , and 90.6 pts at  $96.3^\circ$  (Thomson)

Sol in 4 pts cold, and 2 pts boiling  $\text{H}_2\text{O}$  (Wittstein)

100 pts  $\text{H}_2\text{O}$  dissolve 29.2 pts salt at  $15^\circ$ , and solution has sp gr = 1.441 (Michel and Kraft, A ch (3) 41 478)

Solubility of  $\text{K}_4\text{Fe}(\text{CN})_6$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$-2^\circ$	$+7^\circ$	$14^\circ$	$30^\circ$	$56^\circ$
10.8	15.4	17.9	23.0	31.7%
60%	75%	89%	98%	157%
34.0	39.1	41.9	42.6	46.8%

(Étard, A ch 1894, (7) 2 546)

$\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$  sat at  $8^\circ$  has sp gr = 1.13 (Anthon)

Sp gr of  $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$  at  $15^\circ$

$\% \text{ hydrous salt}$	Sp gr	$\% \text{ hydrous salt}$	Sp gr	$\% \text{ hydrous salt}$	Sp gr
1	1.0058	8	1.0479	15	1.0932
2	1.0116	9	1.0542	16	1.0999
3	1.0175	10	1.0605	17	1.1067
4	1.0234	11	1.0669	18	1.1136
5	1.0295	12	1.0734	19	1.1205
6	1.0356	13	1.0800	20	1.1275
7	1.0417	14	1.0866		

(Schiff, A 113 199)

Sp gr of  $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$	Sp gr
1—normal	1.0617
$1/2$ —“	1.0300
$1/4$ —“	1.0150
$1/8$ —“	1.0074
$1/16$ —“	1.0037

(Wagner, Z phys Ch 1890, 5 37)



## Solubility in KOH + Aq at 25°

KOH Normality	g $K_4Fe(CN)_6 \cdot 3H_2O$ per l
0.09984	308.5
0.2496	283.5
0.4963	247.1
0.7036	217.4
0.9415	184.8
1.395	132.1
1.883	86.12

(Grube, Z. Electrochem, 1914, 20, 342)

$K_4Fe(CN)_6 + NaCl + Aq$  sat at 20° contains 26.6 g NaCl and 17.8 g  $K_4Fe(CN)_6$  per 100 g  $H_2O$ , sat at 93° it contains 27.4 g NaCl and 35.9 g  $K_4Fe(CN)_6$  per 100 g  $H_2O$  (Conroy, J. Soc. Chem. Ind. 1898, 17, 105)

$K_4Fe(CN)_6 + KCl + Aq$  sat at 21° contains 27.2 g KCl and 4.2 g  $K_4Fe(CN)_6$  per 100 g  $H_2O$ , sat at 99° it contains 39.6 g KCl and 17.0 g  $K_4Fe(CN)_6$  per 100 g  $H_2O$  (Conroy)

$K_4Fe(CN)_6 + Na_2CO_3 + Aq$  sat at 22° contains 29.9 g  $Na_2CO_3$  and 26.7 g  $K_4Fe(CN)_6$  per 100 g  $H_2O$ , sat at 97° it contains 42.0 g  $Na_2CO_3$  and 27.5 g  $K_4Fe(CN)_6$  per 100 g  $H_2O$  (Conroy)

Insol in liquid  $NH_3$  (Franklin, Am. Ch. J. 1898, 20, 829)

Insol in alcohol even when dilute

Insol in methyl acetate (Naumann, B. 1909, 42, 3790)

Insol in ethyl acetate (Naumann, B. 1904, 37, 3601)

Insol in benzonitrile (Naumann, B. 1914, 47, 1370)

Sol in acetone (Naumann, B. 1904, 37, 4328)

+  $3H_2O$  1 l sat solution in  $H_2O$  contains 319.4 g  $K_4Fe(CN)_6 \cdot 3H_2O$  (Grube, Z. Electrochem. Z. 1914, 20, 342)

Two modifications with different solubilities

25.0 g of  $\alpha$  modification are contained in 100 g of solution at 20°

24.6 g of  $\beta$  modification are contained in 100 g of solution at 20° (Briggs, Chem. Soc. 1911, 99, 1024)

32.0 g  $K_4Fe(CN)_6$  (anhydrous) are dissolved in 100 g  $H_2O$  at 25° (Wagner, Z. phys. Ch. 1910, 71, 425)

**Potassium samarium ferrocyanide,**  
 $KSmFe(CN)_6 \cdot 5H_2O$

Precipitate (Clève)

**Potassium sodium ferrocyanide,**  
 $KNa_3Fe(CN)_6 \cdot 12H_2O$

Sol in  $H_2O$

$KNa_2Fe(CN)_6 \cdot 8H_2O$  Easily sol in  $H_2O$

$K_3NaFe(CN)_6 \cdot 3H_2O$  Permanent Easily sol in  $H_2O$ , insol in alcohol

**Potassium sodium ferrocyanide nitrate,**  
 $K_2Na_2Fe(CN)_6 \cdot 4KNO_3$

Sol in  $H_2O$  (Martius)

**Potassium strontium ferrocyanide,**  
 $K_2SrFe(CN)_6 \cdot 3H_2O$

Easily decomp Sol in  $H_2O$ , sl sol in alcohol (Wyrouboff, A. ch. (4) 21, 276)

**Potassium stannic ferrocyanide,**  
 $KSn_3[Fe(CN)_6]_2 \cdot 68H_2O$  (?)

Ppt (Wyrouboff)  
 $K_4Sn_{10}[Fe(CN)_6]_{11} \cdot 230H_2O$  (?) (Atterberg)

**Potassium titanium ferrocyanide,**  
 $K_3Ti_3[Fe(CN)_6]_2 \cdot 11H_2O$  (?)

Ppt Sol in  $K_4Fe(CN)_6 + Aq$  (Wyrouboff)

$K_4Fe(CN)_6 \cdot 11Ti_3Fe(CN)_6 \cdot 43H_2O$  )  
Ppt (Wyrouboff)

$K_2(TiO)_3[Fe(CN)_6]_2 \cdot 23H_2O$  (?) (Atterberg)

$K_2(TiO)_{11}[Fe(CN)_6]_8 \cdot 110H_2O$  (?) (Atterberg)

**Potassium tungsten ferrocyanide,**  
 $KW_2Fe(CN)_6 \cdot 7H_2O$  (?)

Sol in  $H_2O$  (Wyrouboff)  
 $K_2W_5Fe(CN)_6 \cdot 20H_2O$  Sol in  $H_2O$  (W)

**Potassium uranium ferrocyanide,**  
 $K_2U_3[Fe(CN)_6]_2 \cdot 6H_2O$  (?)

Ppt (Wyrouboff)  
 $K_2(UO_2)_3[Fe(CN)_6]_2 \cdot 6H_2O$  Ppt (Atterberg)

$K_6(UO_2)_5[Fe(CN)_6]_4 \cdot 12H_2O$  Sol in  $H_2O$  (Atterberg)

**Potassium vanadium ferrocyanide,**  
 $K_{18}V[Fe(CN)_6]_6 \cdot 39H_2O$  (?)

Ppt Sl sol in  $H_2O$  (Wyrouboff)  
 $K_6(VO)[Fe(CN)_6]_4 \cdot 60H_2O$  (?) Ppt (Atterberg)

**Potassium ytterbium ferrocyanide,**  
 $KYbFe(CN)_6 \cdot 3H_2O$

Ppt Sol in excess  $K_4Fe(CN)_6$  Aq (Clève, Z. anorg. 1902, 32, 140)

**Potassium yttrium ferrocyanide,**  
 $KYFe(CN)_6 \cdot 2H_2O$

Ppt (Wyrouboff, A. ch. (5) 8, 444)

**Potassium zinc ferrocyanide,**  
 $K_4Zn_3[Fe(CN)_6]_4 \cdot 12H_2O$

Absolutely insol in  $H_2O$  (Wyrouboff, A. ch. (5) 8, 485)

**Potassium ferrocyanide carbonyl,**  
 $K_3Fe(CN)_5(CO) \cdot 3\frac{1}{2}H_2O$

See Carbonyl ferrocyanide, potassium

**Rubidium ferrocyanide,**  $Rb_4Fe(CN)_6 \cdot H_2O$

Sol in less than 1 pt  $H_2O$  at ord temp with great absorption of heat (Wyrouboff, A. ch. (4) 16, 307)

**Silver ferrocyanide**,  $\text{Ag}_4\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$  or dil acids Insol in  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4$  salts + Aq Sol in KCN + Aq  
Decomp by warm  $\text{NH}_4\text{OH} + \text{A-}$  (Weith, Z Ch (2) 5 381)

**Silver ferrocyanide ammonia**,  $\text{Ag}_4\text{Fe}(\text{CN})_6, 2\text{NH}_3 + \text{H}_2\text{O}$ 

(Wyruboff)  
+  $6\text{H}_2\text{O}$  (Gintl)

**Sodium ferrocyanide**,  $\text{Na}_4\text{Fe}(\text{CN})_6 + 12\text{H}_2\text{O}$ 

Efflorescent Less sol in  $\text{H}_2\text{O}$  than  $\text{K}_4\text{Fe}(\text{CN})_6$  Sol in 4.5 pts  $\text{H}_2\text{O}$  at  $12^\circ$  (John)  
100 pts  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 22 pts (Ure's Dict)

100 pts  $\text{H}_2\text{O}$  dissolve at

$18^\circ$	$20^\circ$	$42^\circ$	$53^\circ$	
16.7	17.875	30.2	37.1	pts $\text{Na}_4\text{Fe}(\text{CN})_6$
$58^\circ$	$60^\circ$	$77^\circ$	$80^\circ$	
41.7	42.5	54.8	59.2	pts $\text{Na}_4\text{Fe}(\text{CN})_6$
$96^\circ$	$98^\circ$	$98.5^\circ$		
62.1	61.6	6.30	pts $\text{Na}_4\text{Fe}(\text{CN})_6$	

(Conroy, J Soc Chem Ind 1898, 17 104)

+  $10\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve at

$18^\circ$	$20^\circ$	$42^\circ$	
29.45	31.85	58.5	pts $\text{Na}_4\text{Fe}(\text{CN})_6 + 10\text{H}_2\text{O}$
$53^\circ$	$58^\circ$	$60^\circ$	
75.9	88.4	90.2	pts $\text{Na}_4\text{Fe}(\text{CN})_6 + 10\text{H}_2\text{O}$
$77^\circ$	$80^\circ$	$96^\circ$	
129.5	146.0	157.0	pts $\text{Na}_4\text{Fe}(\text{CN})_6 + 10\text{H}_2\text{O}$
$98^\circ$	$98.5^\circ$		
156.5	161.0	pts $\text{Na}_4\text{Fe}(\text{CN})_6 + 10\text{H}_2\text{O}$	

(Conroy)

**Strontium ferrocyanide**,  $\text{Sr}_2\text{Fe}(\text{CN})_6 + 15\text{H}_2\text{O}$ 

Efflorescent Sol in 2 pts cold, and less than 1 pt boiling  $\text{H}_2\text{O}$  (Bette)  
Excessively sol in  $\text{H}_2\text{O}$  (Wyruboff, A ch (4) 16 280)  
+  $8\text{H}_2\text{O}$  (Wyruboff)

**Thallous ferrocyanide**,  $\text{Tl}_4\text{Fe}(\text{CN})_6 + 2\text{H}_2\text{O}$ 

100 pts  $\text{H}_2\text{O}$  dissolve 0.37 pt at  $18^\circ$ , and 3.93 pts at  $101^\circ$  (Lamy)  
Sol in KCN + Aq (Kuhlmann)

**Thorium ferrocyanide**,  $\text{ThFe}(\text{CN})_6 + 4\text{H}_2\text{O}$ 

Ppt (Cleve, Bull Soc (2) 24 355)

**Tin (stannous) ferrocyanide**,  $\text{Sn}_2\text{Fe}(\text{CN})_6 + 4\text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$  or acids, sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Wyruboff)

**Tin (stannic) ferrocyanide**,  $\text{Sn}_3[\text{Fe}(\text{CN})_6]_2 + 18\frac{1}{2}\text{H}_2\text{O}$  (?)

(Wyruboff)

**Titanium ferrocyanide**,  $\text{Tl}_7[\text{Fe}(\text{CN})_6]_2$  (?)

Ppt (Wyruboff)

**Uranium ferrocyanide**,  $\text{UFe}(\text{CN})_6 + 10\text{H}_2\text{O}$ 

Ppt (Wyruboff)

**Vanadyl ferrocyanide**,  $(\text{VO})_2\text{Fe}(\text{CN})_6 + 11\text{H}_2\text{O}$ 

Ppt (Atterberg)

**Yttrium ferrocyanide**,  $\text{Y}_4[\text{Fe}(\text{CN})_6]_3$ 

Easily sol in  $\text{H}_2\text{O}$ , insol in alcohol (Popp, A 131 179)

**Zinc ferrocyanide**,  $\text{Zn}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$  or acids  
Insol in  $\text{HCl} + \text{Aq}$  (Lea, Sill Am J (2) 31 191)

Sol in  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4$  salts + Aq (Wittstein)

Insol in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett)  
Sl sol in boiling  $\text{K}_4\text{Fe}(\text{CN})_6$ , or  $\text{K}_2\text{Fe}(\text{CN})_6 + \text{Aq}$  (Gore)

$\text{Na}_4\text{Fe}(\text{CN})_6 + \text{NaCl} + \text{Aq}$  sat at  $21^\circ$  contains 29.0 g NaCl and 5.8 g  $\text{Na}_4\text{Fe}(\text{CN})_6$  per 100 g  $\text{H}_2\text{O}$ , sat at  $90^\circ$  it contains 24.7 g NaCl and 21.3 g  $\text{Na}_4\text{Fe}(\text{CN})_6$  per 100 g  $\text{H}_2\text{O}$

**N<sub>4</sub>**

Very sl sol in  
Am Ch J 1898, 20

Insol in alcohol  
+  $4\text{H}_2\text{O}$  Absolutely insol in  $\text{H}_2\text{O}$  (Wyruboff, A ch (5) 8 485)  
+  $8\text{H}_2\text{O}$  (Weith, A 147 329)  
+  $10\text{H}_2\text{O}$  (Pebal, A 233 165)

**Ferrotetranitrososulphidic acid**,

$\text{H}_2\text{S}_2(\text{NO})_4\text{Fe}$

Insol in  $\text{H}_2\text{O}$ , sl sol in alcohol, more easily in ether, very sol in  $\text{CS}$  or  $\text{CHCl}_3$   
Not obtained in a pure state (Pawel, B 15 2600)

**Ethyl ferrotetranitrososulphide**,

$(\text{C}_2\text{H}_5)_2\text{S}(\text{NO})_4\text{Fe}$

Insol in  $\text{H}_2\text{O}$ , difficultly sol in alcohol, more easily in ether, and very easily in  $\text{CS}$ ,  $\text{CHCl}_3$ ,  $\text{C}_2\text{H}_5\text{I}$ , or  $\text{C}_6\text{H}_6$  (Pawel, B 15 2609)

**Ferrous** —,  $\text{FeS}_2(\text{NO})_4\text{Fe}$ 

More difficultly sol in  $\text{H}_2\text{O}$  and alcohol than the hepta salt  
Sol in ether

**Potassium** —,  $\text{K}_2\text{S}_2(\text{NO})_4\text{Fe} + 4\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  Easily sol in alcohol, insol in ether (Pawel, B 15 2600)  
True composition of "nitrosulphide of

iron and potassium" of Roussin (A ch (3) 52 297) (Pawel, B 13 1949)

**Sodium ferrotetranitrososulphide,**  
 $\text{Na}_2\text{S}_2(\text{NO})_4\text{Fe}_2+8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , easily sol in alcohol, insol in ether (Pawel)

True composition of "nitrosulphide of iron and sodium" of Roussin (Pawel)

**Thallium** —,  $\text{Tl}_2\text{S}_2(\text{NO})_4\text{Fe}_2$

Insol in  $\text{H}_2\text{O}$ , alcohol, or ether (Pawel)

**Ferroheptanitrososulphydic acid,**  
 $\text{HS}_2(\text{NO})\text{Fe}_4$

Insol in  $\text{H}_2\text{O}$ , alcohol, and ether Easily sol in  $\text{CS}_2$  or  $\text{CHCl}_3$  (Pawel, B 15 2604)

May be called Ferrinitrososulphydic acid

**Ammonium ferroheptanitrososulphide,**  
 $\text{NH}_4\text{S}_2(\text{NO})_7\text{Fe}_4+\text{H}_2\text{O}$

Less easily sol in  $\text{H}_2\text{O}$  than the K compound (Pawel, B 15 2600)

"Binitrosulphide of iron" of Roussin Sol in about 2 pts boiling  $\text{H}_2\text{O}$ , very sl sol in cold  $\text{H}_2\text{O}$  Very sol in alcohols, methyl, ethyl, or amyl, and in  $\text{HC}_2\text{H}_3\text{O}_2$  Miscible with ether Insol in  $\text{CS}_2$  or  $\text{CHCl}_3$

Decomp by conc  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4$   
 Not attacked by  $\text{H}_2\text{C}_2\text{O}_4$ , or  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6+$

sl in  $\text{NH}_4\text{OH}$ , and  $\text{KOH}+\text{Aq}$  (Roussin, A ch (3) 52 286)

Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Hofmann, Z anorg 1895, 9 299)

**Barium** —

Easily sol in  $\text{H}_2\text{O}$  (Pawel)

**Cæsium** —,  $\text{Fe}_4(\text{NO})_7\text{S}_2\text{Cs}+\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Difficultly sol in alcohol and ether (Pawel)

Sparingly sol in  $\text{H}_2\text{O}$  (Hofmann, Z anorg 1895, 9 298)

**Calcium** —

Easily sol in  $\text{H}_2\text{O}$  (Pawel)

**Ferrous** —,  $\text{Fe}[\text{S}_2(\text{NO})_7\text{Fe}_4]_2+8\text{H}_2\text{O}$

More easily sol in  $\text{H}_2\text{O}$  than Na salt (Pawel)

**Lead** —

Difficultly sol in  $\text{H}_2\text{O}$  (Pawel)

**Magnesium** —

Easily sol in  $\text{H}_2\text{O}$  (Pawel)

**Potassium** —,  $\text{KS}_2(\text{NO})_7\text{Fe}_4$

Sol in  $\text{H}_2\text{O}$ , alcohol, and very sol in ether with slight decomp (Pawel, B 15 2600)

**Rubidium ferroheptanitrososulphide,**  
 $\text{RbS}_2(\text{NO})_7\text{Fe}_4$

Less soluble in  $\text{H}_2\text{O}$  than the  $\text{NH}_4$  salt (Pawel)  
 $+\text{H}_2\text{O}$  Ppt (Hofmann, Z anorg 1895 9 298)

**Sodium** —,  $\text{NaS}_2(\text{NO})_7\text{Fe}_4+2\text{H}_2\text{O}$

More sol in  $\text{H}_2\text{O}$  than the potassium salt (Pawel)

**Thallium** —,  $\text{TlS}_2(\text{NO})_7\text{Fe}_4+\text{H}_2\text{O}$

Very difficultly sol in  $\text{H}_2\text{O}$  More easily sol in alcohol (Pawel) (Hofmann, Z anorg 1895, 9 297)

**Ferrodinitrosothiosulphonic acid**

**Ammonium ferrodinitrosothiosulphonate,**  
 $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_3\text{NH}_4+\text{H}_2\text{O}$

Can be cryst from warm  $\text{H}_2\text{O}$  without decomp (Hofmann, Z anorg 1895, 8 321)

**Cæsium** —,  $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_3\text{Cs}$

Sparingly sol in  $\text{H}_2\text{O}$  (Hofmann)

**Potassium** —,  $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_3\text{K}+\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  without decomp at 80

Sol in 50% alcohol

Sol in  $\text{H}_2\text{SO}_4$  without decomp (Hofmann)

**Rubidium** —,  $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_3\text{Rb}+\text{H}_2\text{O}$

Less sol in  $\text{H}_2\text{O}$  than the corresponding Na salt (Hofmann)

**Sodium** —,  $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_3\text{Na}+2\text{H}_2\text{O}$

Closely resembles K salt, but is more so in  $\text{H}_2\text{O}$  and alcohol (Hofmann)

**Ferrotungstic acid**

Sol in  $\text{H}_2\text{O}$  (Laurent, C R 31 693)

**Ammonium manganous ferrotungstate,**  
 $12(\text{NH}_4)_2\text{O}, 6\text{MnO}, 2\text{Fe}_2\text{O}_3, 3\text{H}_2\text{O}, 45\text{WO}_3+81\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Laurent)

**Barium ferrotungstate,**  $21\text{BaO}, 2\text{Fe}_2\text{O}_3, 45\text{WO}_3+27\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Laurent)

**Potassium ferrotungstate,**  $9\text{K}_2\text{O}, 2\text{Fe}_2\text{O}_3, 12\text{H}_2\text{O}, 45\text{WO}_3+54\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Laurent)

$18\text{K}_2\text{O}, 2\text{Fe}_2\text{O}_3, 3\text{H}_2\text{O}, 45\text{WO}_3+54\text{H}_2\text{O}$  (Laurent)

**Ferrous acid**

**Barium ferrite,**  $\text{BaO}, \text{Fe}_2\text{O}_3$

Ppt (List, B 11 1512)

**Calcium ferrite,  $4\text{CaO}, \text{Fe}_2\text{O}_3$** 

Insol in  $\text{H}_2\text{O}$ , or sugar +  $\text{H}_2\text{O}$  Decomp by the weakest acids, but not by boiling  $\text{KOH} + \text{Aq}$  (Pelouze, A ch (3) 33 5)

$\text{CaO}, \text{Fe}_2\text{O}_3$  (List)  
 $3\text{CaO}, \text{Fe}_2\text{O}_3$  Much less readily attacked by  $\text{H}_2\text{O}$  and acids than the silicates (Hilpert, B 1909, 42 4581)

$3\text{CaO}, 2\text{Fe}_2\text{O}_3$  As above (Hilpert, B 1909, 42 4581)

**Calcium ferrite chloride,  $\text{CaO}, \text{Fe}_2\text{O}_3, \text{CaCl}_2$** 

Not decomp by  $\text{H}_2\text{O}$  (Chateher, C R 99 276)

**Cupric ferrite,  $\text{CuO}, \text{Fe}_2\text{O}_3$** 

Ppt (List)  
 +  $5\text{H}_2\text{O}$  (List)

**Ferrous argentous ferrite,  $2\text{FeO}, \text{Ag}_2\text{O}, \text{Fe}_2\text{O}_3$  (?)**

Easily decomp by  $\text{HCl} + \text{Aq}$  Not completely sol in dil  $\text{HNO}_3 + \text{Aq}$  Easily sol in conc  $\text{HNO}_3$  Decomp by acetic acid (Rose, Pogg 10 323)

**Magnesium ferrite,  $\text{MgO}, \text{Fe}_2\text{O}_3$** 

Insol in  $\text{H}_2\text{O}$  Not attacked by boiling conc  $\text{HNO}_3$  (Deville C R 52 1264)

Min *Magnesioferrite* Difficultly sol in  $\text{HCl} + \text{Aq}$  (Rammelsberg, Pogg 107 451)  
 +  $4\text{H}_2\text{O}$  Ppt (List, B 11 1512)  
 $6\text{MgO}, \text{Fe}_2\text{O}_3 + 9\text{H}_2\text{O}$  Ppt  
 +  $15\text{H}_2\text{O}$  Min *Pyroaurite*

**Manganous ferrite,  $\text{MnO}, \text{Fe}_2\text{O}_3$** 

Ppt (List)

**Nickel ferrite,  $\text{NiO}, \text{Fe}_2\text{O}_3$** 

Ppt (List)

**Potassium ferrite,  $3\text{K}_2\text{O}, 4\text{Fe}_2\text{O}_3$** 

Decomp by  $\text{H}_2\text{O}, \text{KOH} + \text{Aq}, \text{NaOH} + \text{Aq}$ , etc, but only slowly by  $\text{NH}_4\text{Cl} + \text{Aq}$  (Salm-Horstmar, J pr 55 349)

$\text{K}_2\text{Fe}_2\text{O}_4$  Decomp by  $\text{H}_2\text{O}$  (Rousseau and Bernheim, C R 107 240)

**Silver (argentous) ferrite,  $\text{Ag}_2\text{O}, \text{Fe}_2\text{O}_3$  (?)**

Decomp by dil  $\text{HNO}_3 + \text{Aq}$  (Rose, Pogg 10 323)

**Sodium ferrite,  $\text{Na}_2\text{O}, \text{Fe}_2\text{O}_3$** 

$\text{Na}_2\text{O}$  is dissolved out by  $\text{H}_2\text{O}$  Easily sol in dil  $\text{HCl} + \text{Aq}$  Not easily decomp by  $\text{NH}_4\text{Cl} + \text{Aq}$  (Salm-Horstmar)

**Zinc ferrite,  $\text{ZnO}, \text{Fe}_2\text{O}_3$** 

Sol in boiling conc  $\text{HCl} + \text{Aq}$  (Ebelmen, A ch (3) 33 47)

Min *Franklinite*

**Flavocobaltic compounds**

See also Xanthocobaltic compounds

**Flavocobaltic chloraurate,**

$(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4\text{AuCl}_4$

More easily sol than the chloroplatinate Not wholly insol in absolute alcohol (Jorgensen, Z anorg 5 159)

— **chloroplatinate**,  $[(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4]_2\text{PtCl}_6$   
 As the chloroplatinite (Jorgensen)

— **chloroplatinite**,  $[(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4]_2\text{PtCl}_4$   
 Somewhat sol in  $\text{H}_2\text{O}$ , and not insol in 50% alcohol (Jorgensen)

— **chromate**,  $[(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4]_2\text{Cr}_2\text{O}_7$   
 Ppt (Jorgensen)

— **nitrate**,  $\text{Co}(\text{NO}_2)_2(\text{NH}_3)_4\text{NO}_3$   
 Sol in about 33 pts cold  $\text{H}_2\text{O}$ , insol in  $\text{HNO}_3$  (Jorgensen)  
 $\text{Co}(\text{NO}_2)_2(\text{NH}_3)_4\text{NO}_3, \text{HNO}_3$  Decomp by  $\text{H}_2\text{O}$  or alcohol (Jorgensen)

— **cobaltic nitrite**,  $3(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4, \text{Co}_2(\text{NO}_2)_6 + 2\text{H}_2\text{O}$   
 Sl sol in  $\text{H}_2\text{O}$  (Jorgensen, Z anorg 5 179)

— **diamine cobaltic nitrite**,  
 $(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4,$   
 $(\text{NO}_2)_2(\text{NH}_3)_2\text{Co}(\text{NO}_2)_2$   
 Very sl sol in  $\text{H}_2\text{O}$  (Jorgensen)

— **sulphate**,  $[(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4]_2\text{SO}_4$   
 Sl sol in  $\text{H}_2\text{O}$ , more easily in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Jorgensen)

**Fluoborhydric acid,  $\text{HBF}_4$** 

Decomp by  $\text{H}_2\text{O}$  very rapidly (Landolph, C R 86 603)

**Aluminum fluoboride,  $2\text{AlF}_3, 3\text{BF}_3$** 

Sol in  $\text{H}_2\text{O}$  only when acidulated, sol in acids (Berzelius)

**Ammonium fluoboride,  $\text{NH}_4\text{BF}_4$** 

Easily sol in  $\text{H}_2\text{O}$  Sol in 4 pts  $\text{H}_2\text{O}$  at  $16^\circ$ , and 1 02–1 05 pts boiling  $\text{H}_2\text{O}$  (Stolba, Chem techn Cent Anz 7 459) Sl sol in alcohol

**Barium fluoboride,  $\text{Ba}(\text{BF}_4)_2 + 2\text{H}_2\text{O}$** 

Deliquescent, easily sol in  $\text{H}_2\text{O}$ , decomp by alcohol (Berzelius)

**Cæsium fluoboride,  $\text{CsBF}_4$** 

100 pts  $\text{H}_2\text{O}$  dissolve 0 92 pt  $\text{CsBF}_4$  at  $20^\circ$ , and 0 04 pt at  $100^\circ$  (Godeffroy, B 9 1367)  
 0 02 pts arc sol in 100 pts  $\text{H}_2\text{O}$  at  $20^\circ$  (Erdmann, Arch Pharm 1894, 232 21)

**Calcium fluoboride,  $\text{Ca}(\text{BF}_4)_2$** 

Decomp by  $\text{H}_2\text{O}$ , with formation of a sol acid salt and an insol basic salt (Berzelius)

**Cupric fluoboride,  $\text{Cu}(\text{BF}_4)_2$** 

Deliquescent, and very sol in  $\text{H}_2\text{O}$  (Berzelius)

**Lead fluoboride,  $\text{Pb}(\text{BF}_4)_2$** 

Sol in  $\text{H}_2\text{O}$  Decomp by boiling with  $\text{H}_2\text{O}$  or alcohol into an acid soluble, and a basic insoluble salt (Berzelius)

**Lithium fluoboride,  $\text{LiBF}_4$** 

Hygroscopic Easily sol in  $\text{H}_2\text{O}$  (Berzelius)

**Magnesium fluoboride**

Easily sol in  $\text{H}_2\text{O}$  (Berzelius)

**Potassium fluoboride,  $\text{KBF}_4$** 

Sol in 223 pts  $\text{H}_2\text{O}$  at  $20^\circ$  (Stolba)

Sol in 70.4 pts cold  $\text{H}_2\text{O}$  (Berzelius)

Sol in 15.94 pts  $\text{H}_2\text{O}$  at  $100^\circ$  (Stolba)

1.43 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $20^\circ$  (Erdmann, Arch Pharm 1894, 232 21)

Not more sol in  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ , sol in hot  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{M}_2\text{CO}_3 + \text{Aq}$  (Berzelius) More sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rose, Pogg 80 276) Insol in 20%  $\text{KC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Stromeyer) Insol in cold, sl sol in boiling alcohol

**Rubidium fluoboride,  $\text{RbBF}_4$** 

100 pts  $\text{H}_2\text{O}$  dissolve 0.55 pt at  $20^\circ$ , and 1.0 pt at  $100^\circ$  (Godeffroy, B 9 1337)

0.55 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $20^\circ$  (Erdmann, Arch Pharm 1894, 232 21)

**Sodium fluoboride,  $\text{NaBF}_4$** 

Easily sol in  $\text{H}_2\text{O}$  Very sl sol in alcohol (Berzelius)

**Yttrium fluoboride**

Sol in  $\text{H}_2\text{O}$  with excess of acid (Berzelius)

**Zinc fluoboride,  $\text{Zn}(\text{BF}_4)_2$** 

Deliquescent Sol in  $\text{H}_2\text{O}$  (Berzelius)

**Fluoboric acid,  $\text{HBF}_4$** 

See Fluoborhydric acid

$\text{H}_4\text{B}_2\text{O}_7$ ,  $3\text{HF}$  and  $\text{H}_4\text{B}_2\text{O}_9$ ,  $2\text{HF}$  (?) Fume on air, and are decomp with  $\text{H}_2\text{O}$  (Landolph, B 12 1583)

$\text{HBO}_2$ ,  $3\text{HF}$  Decomp by  $\text{H}_2\text{O}$  (Berzelius, Pogg 59 644)

Is either a mixture, or a solution of  $\text{HBO}_2$  in  $\text{HF}$ , and is decomp by distillation, and the salts are decomp by recrystallisation (Basarow, C R 78 1698)

**Potassium fluoborate,  $\text{K}_2\text{B}_2\text{O}_5\text{F}_2$  (?)**

Sl deliquescent Scarcely sol in boiling alcohol (Schiff, A Suppl 5 175)

See Boron trioxide potassium fluoride,  $\text{B}_2\text{O}_3$ ,  $2\text{KF}$

**Fluochromic acid****Ammonium fluochromate,  $\text{NH}_4\text{CrO}_5\text{F}$** 

Sol in  $\text{H}_2\text{O}$  (Varenne, C R 91 989)

**Potassium fluochromate,  $\text{KCrO}_5\text{F}$** 

Efflorescent Sol in  $\text{H}_2\text{O}$ , with gradual decomp (Streng, A 129 225)

**Fluocolumbic acid**

See also Fluoxycolumbic acid

**Ammonium fluocolumbate fluoxycolumbate,  $(\text{NH}_4)_2\text{CbF}_3$ ,  $2\text{CbOF}_3$ ,  $\text{NH}_4\text{F}$** **Cadmium fluocolumbate,  $\text{Cd}_5\text{H}_5\text{Cb}_3\text{F}_{30} + 28\text{H}_2\text{O}$** 

Insol in, and decomp by  $\text{H}_2\text{O}$  (Streng)

**Cobalt fluocolumbate,  $\text{Co}_5\text{H}_5\text{Cb}_3\text{F}_{30} + 28\text{H}_2\text{O}$** 

Insol in, and decomp by  $\text{H}_2\text{O}$  (Streng)

**Copper fluocolumbate,  $\text{Cu}_2\text{HCbF}_{10} + 9\text{H}_2\text{O}$** 

Insol in, and decomp by  $\text{H}_2\text{O}$

**Ferrous fluocolumbate,  $\text{Fe}_3\text{H}_4\text{Cb}_2\text{F}_{20} + 19\text{H}_2\text{O}$** 

As above

**Manganous fluocolumbate,  $\text{Mn}_5\text{H}_5\text{Cb}_3\text{F}_{30} + 28\text{H}_2\text{O}$** **Mercuric fluocolumbate,  $\text{Hg}_3\text{CbF}_{11} + 8\text{H}_2\text{O}$** 

As above

**Nickel fluocolumbate,  $\text{Ni}_3\text{H}_4\text{Cb}_2\text{F}_{20} + 19\text{H}_2\text{O}$** 

As above

**Potassium fluocolumbate,  $\text{K}_2\text{CbF}_7$** 

Decomp by solution in  $\text{H}_2\text{O}$  (Marginal A ch (4) 8 34)

**Rubidium fluocolumbate,  $\text{Rb CbF}_7$** 

Sol in  $\text{H}_2\text{O}$  and  $\text{HF} + \text{Aq}$  Insol in alcohol (Pennington, J Am Chem Soc 1896, 18 58)

**Zinc fluocolumbate,  $\text{Zn}_5\text{H}_5\text{Cb}_3\text{F}_{30} + 28\text{H}_2\text{O}$** 

Insol in cold  $\text{H}_2\text{O}$ , decomp by hot  $\text{H}_3\text{PO}_4$  (Santesson, Bull Soc (2) 24 52)

**Fluodithionic acid****Cesium monofluodithionate,**

$\text{S}_2\text{O}_5(\text{OH})\text{FCs}_2 + \text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  with decomp

Sol in  $\text{HF}$ , very unstable (Weinland Z anorg 1899, 21 66)

**Potassium difluodithionate,  $\text{S}_2\text{O}_5\text{F}_2\text{K}_2 + 3\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  with decomp

Sol in  $\text{HF}$ , very unstable (Weinland)

**Rubidium difluodithionate**,  $\text{S}_2\text{O}_5\text{F}_2\text{Rb}_2 + 3\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  with decomp  
Sol in  $\text{HF}$ , very unstable (Weinland)

**Fluogermanic acid**,  $\text{H}_2\text{GeF}_6$

Known only in solution (Winkler, J pr (2) 36 177)

**Potassium fluogermanate**,  $\text{K}_2\text{GeF}_6$

Sol in 173.98 pts  $\text{H}_2\text{O}$  at  $18^\circ$  (Winkler)  
Sol in 184.61 pts  $\text{H}_2\text{O}$  at  $18^\circ$  (Kruss and Nilson, B 20 1896)  
Sol in 34.07 pts  $\text{H}_2\text{O}$  at  $100^\circ$  (Winkler)  
Sol in 38.76 pts  $\text{H}_2\text{O}$  at  $100^\circ$  (Kruss and Nilson)  
Insol in alcohol

**Difluoriodic acid**

**Ammonium difluoriodate**,  $\text{NH}_4\text{IO}_2\text{F}_2$

Like K salt  
Sol in 40%  $\text{HF} + \text{Aq}$  (Weinland, Z anorg 1899, 20 30)  
Sol in  $\text{H}_2\text{O}$  Easily decomp (Weinland, B 1897, 30 868)

**Cæsium difluoriodate**,  $\text{CsIO}_2\text{F}_2$

(Weinland, Z anorg 1899, 20 36)

**Cæsium hydrogen difluoriodate**,  
 $\text{CsIO}_2\text{F}_2, \text{HIO}_2\text{F}_2 + 2\text{H}_2\text{O}$

Efflorescent Sol in  $\text{H}_2\text{O}$  with decomp  
(Weinland, Z anorg 1899, 22 257)

**Potassium difluoriodate**,  $\text{KIO}_2\text{F}_2$

Sol in  $\text{H}_2\text{O}$  Decomp in moist air  
(Weinland, B 1897, 30 867)  
Decomp in air Sol in  $\text{H}_2\text{O}$  with decomp  
Sol without decomp in 40%  $\text{HF} + \text{Aq}$   
(Weinland, Z anorg 1899, 20 31)

**Rubidium difluoriodate**,  $\text{RbIO}_2\text{F}_2$

Resembles K salt Sol in  $\text{HF} + \text{Aq}$   
(Weinland, Z anorg 1899, 20 35)

**Rubidium hydrogen difluoriodate**,  
 $\text{RbIO}_2\text{F}_2, \text{HIO}_2\text{F}_2 + 2\text{H}_2\text{O}$

Sol in 40-60%  $\text{HF} + \text{Aq}$  (Weinland, Z anorg 1899, 22 260)

**Sodium difluoriodate**,  $\text{NaIO}_2\text{F}_2$

Decomp by  $\text{H}_2\text{O}$  (Weinland, B 1897, 30 868)  
Sol in  $\text{HF}$  (Weinland, Z anorg 1899, 20 37)

**Fluomanganic acid**,  $\text{H}_2\text{MnF}_6$

Decomp by  $\text{H}_2\text{O}$  Sol in alcohol and ether in absence of  $\text{H}_2\text{O}$  (Nickles, C R 65 107)

**Ammonium fluomanganate**,  $(\text{NH}_4)_2\text{MnF}_6$

More sol than the K salt (Nickles, C R 65 107)  
True composition is  $(\text{NH}_4)_4\text{Mn}_2\text{F}_{10} = 4\text{NH}_4\text{F}, \text{Mn}_2\text{F}_6$  (Christensen, J pr (2) 34 41)

**Cobalt fluomanganate**,  $2\text{CoF}_2, \text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Christensen)

**Nickel fluomanganate**,  $2\text{NiF}_2, \text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Christensen)

**Potassium fluomanganate**,  $\text{K}_2\text{MnF}_6$

Difficultly sol in  $\text{H}_2\text{O}$  Decomp by much  $\text{H}_2\text{O}$  (Nickles, C R 65 107)  
Composition is  $\text{K}_4\text{Mn}_2\text{F}_{10} = 4\text{KF}, \text{Mn}_2\text{F}_6$   
Also with  $2\text{H}_2\text{O}$  (Christensen, J pr (2) 34 41)

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{HCl}, \text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  with decomp Can be recryst from 40%  $\text{HF} + \text{Aq}$  Insol in acetic acid (Weinland and Lauenstein, Z anorg 1899, 20 41)

**Rubidium fluomanganate**,  $\text{Rb}_2\text{MnF}_6 + 2\text{H}_2\text{O}$

As the K salt (Weinland and Lauenstein, Z anorg 1899, 20 44)

**Silver fluomanganate**,  $\text{Ag}_2\text{Mn}_2\text{F}_8 + 14\text{H}_2\text{O}$   
(Christensen, J pr (2) 34 41)

**Sodium fluomanganate**,  $4\text{NaF}, \text{Mn}_2\text{F}_6$

Decomp by much  $\text{H}_2\text{O}$  (Christensen)

**Zinc fluomanganate**,  $2\text{ZnF}_2, \text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Christensen)

**Fluomolybdc acid**

See Fluoxyhypomolybdc, and Fluoxymolybdc acids

**Fluopalladous acid**

**Potassium fluopalladite**,

Sl sol in  $\text{H}_2\text{O}$

**Sodium fluopalladite**

Sl sol in  $\text{H}_2\text{O}$  (Berzelius)

**Fluoperboric acid**

**Ammonium fluoperborate**,  
 $\text{NH}_4\text{OOB}(\text{F})\text{OOB}(\text{F})\text{OONH}_4$

Ppt Insol in ether (Petrenko, C C 1902, I 1191)

**Potassium fluoperborate**,  $\text{K}_4\text{B}_4\text{F}_4\text{O}_{11} + \text{H}_2\text{O}$

Dry salt is rather stable  
Easily sol in  $\text{H}_2\text{O}$  Aqueous solution decomp rapidly when warmed, at ordinary

temp the decomp proceeds slowly Insol in alcohol (Melikoff, B 1899, **32** 3350)  
 $\text{KOOB(F)OOB(F)OK} + 1\frac{1}{2}\text{H}_2\text{O}$  Ppt  
 Insol in ether (Petrenko, C C **1902**, I 1191, J Russ, phys chem Soc **34** 37)

### Fluoperuranic acid

**Potassium fluoperuranate**,  $\text{K}_4\text{U}_4\text{F}_{15}\text{O}_{15} + 4\text{H}_2\text{O} = 3\text{UO}_4\text{KF}, \text{UO}_3\text{F}_2, \text{KF} + 4\text{H}_2\text{O}$   
 Ppt (Lordkipanidse, C C **1900**, II 525)

**Sodium fluoperuranate**,  $\text{UO}_4\text{NaF} + 5\text{H}_2\text{O}$   
 Ppt (Lordkipanidse, C C **1900**, II 525)

### Fluophosphamide, $\text{PF}_3(\text{NH}_2)_2$

Sol in  $\text{H}_2\text{O}$  (Poulenc, A ch (6) **24** 566)

### Fluophosphoric acid

**Monocæsium monofluophosphate**,  
 $\text{P}(\text{OH})_3(\text{OCs})\text{F}$

Like the K salt (Weinland, Z anorg 1899,

— — — — — phosphate,

$\frac{1}{2}\text{F} + \text{Aq}$ , decomp in the air  
 Z anorg 1899, **21** 44)

**Potassium monofluophosphate**,  
 $\text{KHFPO}_3 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$ , unstable (Weinland, B 1898, **31** 124-125)

**Monorubidium monofluophosphate**,  
 $\text{P}(\text{OH})_3(\text{ORb})\text{F}$

Sol in 40%  $\text{HF} + \text{Aq}$  (Weinland, Z anorg 1899, **21** 47)

**Rubidium monofluophosphate**,  
 $\text{RbHFPO}_3 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Weinland, B 1898, **31** 124)

### Fluoplatinic acid

**Ammonium fluoplatinate**

Secomp by  $\text{H}_2\text{O}$  to a sol acid, and an insol basic salt Insol in alcohol (Berzelius)

**Potassium fluoplatinate**

Deliquescent Insol in alcohol Decomp by  $\text{H}_2\text{O}$  (Berzelius)

**Sodium fluoplatinate**

Decomp by  $\text{H}_2\text{O}$  (Berzelius)

### Fluor- and Fluoro-

See Fluor-

### Fluorhydric (Hydrofluoric) acid, $\text{HF}$ or $\text{H}_2\text{F}_2$

Attracts  $\text{H}_2\text{O}$  from air with great avidity. Very sol in  $\text{H}_2\text{O}$  with evolution of much heat. Sat solution has sp gr 1.25 (H Davy)

On boiling the aqueous solution an acid of constant composition is obtained, which boils at  $120^\circ$ , has sp gr 1.15, and contains 35.37%  $\text{HF}$  (Bineau, A ch (3) **7** 257) The residual acid after boiling contains 36 to 38%  $\text{HF}$ , and by standing over  $\text{CaO}$  gives off  $\text{HF}$  until an acid containing 32.5 to 32.7%  $\text{HF}$  is formed. Weaker acids increase their strength to 32.2 to 32.4%  $\text{HF}$ , while an acid containing 32.5%  $\text{HF}$  remains unchanged (Roscoe, A **116**. 218)

Does not attack gutta-percha Sol in  $\text{H}_2\text{SO}_4$

Sp gr of  $\text{HF} + \text{Aq}$  at  $15^\circ$

Sp gr	% HF	Sp gr	% HF	Sp gr	% HF
1.01	2.90	1.10	29.00	1.19	55.10
1.02	5.80	1.11	31.90	1.20	58.00
1.03	8.70	1.12	34.80	1.21	60.90
1.04	11.60	1.13	37.70	1.22	63.80
1.05	14.50	1.14	40.60	1.23	66.70
1.06	17.40	1.15	43.50	1.24	69.60
1.07	20.30	1.16	46.40	1.25	72.50
1.08	23.20	1.17	49.30		
1.09	26.10	1.18	52.20		

(Hart, J Anal Ch **3** 372)

Sp gr of  $\text{HF} + \text{Aq}$  at ord temp

Deg Baumé	Sp gr	% HF
1	1.0069	2.32
2	1.0139	4.04
3	1.0211	5.76
4	1.0283	7.48
5	1.0356	9.20
6	1.0431	10.92
7	1.0505	12.48
8	1.0583	14.04
9	1.0661	15.59
10	1.074	17.15
11	1.082	18.86
12	1.0901	21.64
13	1.0983	24.42
14	1.1067	27.20
15	1.1152	29.98
16	1.1239	32.78
17	1.1326	35.15
18	1.1415	37.53
19	1.1506	39.91
20	1.1598	42.29
21	1.1691	44.67
22	1.1786	47.04
23	1.1883	49.42
24	1.1981	51.57
25	1.2080	53.72
26	1.2182	55.87
27	1.2285	58.02

Sp gr of HF + Aq at ord temp — *Continued*

Deg Baumé	Sp gr	% HF
28	1 2390	60 17
29	1 2497	62 32
30	1 2605	64 47
31	1 2716	66 61
32	1 2828	68 76
33	1 2943	70 91
34	1 3059	73 06
35	1 3177	75 21
36	1 3298	77 36
37	1 3421	79 51
38	1 3546	81 66
39	1 3674	83 81
40	1 3804	85 96
41	1 3937	88 10
42	1 4072	90 24
43	1 4211	92 39
44	1 4350	94 54
45	1 4493	96 69

(Eckelt, Ch Z 1898, 22 225)

Sp gr of HF + Aq at 0°

% HF	Sp gr	% HF	Sp gr
0 484	1 005	71 73	1 262
1 504	1 009	72 21	1 260
2 48	1 012	78 05	1 260
4 80	1 017	84 27	1 235
7 75	1 035	87 72	1 212
15 85	1 065	88 11	1 210
24 47	1 097	88 82	1 207
28 48	1 110	89 02	1 202
29 83	1 120	89 15	1 200
34 23	1 130	89 82	1 190
38 50	1 145	90 20	1 185
41 00	1 155	90 64	1 175
41 15	1 155	91 04	1 165
41 92	1 157	92 09	1 152
47 52	1 182	92 81	1 135
48 49	1 187	92 91	1 130
50 97	1 200	94 26	1 095
55 09	1 217	95 84	1 065
55 39	1 220	97 50	1 035
57 66	1 230	98 22	1 022
61 66	1 245	100 05	1 0005
65 19	1 255		

(Hill, Roy Soc Proc 1909, 83 A 144)

Sp gr of HF + Aq at 18°

% HF	Sp gr
0 484	1 003
1 504	1 005
2 48	1 009
4 80	1 017
7 75	1 028
15 85	1 058
24 47	1 087
29 83	1 103

(Hill)

Aq solution of sp gr 1 138 at 18° contains 43 2% HF and has a constant bpt of 111° at 750 mm (Deussen, Z anorg 1906, 49 297)

The strongest acid that can be obtained by distillation contains 48 17% HF and boils at 125–125 5° (Gore)

### Fluorides

The alkali fluorides, also AgF and SnF<sub>2</sub>, are sol in H<sub>2</sub>O, the fluorides of Fe, Sr, and Cd are sl sol, the others are insol in H<sub>2</sub>O. Most fluorides are sol in acids, especially HF + Aq

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 822)

See under each element

### Fluorine, F<sub>2</sub>

Decomposes H<sub>2</sub>O and all organic solvent with great violence (Moissan, C R 103 202 and 256)

Liquified at –185° to a yellowish liquid which does not dissolve glass nor ignite cooled Si, B, C, S, P, or Fe (Moissan, C R 1897, 124 1202–1204)

### Fluomolybdic acid

Ammonium fluomolybdate, (NH<sub>4</sub>)MoF<sub>4</sub> + H<sub>2</sub>O

Somewhat more sol in H<sub>2</sub>O than the K salt. Hydrolysed by H<sub>2</sub>O (Rosenheim, Z anorg 1905, 46 321)

(NH<sub>4</sub>)<sub>2</sub>Mo<sub>2</sub>F<sub>8</sub> + 2H<sub>2</sub>O (Rosenheim)

Potassium fluomolybdate, KMoF<sub>4</sub> + H<sub>2</sub>O

Nearly insol in H<sub>2</sub>O (Rosenheim)

### Fluoselenenic acid

Ammonium monofluoselenate,

SeO<sub>3</sub>(OH)(NH<sub>4</sub>)<sub>2</sub>

Not hygroscopic

Easily sol H<sub>2</sub>O with decomp

Sol in HF (Weinland, Z anorg 1899, 21 58)

Tripotassium difluodiselenate, Se<sub>2</sub>O<sub>7</sub>·3K<sub>2</sub>H + H<sub>2</sub>O

Decomp in the air, sol in H<sub>2</sub>O with decomp, sol in HF (Weinland)

Tri-rubidium difluodiselenate, Se<sub>2</sub>O<sub>7</sub>·F<sub>2</sub>·Rb<sub>3</sub>H + H<sub>2</sub>O

Decomp in the air, sol in H<sub>2</sub>O with decomp, sol in HF (Weinland, Z anorg 1899, 21 57)



**Fluosilicic acid,  $\text{H}_2\text{SiF}_6$** 

Sp gr of  $\text{H}_2\text{SiF}_6 + \text{Aq}$  at  $17.5^\circ$  ( $\text{H}_2\text{O}$  at  $17.5^\circ = 1.000$ )

% $\text{H}_2\text{SiF}_6$	Sp gr	% $\text{H}_2\text{SiF}_6$	Sp gr
2	1.0161	20	1.1748
4	1.0324	22	1.1941
6	1.0491	24	1.2136
8	1.0661	26	1.2335
10	1.0834	28	1.2537
12	1.1011	30	1.2742
14	1.1190	32	1.2951
16	1.1373	34	1.3162
18	1.1559		

(Stolba, J pr 90 193)

+  $2\text{H}_2\text{O}$  Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Kessler, C R 90 1285) Solution decomp into HF and  $\text{SiF}_4$  on evaporation, when it becomes concentrated

**Fluosilicates**

Most of the fluosilicates are sol in  $\text{H}_2\text{O}$ , but the alkali salts (especially K) and the Ba salt are only sl sol in  $\text{H}_2\text{O}$

**Aluminum fluosilicate,  $\text{Al}_2(\text{SiF}_6)_3$** 

Easily sol in  $\text{H}_2\text{O}$  After evaporating to dryness, the residue is slowly but completely sol in  $\text{H}_2\text{O}$  (Deville, A ch (3) 61 327)

Insol in acetone (Naumann, B 1904, 37 4328)

**Aluminum fluosilicate silicate,  $\text{Al}_2\text{SiF}_{10}$ ,  $5\text{Al}_2\text{SiO}_5$** 

Min Topaz Insol in acids

**Ammonium fluosilicate,  $(\text{NH}_4)_2\text{SiF}_6$** 

Sol in 538 pts  $\text{H}_2\text{O}$  at  $17.5^\circ$  to form a solution of 1.0961 sp gr, sol in 18 pts hot  $\text{H}_2\text{O}$ , sol in 45.5 pts alcohol of 31% (Stolba, C C 1877 418)

Insol in acetone (Naumann, B 1904, 37 4329, Erdmann, C C 1899, II 1014)

$3\text{NH}_4\text{F} \cdot \text{SiF}_4 = (\text{NH}_4)_2\text{SiF}_6 \cdot \text{NH}_4\text{F}$  Sol in  $\text{H}_2\text{O}$  (Maignac, Ann Min (5) 15 221)

**Barium fluosilicate,  $\text{BaSiF}_6$** 

Sol in 3802 pts cold  $\text{H}_2\text{O}$  (Fresenius, A 59 120)

Sol in 3731 pts  $\text{H}_2\text{O}$  at  $17.5^\circ$  in 3315 pts at  $21^\circ$ , in 1175 pts at  $100^\circ$  (Stolba, J pr 96 22)

Sol in 640-733 pts  $\text{H}_2\text{O}$  containing a little HCl (Fresenius)

488 pts HCl + Aq containing 4.25% HCl dissolve 1 pt at  $22^\circ$  (Stolba)

More sol in  $\text{HNO}_3 + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Fresenius)

272 pts  $\text{HNO}_3 + \text{Aq}$ , containing 8%  $\text{NO}_2$ , dissolve 1 pt at  $22^\circ$  (Stolba)

1 pt  $\text{BaSiF}_6$  dissolves in 428 pts sat  $\text{NH}_4\text{Cl} + \text{Aq}$ , in 589 pts sat  $\text{NH}_4\text{Cl} + \text{Aq} + 2$  vols  $\text{H}_2\text{O}$  (Mallet, Sill Am J (2) 28 48)

1 pt  $\text{BaSiF}_6$  dissolves in 306 pts sat  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $22^\circ$ , in 361 pts 15% solution of  $\text{NH}_4\text{Cl}$ , in 563 pts sat boiling  $\text{NaCl} + \text{Aq}$ , in 349 pts 10% solution of  $\text{NaCl}$  at boiling temp, in 2185 pts 10% solution of  $\text{NaCl}$  at  $20^\circ$ , in 1140 pts 5% solution of  $\text{NaCl}$  at  $20^\circ$  (Stolba)

Nearly absolutely insol in alcohol (Fresenius)

Solubility in a mixture of  $\text{H}_2\text{O}$ , alcohol (96%), HCl + Aq (20%),  $\text{H}_2\text{SiF}_6 + \text{Aq}$  (3.7%)  
1 pt  $\text{BaSiF}_6$  is sol in pts of solutions of given composition

$\text{H}_2\text{O}$	Alcohol	HCl + Aq	$\text{H}_2\text{SiF}_6 + \text{Aq}$	$\text{BaSiF}_6$
50	50	0	0	37,219
74 1	25	0 9	0	5,263
70 8	25	4 2	0	2,860
77 95	20	0 9	1 15	39,061
73 0	25	0 9	1 1	70,679
97 09	0	1 25	1 66	3,247
75 0	25	0	0	16,914

(Fresenius, Z anal 29 143)

**Cadmium fluosilicate,  $\text{CdSiF}_6 + 6\text{H}_2\text{O}$** 

Extremely sol in  $\text{H}_2\text{O}$  Easily sol in 50% alcohol (Engelskirchen, Dissert 1903)

**Cæsium fluosilicate,  $\text{CsSiF}_6$** 

Sol in 166 pts  $\text{H}_2\text{O}$  at  $17^\circ$ , and much less hot  $\text{H}_2\text{O}$  Insol in alcohol (Preis, J pr 103 410)

**Calcium fluosilicate,  $\text{CaSiF}_6 + 2\text{H}_2\text{O}$** 

Sl sol in, and partly decomp by  $\text{H}_2\text{O}$  Sol in HF and HCl + Aq Sol in fluosilicic acid without decomp Easily sol in 60% alcohol (Fleischer)

**Cerium fluosilicate**

Very difficulty sol in  $\text{H}_2\text{O}$ , acetic, or fluosilicic acids Insol in alcohol (Stolba, C C 1874 130)

**Chromium fluosilicate**

Deliquescent (Berzelius)

Efflorescent Sol in  $\text{H}_2\text{O}$  (Börlin)

**Cobaltous fluosilicate,  $\text{CoSiF}_6 + 6\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  (Berzelius)

**Cuprous fluosilicate,  $\text{Cu}_2\text{SiF}_6$** 

Insol in  $\text{H}_2\text{O}$  (Berzelius, Pogg 1 199)

**Cupric fluosilicate,  $\text{CuSiF}_6 + 6\text{H}_2\text{O}$** 

Deliquescent in moist, efflorescent in dry air

Sol in 0.428 pt  $\text{H}_2\text{O}$  at  $17^\circ$  Sp gr of solution sat at  $17^\circ = 1.6241$

Sol in 17.5 pts alcohol of 62 vol % at  $20^\circ$ , in 150 pts of 85% at  $20^\circ$ , in 617 pts of 92% at  $20^\circ$  (Stolba, J pr 102 7)

**Insol** in methyl acetate (Naumann, B 1909, 42 3790)  
Contains  $6\frac{1}{2}$  H<sub>2</sub>O (Stolba)  
+  $5\frac{1}{2}$  H<sub>2</sub>O (Knop and Wolf)

**Cupric fluosilicate phosphate**,  $\text{CuSiF}_6$ ,  
 $\text{Cu}_3(\text{PO}_4)_2$

**Insol** in H<sub>2</sub>O, but easily sol in dil HCl + Aq (Thorpe and Rodger, Chem Soc 55 320)

**Glucinum fluosilicate**

Known only in solution

**Iron (ferrous) fluosilicate**,  $\text{FeSiF}_6 \cdot 6\text{H}_2\text{O}$   
Easily sol in H<sub>2</sub>O (Berzelius)

**Iron (ferric) fluosilicate**,  $\text{Fe}_2(\text{SiF}_6)_3$   
Sol in H<sub>2</sub>O (Berzelius)

**Lead fluosilicate**,  $\text{PbSiF}_6 \cdot 2\text{H}_2\text{O}$

Deliquescent Easily sol in H<sub>2</sub>O  
**Insol** in acetone (Naumann, B 1904, 37 4329)  
+ 4H<sub>2</sub>O (Marignac)

**Lithium fluosilicate**,  $\text{Li}_2\text{SiF}_6 \cdot 2\text{H}_2\text{O}$

100 pts H<sub>2</sub>O at 17° dissolve 73 pts crystalline salt (Marignac)  
100 pts cold H<sub>2</sub>O dissolve 52.6 pts crystals  
Sol in dil alcohol (Stolba, J pr 91 456)  
100 pts alcohol of 46 vol % dissolve about 4 pts, and 100 pts alcohol of 79 vol % dissolve about 0.4 pt crystals (Stolba, Z anal 3 311)

**Insol** in ether or benzene  
**Insol** in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)  
**Insol** in methyl acetate (Naumann, B 1909, 42 3790)  
**Insol** in ethyl acetate (Naumann, B 1904, 37 3601)

**Magnesium fluosilicate**,  $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$

Efflorescent Sol in 1534 pts cold H<sub>2</sub>O, forming a solution of 1.235 sp gr at 17.5° Separates out SiO<sub>2</sub> on warming, which nearly all redissolves on cooling (Stolba, C C 1877 578)

**Magnesium fluosilicate silicate**,  $\text{Mg}_3\text{Si}_2\text{F}_{18}$ ,  
 $\pi\text{Mg}_3\text{Si}_2\text{O}_9$

Min *Humite* *Chondrodite* Gelatinises with HCl, or H<sub>2</sub>SO<sub>4</sub> + Aq

**Manganous fluosilicate**,  $\text{MnSiF}_6 \cdot 6\text{H}_2\text{O}$

Sol in H<sub>2</sub>O (Marignac, J pr 83 202)  
100 pts dissolve in 71.4 pts H<sub>2</sub>O at 17.5°, and sp gr of solution = 1.44825 Much more sol in hot H<sub>2</sub>O, and less sol in alcohol, the stronger the alcohol (Stolba, C C 1883 292)

**Mercurous fluosilicate**,  $\text{Hg}_2\text{SiF}_6$

Sl sol in H<sub>2</sub>O without decomp (Lemaire, C C 1897, I 1046)  
+ 2H<sub>2</sub>O Sl sol in H O More easily sol in acidified H<sub>2</sub>O, but precipitated by HCl + Aq (Berzelius)

**Mercuric fluosilicate, basic**,  $\text{HgSiF}_6$ ,  $\text{HgO} + 3\text{H}_2\text{O}$

Decomp by H<sub>2</sub>O, but sol in weakest acids (Berzelius, Pogg 1 200)

**Mercuric fluosilicate**,  $\text{HgSiF}_6 \cdot 6\text{H}_2\text{O}$

Deliquescent, and easily sol in H<sub>2</sub>O (Finkener, Pogg 111 246)

**Nickel fluosilicate**,  $\text{NiSiF}_6 \cdot 6\text{H}_2\text{O}$

Easily sol in H<sub>2</sub>O (Marignac, Ann Min (5) 15 262)

**Potassium fluosilicate**,  $\text{K}_2\text{SiF}_6$

Sol in 833.1 pts H<sub>2</sub>O at 17.5°, and 104.8 pts at 100° (Stolba, J pr 103 396) Sol in 3800 pts cold, and more easily sol in hot H<sub>2</sub>O (Fresenius)

More sol in HCl + Aq than in H O  
Sol in 337 pts HCl + Aq of 26.5% at 14°, in 307 pts of 25.7% at 15°, in 340 pts of 14.1% at 14°, in 303 pts of 13.6% at 15°, in 327 pts of 9.6% at 14°, in 313 pts of 9.2% at 15°, in 376 pts of 2.7% at 14°, in 319 pts of 2.4% at 15°, in 409 pts of 1.8% at 14° (Stolba, l c)

Sol in 428 pts sat, and 589 pts dil NH<sub>4</sub>Cl + Aq (Mallet)  
Much less sol in K<sub>2</sub>SO<sub>4</sub>, KNO<sub>3</sub>, or KCl + Aq, but more sol in NH<sub>4</sub>Cl + Aq than in H<sub>2</sub>O (Stolba)

Sol in 24,066 pts K<sub>2</sub>SO<sub>4</sub> + Aq containing 9.92% K<sub>2</sub>SO<sub>4</sub> at 17°, in 17,858 pts containing 6% at 18°, in 19,530 pts containing 5% at 17°, in 10,721 pts containing 1% at 17°

Sol in 125,000 pts KNO<sub>3</sub> + Aq containing 18.4% KNO<sub>3</sub> at 15°, in 43,478 pts containing 8.7% at 15°, in 1735 pts containing 8.8% at 100°, in 35,814 pts containing 4.3% at 15°, in 10,203 pts containing 1.00% at 15°

Sol in 40,070 pts KCl + Aq containing 25% KCl at 17°, in 38,352 pts containing 18.4% at 17°, in 41,254 pts containing 13.4% at 14°, in 24,032 pts containing 6.7% at 12°, in 1200 pts containing 0.65% at 17°, in 1095 pts containing 0.45% at 18°

Sol in 358 pts NH<sub>4</sub>Cl + Aq containing 26.3% NH<sub>4</sub>Cl at 17°, in 306 pts containing 15% at 15°, in 339 pts containing 10% at 15°, in 436 pts containing 5% at 15° (Stolba, J pr 103 306)

**Insol** in liquid CO (Buchner, Z phys Ch 1906, 54 674)

**Insol** in liquid NH<sub>3</sub> (Gore, Am ch J 1898, 20 829)

Completely pptd from aqueous solution by an equal vol of alcohol

**Si sol in benzonitrile** (Naumann, B 1914, 47 1369)  
**Insol in methyl acetate** (Naumann, B 1909, 42 3790)

### Rubidium fluosilicate, $\text{Rb}_2\text{SiF}_6$

Sol in 625 pts  $\text{H}_2\text{O}$  at  $20^\circ$ , and 73 05–74 5 pts at  $100^\circ$  More sol in acidified water  
**Insol in alcohol** (Stolba, J pr 101 1)  
**Insol in  $\text{H}_2\text{O}$**  (Eggeling, Z anorg 1905, 46 175)  
 Less sol in  $\text{H}_2\text{O}$  than  $\text{K}_2\text{SiF}_6$  (Gossner, Zeit Kryst 1904, 38 149)

### Silver fluosilicate, $\text{Ag}_2\text{SiF}_6 + 4\text{H}_2\text{O}$

Deliquescent Easily sol in  $\text{H}_2\text{O}$  (Marignac, Ann Min (5) 15 221)

### Sodium fluosilicate, $\text{Na}_2\text{SiF}_6$

Much more sol in  $\text{H}_2\text{O}$  than  $\text{K}_2\text{SiF}_6$ , especially in hot  $\text{H}_2\text{O}$  Addition of acid does not increase solubility (Berzelius)

Sol in 153 3 pts  $\text{H}_2\text{O}$  at  $17 5^\circ$ , and 40 66 pts at  $100^\circ$  Easily forms supersaturated solutions (Stolba, Z anal 11 199)

Much less sol in  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Stolba, J pr 1865 (1) 96 26)

Precipitated completely from aqueous solution by alcohol (Rose)

**Insol in methyl acetate** (Naumann, B 1909, 42 3790)

### Strontium fluosilicate, $\text{SrSiF}_6 + 2\text{H}_2\text{O}$

Sol in cold  $\text{H}_2\text{O}$ , but decomp somewhat on heating Sol in 31 06 pts  $\text{H}_2\text{O}$  (Fresenius)

Easily sol in acidified  $\text{H}_2\text{O}$  without decomp Sol in alcohol

Solubility in a mixture of  $\text{H}_2\text{O}$ , alcohol (96%),  $\text{HCl} + \text{Aq}$  (20%),  $\text{H}_2\text{SiF}_6 + \text{Aq}$  (3 7%)  
 1 pt  $\text{SrSiF}_6$  is sol in pts of solutions of given composition

$\text{H}_2\text{O}$	Alcohol	$\text{HCl} + \text{Aq}$	$\text{H}_2\text{SiF}_6 + \text{Aq}$	$\text{SrSiF}_6$
50	50	0	0	15 29
74 1	25	0	0	82 93
70 8	25	4 2	0	50 9
77 95	20	0 9	1 15	55 0
73	25	0 9	1 1	82 97
75	25	0	0	147 4
95 24	0	2 04	2 72	7 3

(Fresenius, Z anal 29 143)

### Thallous fluosilicate, $\text{Tl}_2\text{SiF}_6 + 2\text{H}_2\text{O}$

Very easily sol in  $\text{H}_2\text{O}$  (Kuhlmann)

### Thorium fluosilicate, $\text{Th}(\text{OH})_2\text{SiF}_6$ (?)

(Cleve)

### Tin (stannic) fluosilicate, $\text{SnF}_4, \text{SiF}_4$

Very easily sol in  $\text{H}_2\text{O}$  (Berzelius)

### Uranyl fluosilicate

Very sl sol in acids (Berzelius)

Sol in alcohol (Stolba, Z anal 3 71)

### Vanadium fluosilicate

Deliquescent Sol in  $\text{H}_2\text{O}$  (Guyard, Bull Soc (2) 25 352)

### Yttrium fluosilicate

**Insol in pure, sol in acidified  $\text{H}_2\text{O}$**  (Berzelius)

### Zinc fluosilicate, $\text{ZnSiF}_6 + 6\text{H}_2\text{O}$

Very easily sol in  $\text{H}_2\text{O}$  (Berzelius)

### Zirconium fluosilicate

Sol in  $\text{H}_2\text{O}$  Solution clouds up on boiling (Berzelius)

### Fluostannic acid

### Ammonium fluostannate, $(\text{NH}_4)_2\text{SnF}_6$

Sol in  $\text{H}_2\text{O}$  (Marignac, Ann Min (5) 15 224)

$4\text{NH}_4\text{F}, \text{SnF}_4$  Sol in  $\text{H}_2\text{O}$  (Marignac)

### Barium fluostannate, $\text{BaSnF}_6$

Slowly sol in  $\text{H}_2\text{O}$

$+3\text{H}_2\text{O}$  Sol in 18 pts  $\text{H}_2\text{O}$  at  $18^\circ$  (Marignac, Ann Min (5) 15 246)

Decomp by warming with  $\text{H}_2\text{SO}_4$  with evolution of  $\text{HF}$  (Emich, M 1904, 25 1912)

### Calcium fluostannate, $\text{CaSnF}_6 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Marignac, Ann Min (5) 15 250)

### Cadmium fluostannate, $\text{CdSnF}_6 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Marignac)

### Cobaltous fluostannate, $\text{CoSnF}_6 + 6\text{H}_2\text{O}$

(Gossner, Zeit Kryst 1907, 42 482)

### Cupric fluostannate, $\text{CuSnF}_6 + 4\text{H}_2\text{O}$

Not deliquescent (Marignac, Ann Min (5) 15 291)

### Lithium fluostannate, $\text{Li}_2\text{SnF}_6 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Marignac, Ann Min (5) 15 242)

### Magnesium fluostannate, $\text{MgSnF}_6 + 6\text{H}_2\text{O}$

Not deliquescent Sol in  $\text{H}_2\text{O}$  (Marignac, Ann Min (5) 15 256)

### Manganous fluostannate, $\text{MnSnF}_6 + 6\text{H}_2\text{O}$

Slowly efflorescent (Marignac)

### Nickel fluostannate, $\text{NiSnF}_6 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Marignac, Ann Min (5) 15 262)

**Potassium fluostannate,  $K_2SnF_6 + H_2O$** 

Two modifications—(a) *Thin plates* Sol in 23 pts  $H_2O$  at  $100^\circ$ , and in 15–16 pts at  $18^\circ$  (Marignac)

(b) *Octahedra* Sol in 3 pts  $H_2O$  at  $100^\circ$ , and 27 pts at  $18^\circ$  (Marignac)

Sol in hot  $H_2O$  Can be crvst from hot  $H_2O$  With conc  $H_2SO_4$ , HF is evolved (Emich, M 1904, 25 911)

**Potassium hydrogen fluostannate,  $3KF, HF, SnF_4$** 

Sol in  $H_2O$  (Marignac)

**Silver fluostannate,  $Ag_2SnF_6 + 4H_2O$** 

Sl deliquescent Easily sol in  $H_2O$  (Marignac)

**Sodium fluostannate,  $Na_4SnF_6$** 

Sol in 18–19 pts  $H_2O$  at  $20^\circ$  (Marignac)

**Strontium fluostannate,  $SrSnF_6 + 2H_2O$** 

Sol in 5.5 pts  $H_2O$  at  $18^\circ$  (Marignac)

**Zinc fluostannate,  $ZnSnF_6 + 6H_2O$** 

Sol in  $H_2O$  (Marignac)

**Fluosulphonic acid,  $HSO_3F$** 

See Sulphuryl hydroxyl fluoride

**Ammonium fluosulphonate,  $FSO_3NH_4$** 

Easily sol in  $H_2O$  from which it can be cryst

Sol in ethyl alcohol, more sol in methyl alcohol Can be crvst from abs alcohol (Traube, B 1913, 46 2528)

**Sodium fluosulphonate,  $FSO_3Na$** 

Hydroscoptic

Sol in alcohol and acetone (Traube)

**Fluosulphuric acid****Tricæsium difluodisulphate,  $S_2O_7F_2Cs_3H + H_2O$** 

As the K salt (Weinland, Z anorg 1899, 21 53)

**Tripotassium difluodisulphate,  $S_2O_7F_2K_3H + H_2O$** 

Sol in HF, quite stable in air, sol in  $H_2O$  with decomp (Weinland, Z anorg 1899, 21 51)

**Trirubidium difluodisulphate,  $S_2O_7F_2Rb_3H + H_2O$** 

Sol in HF (Weinland, Z anorg 1899, 21 53)

**Fluotantallic acid****Ammonium fluotantalate,  $(NH_4)_2TaF_7$** 

Very sol in  $H_2O$  (Marignac, A ch (4) 9 272)

$(NH_4)_2TaF_7$  (Balke, J Am Chem Soc 1905, 27 1151)

**Cæsium fluotantalate,  $CsTaF_6$** 

Can be recryst from HF + Aq (Balke)

$Cs_2TaF_7$  Can not be recryst from  $H_2O$  as it tends to go into  $CsF, TaF_5$  (Balke, J Am Chem Soc 1905, 27 1151)

$15CsF, TaF_5$  Sl sol in  $H_2O$  (Pennington, J Am Chem Soc 1896, 18 59)

**Calcium fluotantalate**

Difficulty sol in  $H_2O$  (Berzelius)

**Cupric fluotantalate,  $Cu_2TaF_7 + 4H_2O$** 

Deliquescent Easily sol in  $H_2O$  (Marignac, A ch (4) 9 294)

**Lead fluotantalate**

Difficulty sol in  $H_2O$  (Berzelius)

**Lithium fluotantalate,  $LiF, TaF_5 + 2H_2O$** 

Can be recryst from conc HF (Balke, J Am Chem Soc 1905, 27 1143)

**Potassium fluotantalate,  $K_2TaF_7$** 

Sl sol in cold, much more easily in hot  $H_2O$  Decomposes, with formation of a white precipitate on boiling (Berzelius)

Much more sol in HF + Aq 1 pt of the salt is sol in 200 pts  $H_2O$  containing a trace of HF, and in 150–160 pts of  $H_2O$  containing a little more HF (Marignac, A ch (4) 9 267)

**Potassium hydrogen fluotantalate,  $KF, HF, TaF_5$  (?)**

Sol in  $H_2O$  (Berzelius)

**Rubidium fluotantalate,  $Rb_2TaF_7$** 

Sol in HF + Aq (Pennington, J Am Ch Soc 1896, 18 58)

$3RbF, 2TaF_5$  (Balke, J Am Chem Soc 1905, 27 1151)

**Sodium fluotantalate,  $3NaF, TaI_5$** 

Easily sol in  $H_2O$

$Na_2TaF_7 + H_2O$  Sol in  $H_2O$  (Marignac)

**Thallos fluotantalate,  $11LiTaF_7$** 

Sol in  $H_2O$  On boiling the aqueous solution tantalic acid separates

Decomp by conc  $H_2SO_4$  Difficulty sol in cold, easily sol in hot HF (Ephrum B 1909, 42 4461)

**Zinc fluotantalate,  $ZnTaF_7 + 7H_2O$** 

Very deliquescent Sol in  $H_2O$  (Marignac, A ch (4) 9 249)

**Fluotelluric acid****Ammonium fluotellurate,  $NH_4Tel_5 + H_2O$** 

Decomp by  $H_2O$  (Hogbom, Bull Soc (2) 35 60)

**Barium fluotellurate**,  $\text{Ba}(\text{TeF}_6)_2 + \text{H}_2\text{O}$

As above

**Potassium fluotellurate**,  $\text{KTeF}_6$

As above

$\text{TeO}_3\text{F}_2\text{K}_2 + 3\text{H}_2\text{O}$  Stable in dry air, only sl sol in  $\text{H}_2\text{O}$  with decomp, sol in HF (Weinland, Z anorg 1899, 21 61)

**Rubidium difluotellurate**,  $\text{TeO}_3\text{F}_2\text{Rb}_2 + 3\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  with decomp Sol in HF (Weinland, Z anorg 1899, 21 62)

**Fluotitanic acid**

Known only in solution as titanium hydrogen fluoride

**Ammonium fluotitanate**,  $(\text{NH}_4)_2\text{TiF}_6$

Sol in  $\text{H}_2\text{O}$  (Marignac)

$3\text{NH}_4\text{F}$ ,  $\text{TiF}_4$  Sol in  $\text{H}_2\text{O}$  (Marignac)

**Ammonium fluosequititanate**,  $6\text{NH}_4\text{F}$ ,  $\text{Ti}_2\text{F}_6$

Easily sol in  $\text{H}_2\text{O}$  Sl sol in  $\text{NH}_4\text{F} + \text{Aq}$  (Petersen, J pr (2) 40 54)

Insol in  $\text{NH}_4\text{F} + \text{Aq}$  (Piccini, C R 97 1064)

$4\text{NH}_4\text{F}$ ,  $\text{Ti}_2\text{F}_6$  Properties as the corresponding K salt (Piccini, B 18 257 R)

e,  $\text{BaTiF}_6$

$\text{H}_2\text{O}$  More easily sol in a (Engelskirchen, Dissert

$+\frac{1}{2}\text{H}_2\text{O}$  (Emich, M 1904, 25 907)

**Cadmium fluotitanate**,  $\text{CdTiF}_6 + 6\text{H}_2\text{O}$

Extremely sol in  $\text{H}_2\text{O}$  Easily sol in 50% alcohol (Engelskirchen, Dissert 1903)

**Cesium fluotitanate**,  $\text{Cs}_2\text{TiF}_6$

More sol in hot than cold  $\text{H}_2\text{O}$  and much more sol than the Rb comp (Engelskirchen, Dissert 1903)

$4\text{CsF}$ ,  $\text{TiF}_4$  More sol in  $\text{H}_2\text{O}$  than  $\text{Cs}_{15}\text{TaF}_{20}$  and is not decomp by pure  $\text{H}_2\text{O}$  (Pennington, J Am Chem Soc 1896, 18 60)

**Calcium fluotitanate**,  $\text{CaTiF}_6 + 3\text{H}_2\text{O}$

Decomp by pure  $\text{H}_2\text{O}$  Sol without decomp in acidified  $\text{H}_2\text{O}$  (Berzelius)

Separates a precipitate with cold  $\text{H}_2\text{O}$ , which dissolves on heating (Marignac, Ann Min (5) 15 250)

**Cupric fluotitanate**,  $\text{CuTiF}_6 + 4\text{H}_2\text{O}$

Sol in pure  $\text{H}_2\text{O}$  with partial decomp, easily and completely sol in acidified  $\text{H}_2\text{O}$  (Berzelius)

**Cupric fluotitanate ammonium fluoride**,

$\text{CuTiF}_6$ ,  $\text{NH}_4\text{F} + 4\text{H}_2\text{O}$

Efflorescent Easily sol in  $\text{H}_2\text{O}$  (Marignac, Ann Min (5) 15 267)

**Cupric fluotitanate potassium fluoride**,

$\text{CuTiF}_6$ ,  $\text{KF} + 4\text{H}_2\text{O}$

As the above salt (Marignac)

**Ferrous fluotitanate**,  $\text{FeTiF}_6 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Weber, Pogg 120 287)

**Ferric fluotitanate**

Decomp by  $\text{H}_2\text{O}$  (Berzelius)

**Lead fluotitanate**

Easily sol in  $\text{H}_2\text{O}$  (Berzelius)

**Lithium fluotitanate**,  $\text{Li}_2\text{TiF}_6 + 2\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Engelskirchen, Dissert, 1903)

**Magnesium fluotitanate**,  $\text{MgTiF}_6 + 6\text{H}_2\text{O}$

Easily sol in cold  $\text{H}_2\text{O}$  (Marignac, Ann Min (5) 15 257)

**Nickel fluotitanate**,  $\text{NiTiF}_6 + 6\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Weber, Pogg 120 282)

**Potassium fluotitanate**,  $\text{K}_2\text{TiF}_6$

Difficultly sol in cold, much more easily in hot  $\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve at

0° 3° 6° 10° 14° 20°

0 556 0 667 0 775 0 909 1 042 1 28 pts  $\text{K}_2\text{TiF}_6$  (Marignac, A ch (4) 8 65)

Sol in 78 6 pts  $\text{H}_2\text{O}$  at 21° Sol in acids (Piccini, Gazz (h) 1886, 16 104)

Sol in 78 pts  $\text{H}_2\text{O}$  at 20°, 9 4 pts at 100° By addition of small amount of HF, the solubility is increased (Weiss and Kaiser, Z anorg 1910, 65 354)

Sol in HF (Marchetti, Z anorg 1895, 10 66)

$+\text{H}_2\text{O}$  Much less sol in  $\text{H}_2\text{O}$  in presence of KBr or KI (Hall, J Am Chem Soc 1904, 26 1246)

Sol in  $\text{H}_2\text{O}$  or HF with decomp (Marchetti, Z anorg 1895, 10 66)

**Potassium fluosesquititanate**,  $4\text{KF}$ ,  $\text{Ti}_2\text{F}_6$

Scarcely sol in  $\text{H}_2\text{O}$ , sol in dil acids (Piccini, B 18 257 R)

**Rubidium fluotitanate**,  $\text{Rb}_2\text{TiF}_6$

Very sl sol in cold, somewhat more sol in hot  $\text{H}_2\text{O}$  (Engelskirchen, Dissert 1903)

**Silver fluotitanate**

Very deliquescent (Marignac)

**Sodium fluotitanate**,  $\text{Na}_2\text{TiF}_6$

Much more sol in  $\text{H}_2\text{O}$  than the corresponding potassium salt (Marignac, Ann Min (5) 15 238)

**Sodium hydrogen fluotitanate**,  $\text{Na}_2\text{TiF}_6$ ,  $\text{NaHF}_2$   
Sol in  $\text{H}_2\text{O}$  (Marignac)

**Strontium fluotitanate**,  $\text{SrTiF}_6 + 2\text{H}_2\text{O}$   
Sol in cold  $\text{H}_2\text{O}$  Solution clouds up on heating (Marignac)

**Zinc fluotitanate**,  $\text{ZnTiF}_6 + 6\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Marignac, A ch (3) 60 304)

### Fluovanadic acid

**Ammonium fluovanadate**,  $3\text{NH}_4\text{F}$ ,  $\text{VF}_3$   
Moderately sol in  $\text{H}_2\text{O}$  More easily sol in dil acids Nearly insol in alcohol or MF + Aq (Petersen, J pr (2) 40 52)  
 $2\text{NH}_4\text{F}$ ,  $\text{VF}_3 + \text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$   
Sl sol in alcohol (Petersen)  
 $\text{NH}_4\text{F}$ ,  $\text{VF}_3 + 2\text{H}_2\text{O}$  As above (Petersen)

**Cadmium fluovanadate**,  $\text{CdF}_2$ ,  $\text{VF}_3 + 7\text{H}_2\text{O}$   
Very sl sol in  $\text{H}_2\text{O}$  (Piccini and Giorgis, Gazz ch it 22, 1 89)

**Cobalt fluovanadate**,  $\text{CoF}_2$ ,  $\text{VF}_3 + 2\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  without decomp (Petersen, l c)

**Nickel fluovanadate**,  $\text{NiF}_2$ ,  $\text{VF}_3 + 2\text{H}_2\text{O}$   
As the Co salt (Petersen)

**Potassium fluovanadate**,  $2\text{KF}$ ,  $\text{VF}_3 + \text{H}_2\text{O}$   
Sl sol in  $\text{H}_2\text{O}$ , easily sol in acids Insol in  $\text{KF} + \text{Aq}$  (Petersen, J pr (2) 40 51)

**Potassium fluovanadate fluoxyvanadate**,  $4\text{KF}$ ,  $\text{VF}_3$ ,  $\text{VOF}_3$   
Easily sol in  $\text{H}_2\text{O}$ , and still more easily in  $\text{HF} + \text{Aq}$  Sl sol in  $\text{KF} + \text{Aq}$  (Petersen, J pr (2) 40 274)

**Sodium fluovanadate**,  $5\text{NaF}$ ,  $2\text{VF}_3 + \text{H}_2\text{O}$   
As the potassium salt (Petersen)

**Thalious fluovanadate**,  $\text{TlF}$ ,  $\text{VF}_3 + 2\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$   
Sol with decomp in conc  $\text{H}_2\text{SO}_4$ , dil  $\text{HNO}_3$ , or cold dil  $\text{HCl}$   
Insol in  $\text{NaOH} + \text{Aq}$  (Ephraim, B 1909, 42 4460)  
 $2\text{TlF}$ ,  $\text{VF}_3 + \text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$   
Sol in conc  $\text{H}_2\text{SO}_4$ , dil  $\text{HNO}_3$ , or cold dil  $\text{HCl}$  with decomp  
Insol in cold or hot  $\text{NaOH} + \text{Aq}$  (Ephraim, B 1909, 42 4461)

**Zinc fluovanadate**,  $\text{ZnF}_2$ ,  $\text{VF}_3 + 7\text{H}_2\text{O}$   
Sl sol in cold  $\text{H}_2\text{O}$  Decomp on heating (Piccini and Giorgis)

### Fluoxycolumbic acid

**Ammonium fluoxycolumbate**,  $3\text{NH}_4\text{F}$ ,  $\text{CbOF}_3$   
*Cubic salt* Sol in  $\text{H}_2\text{O}$  (Marignac, A ch (4) 8 38)  
 $2\text{NH}_4\text{F}$ ,  $\text{CbOF}_3$  *Lamellar salt* Much more sol in  $\text{H}_2\text{O}$  than  $2\text{KF}$ ,  $\text{CbOF}_3$  (M)  
 $5\text{NH}_4\text{F}$ ,  $3\text{CbOF}_3 + \text{H}_2\text{O}$  *Hexagonal salt* (M)  
 $\text{NH}_4\text{F}$ ,  $\text{CbOF}_3$  *Rectangular salt* (M)

**Ammonium fluoxycolumbate columbium fluoride**,  $3\text{NH}_4\text{F}$ ,  $\text{CbOF}_3$ ,  $\text{CbF}_5$   
(Marignac)

**Cupric fluoxycolumbate**,  $\text{CuF}_2$ ,  $\text{CbOF}_3 + 4\text{H}_2\text{O}$   
Sl deliquescent Sol in  $\text{H}_2\text{O}$  (Marignac, A ch (4) 8 42)

**Potassium fluoxycolumbate**,  $2\text{KF}$ ,  $\text{CbOF}_3 + \text{H}_2\text{O}$   
Sol in 12.5-13 pts  $\text{H}_2\text{O}$  at  $17-21^\circ$  Much more sol in hot  $\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$  containing  $\text{HF}$ . (Marignac)  
 $3\text{KF}$ ,  $\text{CbOF}_3$  Decomp by  $\text{H}_2\text{O}$  into above salt (M)  
 $5\text{KF}$ ,  $3\text{CbOF}_3 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (M)  
 $4\text{KF}$ ,  $3\text{CbOF}_3 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (M)  
 $3\text{KF}$ ,  $2\text{Cb}_2\text{O}_5 + 5\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Petersen, J pr (2) 40 287)  
 $\text{KF}$ ,  $\text{Cb}_2\text{O}_5 + 3\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Petersen)  
 $2\text{KF}$ ,  $3\text{Cb}_2\text{O}_5\text{F}$  Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HF}$  (Kruss and Nilson, B 20 1689)  
See also Fluoxypercolumbate, potassium

**Potassium hydrogen fluoxycolumbate**,  $3\text{KF}$ ,  $\text{HF}$ ,  $\text{CbOF}_3$   
Sol in  $\text{H}_2\text{O}$  (Marignac)

**Sodium fluoxycolumbate**,  $2\text{NaF}$ ,  $\text{CbOF}_3 + 2\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$   
 $\text{NaF}$ ,  $\text{CbOF}_3 + \text{H}_2\text{O}$  (Marignac)

**Zinc fluoxycolumbate**,  $\text{ZnF}_2$ ,  $\text{CbOF}_3 + 6\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Marignac, A ch (4) 8. 41)

### Fluoxyhypomolybdic acid

**Ammonium fluoxyhypomolybdate**,  $\text{MoOF}_3$ ,  $2\text{NH}_4\text{F}$   
Decomp by  $\text{H}_2\text{O}$  (Mauro, Gazz ch it 19 179)  
 $3\text{MoOF}_3$ ,  $5\text{NH}_4\text{F} + \text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Mauro)

**Cupric fluoxyhypomolybdate**,  $\text{CuF}_2$ ,  $\text{MoOF}_3 + 4\text{H}_2\text{O}$   
Deliquescent Sol in  $\text{H}_2\text{O}$  (Mauro, Real Ac Linc 1892, 1 194)

**Potassium fluoxyhypomolybdate**,  $\text{MoOF}_3$ ,  $2\text{KF} + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with decomp  
Sol in  $\text{HF}$  or  $\text{HCl} + \text{Aq}$  (Mauro and Panabianco, Gazz ch it 12 80)  
 $3\text{MoOF}_3$ ,  $5\text{KF} + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with decomp (Mauro, Gazz ch it 19 179)

**Thallous fluoxyhypomolybdate**,  $2\text{TlF}$ ,  $\text{MoOF}_3$

(Mauro, B 1894, 27R 109)

**Zinc fluoxyhypomolybdate**,  $\text{ZnF}_2$ ,  $\text{MoOF}_3 + 6\text{H}_2\text{O}$

Rapidly deliquescent Sol in  $\text{H}_2\text{O}$   
(Mauro, Real Ac Linc 1892 1 194)

**Fluoxyhypovanadic acid**

See Fluoxyvanadic acid

**Fluoxymanganic acid**

**Ammonium fluoxymanganate**,  $(\text{NH}_4)_2\text{MnOF}_4$

Precipitate (Nicklès)

**Potassium fluoxymanganate**,  $\text{K}_2\text{MnOF}_4$

Precipitate (Nicklès, C R 65 107)

**Sesquifluoxymanganic acid**

**Potassium sesquifluoxymanganate**,

$\text{K}_4\text{Mn}_2\text{O}_7 = 4\text{KF}$ ,  $\text{Mn}_2\text{O}_7$

Precipitate (Nicklès)

**Fluoxymolybdic acid**

See also Fluoxyhypomolybdic, and fluoxypermolybdic acids

**Ammonium fluoxymolybdate**,  $\text{NH}_4\text{F}$ ,  $\text{MoO}_2\text{F}_2$

Sol in  $\text{H}_2\text{O}$  (Mauro, Gazz ch it 20 109)

$+ \text{H}_2\text{O}$  More sol in  $\text{H}_2\text{O}$  than  $2\text{NH}_4\text{F}$ ,  $\text{MoO}_2\text{F}_2$  (Delafontaine, N Arch Sci ph nat 30 250)

Correct formula is  $3\text{NH}_4\text{F}$ ,  $\text{MoO}_2\text{F}_2$  (Mauro, Gazz ch it 18 120)

$2\text{NH}_4\text{F}$ ,  $\text{MoO}_2\text{F}_2$  Much more sol than  $2\text{KF}$ ,  $\text{MoO}_2\text{F}_2$  (Delafontaine)

$3\text{NH}_4\text{F}$ ,  $\text{MoO}_2\text{F}_2$  Sol in  $\text{H}_2\text{O}$  (Mauro)

$5\text{NH}_4\text{F}$ ,  $3\text{MoO}_2\text{F}_2 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Mauro, Gazz ch it 20 109)

**Ammonium fluoxymolybdate molybdate**,

$\text{MoO}_2\text{F}_2$ ,  $4\text{NH}_4\text{F}$ ,  $(\text{NH}_4)_2\text{MoO}_4$

Sol in  $\text{H}_2\text{O}$ , but with decomp (Mauro, Gazz ch it 18 120)

**Cadmium fluoxymolybdate**,  $\text{CdF}_2$ ,  $\text{MoO}_2\text{F}_2 + 6\text{H}_2\text{O}$

Sl efflorescent (Delafontaine, J B 1867 236)

**Cobaltous fluoxymolybdate**,  $\text{CoF}_2$ ,  $\text{MoO}_2\text{F}_2 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Delafontaine, J B 1867 236)

**Cupric fluoxymolybdate**,  $\text{CuF}_2$ ,  $\text{MoO}_2\text{F}_2 + 4\text{H}_2\text{O}$

Deliquescent (Mauro, Real Ac Linc 1892, 1 194)

**Nickel fluoxymolybdate**,  $\text{NiF}_2$ ,  $\text{MoO}_2\text{F}_2 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Delafontaine, J B 1867 236)

**Potassium fluoxymolybdate**,  $2\text{KF}$ ,  $\text{MoO}_2\text{F}_2 + \text{H}_2\text{O}$

Easily sol in boiling  $\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  with decomp Sol in  $\text{HF}$  (Marchetti, Z anorg 1895 10 68)  
 $\text{KF}$ ,  $\text{MoO}_2\text{F}_2 + \text{H}_2\text{O}$  Gradually efflorescent (Delafontaine)

**Rubidium fluoxymolybdate**,  $2\text{RbF}$ ,  $2\text{MoO}_2\text{F}_2 + 2\text{H}_2\text{O}$

Sol in cold, more sol in hot  $\text{H}_2\text{O}$  (Delafontaine)

**Sodium fluoxymolybdate**,  $\text{NaF}$ ,  $\text{MoO}_2\text{F}_2 + \frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Delafontaine)

**Thallous fluoxymolybdate**,  $2\text{TlF}$ ,  $\text{MoO}_2\text{F}_2 + \text{H}_2\text{O}$

Sol in hot  $\text{H}_2\text{O}$  (Delafontaine)

**Zinc fluoxymolybdate**,  $\text{ZnF}_2$ ,  $\text{MoO}_2\text{F}_2 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Delafontaine)

**Fluoxypercolumbic acid**

**Potassium fluoxypercolumbate**,  $2\text{KF}$ ,  $\text{CbO}_2\text{F}_2 + \text{H}_2\text{O}$

(Piccini, Z anorg 2 21)  
Sol in  $\text{H}_2\text{O}$  with decomp  
Sol in  $\text{HF}$  (Marchetti, Z anorg 1895, 10 67)

**Fluoxypermolybdic acid**

**Ammonium fluoxypermolybdate**,  $\text{MoO}_3\text{F}_2$ ,  $3\text{NH}_4\text{F}$

Sol in  $\text{H}_2\text{O}$  (Piccini, Z anorg 1 51)

**Cæsium fluoxypermolybdate**,  $\text{MoO}_3\text{F}_2$ ,  $2\text{CsF} + \text{H}_2\text{O}$

(Piccini)

**Potassium fluoxypermolybdate**,  $\text{MoO}_3\text{F}_2$ ,  $2\text{KF} + \text{H}_2\text{O}$

Not very sol in  $\text{H}_2\text{O}$ , more sol in  $\text{HF} + \text{Aq}$  without decomp (Piccini)

**Rubidium fluoxypermolybdate**,  $\text{MoO}_3\text{F}_2$ ,  $2\text{RbF} + \text{H}_2\text{O}$

Somewhat more sol in  $\text{H}_2\text{O}$  than K salt  
Easily sol in  $\text{HF} + \text{Aq}$  (Piccini)

### Fluoxypertantalic acid

**Potassium fluoxypertantalate**,  $2\text{KF}$ ,  $\text{TaO}_2\text{F}_3 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Piccini, Z anorg 2 21)

**Fluoxypertitanic acid**,  $\text{TiO}_2\text{F}_2$ ,  $\text{HF}$

Known only in solution (Piccini, B 18 255 R)

**Ammonium fluoxypertitanate**,  $\text{TiO}_2\text{F}_2$ ,  $2\text{NH}_4\text{F}$

Very unstable (Piccini, Gazz ch it 17 479)

$\text{TiO}_2\text{F}_2$ ,  $3\text{NH}_4\text{F}$  Sol in  $\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}_2$  (Piccini, Z anorg 1895, 10 439)

$2\text{TiO}_2\text{F}_2$ ,  $3\text{NH}_4\text{F}$  Sol in  $\text{H}_2\text{O}$  (Piccini, B 18 698 R)

**Barium fluoxypertitanate**,  $\text{TiO}_2\text{F}_2$ ,  $\text{BaF}_2$   
Precipitate Easily sol in acids (Piccini, B 18 698 R)

$2\text{TiO}_2\text{F}_2$ ,  $3\text{BaF}_2$  Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Piccini, Gazz ch it 17 479)

**Potassium fluoxypertitanate**,  $\text{TiO}_2\text{F}_2$ ,  $2\text{KF}$

Sol in  $\text{H}_2\text{O}$  (Piccini, B 21 1391)

Sol in  $\text{H}_2\text{O}_2$  (Piccini, Z anorg 1895, 10 438)

### Fluoxypertungstic acid

**Potassium fluoxypertungstate**,  $2\text{KF}$ ,  $\text{WO}_3\text{F} + \text{H}_2\text{O}$

(Piccini, Z anorg 2 11)

### Fluoxytantalic acid

See also Fluoxypertantalic acid

**Ammonium fluoxytantalate**,  $3\text{NH}_4\text{F}$ ,  $\text{TaOF}_2$

Easily sol in  $\text{H}_2\text{O}$  The solution clouds up by standing or on warming (Joly, C R 81 1266)

### Fluoxytitanic acid

See also Fluoxypertitanic acid

**Barium fluoxytitanate**,  $\text{TiOF}_2$ ,  $\text{BaF}_2$

Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Piccini, Gazz ch it 17 479)

### Fluoxytungstic acid

**Ammonium fluoxytungstate**,  $2\text{NH}_4\text{F}$ ,  $\text{WO}_2\text{F}_2$

Very sol in  $\text{H}_2\text{O}$  (Marignac, A ch (3) 69 65)

$\text{NH}_4\text{F}$ ,  $\text{WO}_2\text{F}_2 + \text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$   
Crystallises unchanged from  $\text{H}_2\text{O}$  containing  $\text{HF}$  (Marignac)

**Ammonium fluoxytungstate tungstate**,  $4\text{NH}_4\text{F}$ ,  $\text{WO}_2\text{F}_2$ ,  $(\text{NH}_4)_2\text{WO}_4$

Incompletely sol in  $\text{H}_2\text{O}$  Residue dissolves in  $\text{NH}_4\text{OH} + \text{Aq}$  (Marignac)

**Cadmium fluoxytungstate**

Very sol in  $\text{H}_2\text{O}$  (Marignac)

**Cupric fluoxytungstate**,  $\text{CuF}_2$ ,  $\text{WO}_2\text{F}_2 + 4\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Marignac, C R 55 888)

**Cupric fluoxytungstate ammonium fluoride**,  $\text{CuF}_2$ ,  $\text{WO}_2\text{F}_2$ ,  $\text{NH}_4\text{F} + 4\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Marignac)

**Manganese fluoxytungstate**

Very sol in  $\text{H}_2\text{O}$  (Marignac)

**Nickel fluoxytungstate**,  $\text{NiF}_2$ ,  $\text{WO}_2\text{F}_2 + 10\text{H}_2\text{O}$

Deliquescent Very sol in  $\text{H}_2\text{O}$  (Marignac)

**Potassium fluoxytungstate**,  $\text{KF}$ ,  $\text{WO}_2\text{F}_2 + \text{H}_2\text{O}$

Can be recrystallised without decomp only from  $\text{H}_2\text{O}$  containing  $\text{HF}$  (Marignac, A ch (3) 69 70)

$2\text{KF}$ ,  $\text{WO}_2\text{F}_2 + \text{H}_2\text{O}$  Difficultly sol in cold, more easily in hot  $\text{H}_2\text{O}$  (Berzelius)

Sol in 17 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Marignac)

Can be recrystallised without decomp from  $\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$  containing  $\text{HF}$  (Marignac)

Sol in  $\text{H}_2\text{O}$  with decomp Sol in  $\text{HF}$  (Marchetti, Z anorg 1895, 10 71)

See also Fluoxypertungstate, potassium

### Silver fluoxytungstate

Very easily sol in  $\text{H}_2\text{O}$  (Marignac)

**Sodium fluoxytungstate**,  $2\text{NaF}$ ,  $\text{WO}_2\text{F}_2$

More sol in  $\text{H}_2\text{O}$  than the corresponding K compound (Berzelius)

**Thallos fluoxytungstate**,  $\text{TlF}$ ,  $\text{WO}_2\text{F}_2$

Insol in  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$

(Ephraim and Heymann, B 1909, 42 4463)

$2\text{TlF}$ ,  $\text{WO}_2\text{F}_2$  Insol in  $\text{H}_2\text{O}$  but decomp thereby (Ephraim and Heymann, B 1909, 42 4462)

$3\text{TlF}$ ,  $2\text{WO}_2\text{F}_2$  Insol in  $\text{H}_2\text{O}$  Decomp by acids (Ephraim and Heymann, B 1909, 42 4462)

**Zinc fluoxytungstate**,  $\text{ZnF}_2$ ,  $\text{WO}_2\text{F}_2 + 10\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Marignac)



**Fluoxyuranic acid**

**Ammonium fluoxyuranate**,  $3\text{NH}_4\text{F}$ ,  $\text{UO}_2\text{F}_2$   
 Easily sol in  $\text{H}_2\text{O}$ , less in  $\text{HF}$  Insol in alcohol (Bolton)  
 100 g solution sat at  $27^\circ$  contain 10.11 g salt  
 100 g solution sat at  $81.3^\circ$  contain 20.71 g salt

(Burger, Dissert 1904)

**Barium fluoxyuranate**,  $3\text{BaF}_2$ ,  $2\text{UO}_2\text{F}_2 + 2\text{H}_2\text{O}$   
 Traces dissolve in hot  $\text{H}_2\text{O}$  Easily sol in dil acids (Bolton)

**Potassium fluoxyuranate**,  $3\text{KF}$ ,  $\text{UO}_2\text{F}_2$   
 Sol in 8 pts  $\text{H}_2\text{O}$  at  $21^\circ$  Insol in alcohol and ether (Bolton, J pr 99 269)  
 Does not exist (Smithells, Chem Soc 43 125)  
 $4\text{KF}$ ,  $\text{UO}_2\text{F}_2$  Insol in  $\text{H}_2\text{O}$  Easily sol in dil acids (Ditte, C R 91 115)  
 $5\text{KF}$ ,  $2\text{UO}_2\text{F}_2$  (Baker, Chem Soc 35 760)  
 $3\text{KF}$ ,  $2\text{UO}_2\text{F}_2 + 2\text{H}_2\text{O}$  (Baker)

**Sodium fluoxyuranate**,  $\text{NaF}$ ,  $\text{UO}_2\text{F}_2$   
 $+2\text{H}_2\text{O}$  Not efflorescent  
 $+4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  and dil acids Sl sol in conc  $\text{HCl} + \text{Aq}$  Sol in conc  $\text{H}_2\text{SO}_4$ , J B 1866 212)  
 $\text{UO}_2\text{F}_2$  (Ditte)  
 Does not exist (Smithells, Chem Soc 43 125)

**Fluoxyvanadic acid**

**Ammonium fluoxyvanadate**,  $12\text{NH}_4\text{F}$ ,  $\text{V}_2\text{O}_5$ ,  $2\text{VOF}_3$

Easily sol in  $\text{H}_2\text{O}$ , and not attacked by cold conc  $\text{H}_2\text{SO}_4$  (Baker, Chem Soc 33 388)

Formula is  $3\text{NH}_4\text{F}$ ,  $\text{VO}_2\text{F}$  (Petersen, J pr (2) 40 289)  
 $3\text{NH}_4\text{F}$ ,  $\text{VO}_2\text{F}$  Sol in  $\text{H}_2\text{O}$  (Petersen, l c)

Much less sol in  $\text{H}_2\text{O}$  in presence of  $\text{NH}_4\text{F}$  (Piccini and Giorgis, Gazz ch it 27 1 65)  
 $+ \text{H}_2\text{O}$  (Piccini and Giorgis, Gazz ch it 1892, 22 55)

$3\text{NH}_4\text{F}$ ,  $\text{VOF}_2$  "Hypovanadate" Quite sol in  $\text{H}_2\text{O}$  Very sl sol in  $\text{MF} + \text{Aq}$  Less sol in alcohol than in  $\text{H}_2\text{O}$  (Petersen, J pr (2) 40 195)

$2\text{NH}_4\text{F}$ ,  $\text{VOF}_2$  Sol in  $\text{H}_2\text{O}$  (Petersen)  
 $+ \text{H}_2\text{O}$  (Piccini and Giorgis)

$7\text{NH}_4\text{F}$ ,  $4\text{VOF}_2 + 5\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Petersen)

$3\text{NH}_4\text{F}$ ,  $2\text{VO}_2\text{F}$  Sol in  $\text{H}_2\text{O}$  without decomp Sol in conc  $\text{HF} + \text{Aq}$  (Piccini and Giorgis, Gazz ch it 24 1 68)

$3\text{NH}_4\text{F}$ ,  $2\text{VOF}_3 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with decomp  
 $\text{V}_2\text{O}_5$ ,  $2\text{NH}_4\text{F}$  (Ditte, C R 106 270)

$\text{V}_2\text{O}_5$ ,  $8\text{NH}_4\text{F} + 4\text{H}_2\text{O}$  As above  
 $\text{V}_2\text{O}_5$ ,  $4\text{NH}_4\text{F} + 4\text{H}_2\text{O}$  As above Sol in  $\text{H}_2\text{O}$

**Ammonium hydrogen fluoxyvanadate**,  $7\text{NH}_4\text{F}$ ,  $\text{HF}$ ,  $4\text{VO}_2\text{F}$

Verv sol in  $\text{H}_2\text{O}$  (Petersen, J pr (2) 40 284)

**Ammonium hydrogen trifluoxyvanadate**,  $3\text{HF}$ ,  $9\text{NH}_4\text{F}$ ,  $5\text{VOF}_3$

Easily sol in  $\text{H}_2\text{O}$  Sl sol in  $\text{MF} + \text{Aq}$  (Petersen, J pr (2) 40 280)

$3\text{NH}_4\text{F}$ ,  $3\text{HF}$ ,  $2\text{VOF}_3$  Sol in  $\text{H}_2\text{O}$  (Baker, Chem Soc 33 388)

Identical with  $3\text{HF}$ ,  $9\text{NH}_4\text{F}$ ,  $5\text{VOF}_3$  (Petersen)

**Barium fluoxyvanadate**,  $\text{BaF}_2$ ,  $\text{VO}_2\text{F}$

Ppt (Ephram, Z anorg 1903, 35 79)

**Cadmium fluoxyvanadate**,  $\text{CdF}_2$ ,  $\text{VOF}_2 + 7\text{H}_2\text{O}$

"Hypovanadate" As the Co salt (Piccini and Giorgis)

**Cobalt fluoxyvanadate**,  $\text{CoF}_2$ ,  $\text{VOF}_2 + 7\text{H}_2\text{O}$

"Hypovanadate" Sol in  $\text{H}_2\text{O}$  (Piccini and Giorgis)

**Nickel fluoxyvanadate**,  $\text{NiF}_2$ ,  $\text{VOF}_2 + 7\text{H}_2\text{O}$

"Hypovanadate" As the Co salt (Piccini and Giorgis)

**Potassium fluoxyvanadate**,  $7\text{KF}$ ,  $3\text{VOF}_2$

Very sl sol in  $\text{H}_2\text{O}$  and  $\text{MF} + \text{Aq}$  Easily sol in dil acids (Petersen, J pr (2) 40 199)

$2\text{KF}$ ,  $\text{VOF}_2$  As above (Petersen)

$2\text{KF}$ ,  $2\text{V}_2\text{O}_5 + 8\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$  (Ditte, C R 105 1067)

$2\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$  As above

$2\text{KF}$ ,  $4\text{V}_2\text{O}_5 + 8\text{H}_2\text{O}$  As above

$4\text{KF}$ ,  $\text{V}_2\text{O}_5$  Less sol than  $4\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 2\text{H}_2\text{O}$ , and  $+3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

$4\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 4\text{H}_2\text{O}$ , and  $+6\text{H}_2\text{O}$  Less sol than  $2\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$

$8\text{KF}$ ,  $\text{V}_2\text{O}_5 + 2\text{H}_2\text{O}$ , and  $+3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

**Potassium trifluoxyvanadate**,  $2\text{KF}$ ,  $\text{VOF}_3$

Ppt (Petersen, J pr (2) 40 272)

$6\text{KF}$ ,  $\text{V}_2\text{O}_5$ ,  $2\text{VOF}_3 + 2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Insol in cold conc  $\text{H}_2\text{SO}_4$  (Baker, Chem Soc 33 300)

Formula is  $3\text{KF}$ ,  $2\text{VO}_2\text{F}$  (Piccini and Giorgis)

See also Fluovanadate fluoxyvanadate, potassium

**Potassium fluoxyvanadate**,  $2\text{KF}$ ,  $\text{VO}_2\text{F}$

Easily sol in  $\text{H}_2\text{O}$  (Petersen, J pr (2) 40 278)

3KF, VO<sub>2</sub>F As above (Petersen)  
 3KF, 2VO<sub>2</sub>F Sol in H<sub>2</sub>O, scarcely attacked by H<sub>2</sub>SO<sub>4</sub> (Piccini and Giorgis)

**Potassium hydrogen fluoxyvanadate**, 3KF, HF, 2VOF<sub>3</sub>  
 Sol in H<sub>2</sub>O (Petersen)

**Sodium fluoxyvanadate**, 8NaF, 3VOF<sub>2</sub>+2H<sub>2</sub>O

Sol in H<sub>2</sub>O (Petersen, J pr (2) 40 200)  
 3NaF, VO<sub>2</sub>F, VOF<sub>3</sub> (?) Very easily decomp (Piccini and Giorgis)  
 2NaF, 2V<sub>2</sub>O<sub>5</sub>+10H<sub>2</sub>O Sol in H<sub>2</sub>O (Ditte, C R 106 270)

4NaF, V<sub>2</sub>O<sub>5</sub> As above  
 4NaF, 3V<sub>2</sub>O<sub>5</sub>+18H<sub>2</sub>O As above  
 6NaF, V<sub>2</sub>O<sub>5</sub>+5H<sub>2</sub>O As above  
 8NaF, V<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O (As above)

**Thallous fluoxyvanadate**, 2TlF, VOF<sub>2</sub>

Somewhat sol in cold H<sub>2</sub>O without decomp  
 Sol in boiling H<sub>2</sub>O with exception of a black residue, which is easily sol in dil H<sub>2</sub>SO<sub>4</sub> (Ephraim, B 1909, 42 4460)

3TlF, 2VO<sub>2</sub>F Insol in H<sub>2</sub>O Sol in H<sub>2</sub>O containing H<sub>2</sub>SO<sub>4</sub> (Ephraim and Heymann, B 1909, 42 4459)

**Zinc fluoxyvanadate**, ZnF<sub>2</sub>, ZnO, 2VOF<sub>3</sub>+14H<sub>2</sub>O

Decomp on air, sol in H<sub>2</sub>O (Baker, Chem Soc 33 388)

True composition is represented by the formula ZnF<sub>2</sub>, VO<sub>2</sub>F+7H<sub>2</sub>O (Petersen)

ZnF<sub>2</sub>, VO<sub>2</sub>F+7H<sub>2</sub>O Very sol in H<sub>2</sub>O (Piccini and Giorgis)

ZnF<sub>2</sub>, VOF<sub>3</sub>+7H<sub>2</sub>O "Hypovanadate"  
 Sol in cold H<sub>2</sub>O, but decomp by boiling, sol in dil HF+Aq (Piccini and Giorgis)

## Fluozirconic acid

**Ammonium fluozirconate**, (NH<sub>4</sub>)<sub>2</sub>ZrF<sub>6</sub>

Sol in H<sub>2</sub>O  
 3NH<sub>4</sub>F, ZrF<sub>4</sub> Sol in H<sub>2</sub>O (Marignac)

**Cadmium fluozirconate**, 2CdF<sub>2</sub>, ZrF<sub>4</sub>+6H<sub>2</sub>O

Sol in H<sub>2</sub>O, can be recrystallised therefrom (Marignac, A ch (3) 60 257)

CdZrF<sub>6</sub>+6H<sub>2</sub>O Sol in H<sub>2</sub>O (Marignac)

**Cæsium fluozirconate**, CsF, ZrF<sub>4</sub>+H<sub>2</sub>O

Sol in H<sub>2</sub>O without decomp (Wells, Z anorg 1895, 10 434)

2CsF, ZrF<sub>4</sub> Sol in H<sub>2</sub>O without decomp (Wells, Z anorg 1895, 10, 434)

2CsF, 3ZrF<sub>4</sub>+2H<sub>2</sub>O Only sl sol in H<sub>2</sub>O (Wells, Z anorg 1895, 10 434)

**Cupric fluozirconate**, 2CuF<sub>2</sub>, ZrF<sub>4</sub>+12H<sub>2</sub>O

Easily sol in cold H<sub>2</sub>O (Marignac, A ch (3) 60 296)

3CuF<sub>2</sub>, 2ZrF<sub>4</sub>+16H<sub>2</sub>O Sol in H<sub>2</sub>O (Marignac)

**Lithium fluozirconate**, 2LiF, ZrF<sub>4</sub>

Ppt (Wells, Am J Sci 1897, (4) 3 468)

4LiF, ZrF<sub>4</sub>+½H<sub>2</sub>O Sol in H<sub>2</sub>O with decomp (Wells, Am J Sci 1897, (4) 3 469)

**Magnesium fluozirconate**, MgZrF<sub>6</sub>+5H<sub>2</sub>O

Sol in H<sub>2</sub>O (Marignac)

**Manganous fluozirconate**, MnZrF<sub>6</sub>+5H<sub>2</sub>O

Sol in H<sub>2</sub>O (Marignac, J pr 83 202)

**Nickel fluozirconate**, 2NiF<sub>2</sub>, ZrF<sub>4</sub>+12H<sub>2</sub>O

Sol in H<sub>2</sub>O (Marignac, A ch (3) 60 291)

NiZrF<sub>6</sub>+6H<sub>2</sub>O Sol in H<sub>2</sub>O (Marignac)

**Nickel potassium fluozirconate**, K<sub>2</sub>ZrF<sub>6</sub>,

NiZrF<sub>6</sub>+8H<sub>2</sub>O

Sol in H<sub>2</sub>O (Marignac)

**Potassium fluozirconate**, KF, ZrF<sub>4</sub>+H<sub>2</sub>O

Much more sol in hot, than cold H<sub>2</sub>O (Marignac)

2KF, ZrF<sub>4</sub>=K<sub>2</sub>ZrF<sub>6</sub> 100 pts H<sub>2</sub>O dissolve at 2°, 0.781 pt, at 15°, 1.41 pts, at 19° 1.69 pts, at 100°, 25.0 pts K<sub>2</sub>ZrF<sub>6</sub> (Marignac)

Insol in liquid NH<sub>3</sub> (Gore, Am Ch J 1898, 20 829)

3KF, ZrF<sub>4</sub>

**Sodium fluozirconate**, 5NaF, ZrF<sub>4</sub>

100 pts H<sub>2</sub>O dissolve 0.387 pt at 18°, and 1.67 pts at 100° (Marignac)

2NaF, ZrF<sub>4</sub> (Wells, Am J Sci 1897, (4) 3 469)

5NaF, 2ZrF<sub>4</sub> Sol in H<sub>2</sub>O with decomp (Wells)

**Tellurium fluozirconate**, TeF, ZrF<sub>4</sub>

Sol in H<sub>2</sub>O without decomp (Wells, Am J Sci 1897, (4) 3 470)

+H<sub>2</sub>O Sol in H<sub>2</sub>O without decomp (Wells)

3TeF, ZrF<sub>4</sub> Sol in H<sub>2</sub>O without decomp (Wells)

5TeF, 3ZrF<sub>4</sub> Sol in H<sub>2</sub>O without decomp (Wells)

**Zinc fluozirconate**, ZnZrF<sub>6</sub>+6H<sub>2</sub>O

Sol in H<sub>2</sub>O (Marignac)

2ZnF<sub>2</sub>, ZrF<sub>4</sub>+12H<sub>2</sub>O Sol in H<sub>2</sub>O (Marignac, A ch (3) 60 257)

## Fulminating gold

See Auroamidoimide

## Fulminating platinum

See Fulminoplatinum

**Fulminating silver**

See Silver nitride

**Fulminoplatinum compounds**

See—

*Dichlorofulminoplatinum*

*Trichlorofulminoplatinum*

*Tetrachlorofulminoplatinum*

*Chloroxyfulminoplatinum*

**Fusocobaltic chloride,  $\text{Co}(\text{NH}_3)_4(\text{OH})\text{Cl}_2 + \text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$ , from which it is precipitated by  $\text{NH}_4\text{Cl} + \text{Aq}$ , decomp by boiling  $\text{H}_2\text{O}$ , pptd from aqueous solution by alcohol (Fremy, C R 32 501)

**— nitrate,  $\text{Co}(\text{NH}_3)_4(\text{OH})(\text{NO}_3)_2 + \text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  Properties as the chloride (Fremy)

**— sulphate,  $\text{Co}(\text{NH}_3)_4(\text{OH})\text{SO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Fremy, C R 32 501)

Insol in  $\text{H}_2\text{O}$  Sol in conc  $\text{HCl} + \text{Aq}$ , or  $\text{H}_2\text{SO}_4$ , from which it is precipitated by  $\text{H}_2\text{O}$  (Vortmann, N 6 412)

**Fusible white precipitate**

See Mercuridiammonium chloride

**Gadolinium, Gd**

(Marignac, C R 102 92)

**Gadolinium bromide,  $\text{GdBr}_3 + 6\text{H}_2\text{O}$** 

Sol in  $\text{HBr}$  (Benedicks, Z anorg 1900, 22 403)

**Gadolinium chloride,  $\text{GdCl}_3 + 6\text{H}_2\text{O}$** 

Somewhat deliquescent Sol in  $\text{H}_2\text{O}$  (Benedicks)

**Gadolinium platinum chloride**

See Chloroplatinate, gadolinium

**Gadolinium fluoride,  $\text{GdF}_3$** 

Insol in  $\text{H}_2\text{O}$ , sl sol in hot  $\text{HF}$  (Popovici, B 1908, 41 635)

**Gadolinium hydroxide,  $\text{Gd}(\text{OH})_3$** 

Ppt (Benedicks, Z anorg 1900, 22 402)

**Gadolinium oxide,  $\text{Gd}_2\text{O}_3$** 

Sol in acids (de Boisbaudran, C R 111 394)

Somewhat hygroscopic, easily sol in acids (Benedicks)

**Gallium, Ga**

Not decomp by  $\text{H}_2\text{O}$ , easily sol in cold  $\text{HCl} + \text{Aq}$  Slowly sol in warm dil  $\text{HNO}_3 + \text{Aq}$  Not attacked by conc  $\text{HNO}_3$  free from

$\text{N}_2\text{O}_3$  below  $40-50^\circ$ , and only slowly in presence of  $\text{N}_2\text{O}_3$  (Dupré, C R 86 720)

Easily sol in cold or warm  $\text{KOH} + \text{Aq}$  (de Boisbaudran, A ch (5) 10 100)

**Gallium bromide,  $\text{GaBr}_3$** 

Deliquescent, and sol in  $\text{H}_2\text{O}$

**Gallium dichloride,  $\text{GaCl}_2$** 

Deliquescent, and decomp by  $\text{H}_2\text{O}$  (Nilson and Petersen, C R 107 527)

**Gallium chloride,  $\text{GaCl}_3$** 

Deliquescent, and very sol in little  $\text{H}_2\text{O}$  Decomp by much  $\text{H}_2\text{O}$ , with formation of basic salt, which is slowly sol in dil  $\text{HCl} + \text{Aq}$

**Gallium hydroxide**

Sol in acids, sol in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ , less easily in  $\text{NH}_4\text{OH} + \text{Aq}$ , even in presence of ammonium salts

**Gallium iodide,  $\text{GaI}_3$** 

Deliquescent, and sol in  $\text{H}_2\text{O}$  (de Boisbaudran and Jungfleisch, C R 86 578)

**Gallium suboxide,  $\text{Ga}_2\text{O}_3$  (?)**

Sol in  $\text{HNO}_3 + \text{Aq}$  (Dupré)

Sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$

**Gallium oxide,  $\text{Ga}_2\text{O}_3$** 

Sol in acids

**Germanium, Ge**

Insol in  $\text{HCl} + \text{Aq}$  Easily sol in aqua regia Decomp by  $\text{HNO}_3 + \text{Aq}$  to oxide Conc  $\text{H}_2\text{SO}_4$  decomp to sulphate Insol in boiling  $\text{KOH} + \text{Aq}$  (Winkler, J pr (2) 34 177, 36 177)

**Germanium tetrabromide,  $\text{GeBr}_4$** 

Decomp by  $\text{H}_2\text{O}$  (Winkler)

**Germanium dichloride,  $\text{GeCl}_2$** 

Decompl by  $\text{H}_2\text{O}$  (Winkler)

**Germanium tetrachloride,  $\text{GeCl}_4$** 

Sinks in  $\text{H}_2\text{O}$ , and is gradually decomp thereby (Winkler, J pr 34 177)

Insol in and not attacked by hot conc  $\text{H}_2\text{SO}_4$  (Friedrich, W A B 102, 2b 540)

**Germanium chloroform,  $\text{GeHCl}_3$** 

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  (Winkler)

**Germanium tetrafluoride,  $\text{GeF}_4$** 

Deliquescent, and sol in  $\text{H}_2\text{O}$   $+ 3\text{H}_2\text{O}$  Deliquescent Melts in its crystal  $\text{H}_2\text{O}$  when warmed (Winkler)

**Germanium potassium fluoride**

See Fluogermanate, potassium

**Germanium hydride,  $\text{GeH}_4$** Sl sol in hot  $\text{HCl}$  Sol in  $\text{NaOCl} + \text{Aq}$  (Voegelen, Z anorg 1902, 30 327)**Germanium tetraiodide,  $\text{GeI}_4$** Deliquescent, and sol in  $\text{H}_2\text{O}$  with decomp (Winkler)**Germanium monoxide,  $\text{GeO}$** Not appreciably sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Easily sol in  $\text{HCl} + \text{Aq}$  Insol in alkalis (Winkler, J pr (2) 34 177)Somewhat sol in  $\text{H}_2\text{O}$ , insol in  $\text{H}_2\text{SO}_4 + \text{Aq}$ , even when hot and conc (van Bemmelen, R t c 6 205)**Germanium dioxide,  $\text{GeO}_2$** Not very difficultly sol in  $\text{H}_2\text{O}$  Sol in 247 1 pts  $\text{H}_2\text{O}$  at  $20^\circ$ , in 93 3 pts at  $100^\circ$  (Winkler)Easily sol in alkali carbonates or hydrates  $+ \text{Aq}$ , sl sol in acids**Germanium oxychloride,  $\text{GeOCl}_2$** Insol in  $\text{H}_2\text{O}$ , sol in acids (Winkler, J pr (2) 36 177)**Germanium monosulphide,  $\text{GeS}$** Sol in 402 9 pts  $\text{H}_2\text{O}$  Sol in conc hot  $\text{HCl} + \text{Aq}$  Sol in  $\text{KOH} + \text{Aq}$  Sol in  $(\text{NH}_4)_2\text{S} + \text{Aq}$  when precipitated Insol in  $(\text{NH}_4)_2\text{S} + \text{Aq}$  if crystalline Also exists in a colloidal state (Winkler)**Germanium disulphide,  $\text{GeS}_2$** Sol in 221 9 pts  $\text{H}_2\text{O}$  Easily sol in  $\text{KOH} + \text{Aq}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  Insol in acids Exists also in a colloidal state (Winkler)**Glass**

Numerous and extensive researches have been made on the action of  $\text{H}_2\text{O}$  and various solutions on glass. The older work has a certain historical interest, but only a brief statement of some of the more important results can be given here. For a very thorough résumé of the work before the year 1861, Storer's Dictionary, p 555, should be consulted.

All glass is more or less attacked by  $\text{H}_2\text{O}$ , the more easily the greater the amount of alkali present, the finer it is powdered, and the higher the temperature.

Glass as that of a flask is decomposed to a considerable extent by several days boiling with  $\text{H}_2\text{O}$  a portion of the fixed alkali being dissolved but when powdered glass is rubbed with distilled  $\text{H}_2\text{O}$  in a mortar the  $\text{H}_2\text{O}$  remains pure and exhibits no alkalinity (Scheele).

Glass of alembics is partially dissolved by long boiling with  $\text{H}_2\text{O}$  (Lavoisier).

$\text{H}_2\text{O}$  extracts potash or soda from glass together with

a portion of the silica the decomposition taking place the more easily in proportion as the glass is richer in alkalis more minutely divided or the temperature of the water higher (Bischof Kasin Arch. 1 443).

Powdered crown glass and some varieties of window glass render cold  $\text{H}_2\text{O}$  alkaline when in contact therewith (Dumas).

100 pts finely divided flint glass lose 7 pts potash when boiled one week with  $\text{H}_2\text{O}$  (Griffiths Q J Sci. 20 258).

Retorts of ordinary or flint glass are partially dissolved by  $\text{H}_2\text{O}$  when it is evaporated thereon (Chevreul 1811).

Finely powdered plate glass (Faraday Pogg 18 569) and Thuringian potash glass (Ludwig Arch Pharm. 91 47) reddened moistened turmeric paper.

The alkaline reaction disappears by continued washing but reappears when the glass is freshly rubbed (Griffiths).

Cold  $\text{H}_2\text{O}$  takes up  $\text{SiO}_2$  as well as alkali from glass powder (Fuchs).

Powdered lead glass gives up appreciable amounts of PbO to weakly acidified  $\text{H}_2\text{O}$  (Pelouze).

When powdered white glass containing 12 4%  $\text{Na}_2\text{O}$ , 15 5%  $\text{CaO}$ , and 72 1%  $\text{SiO}_2$  is treated repeatedly with  $\text{H}_2\text{O}$  more than 3% of the glass is dissolved and the undissolved part gives up 1 5%  $\text{CaO}$  to  $\text{HCl} + \text{Aq}$  with effervescence. A glass containing more alkali is 16 3%  $\text{Na}_2\text{O}$ , 6 4%  $\text{CaO}$ , 77 3%  $\text{SiO}_2$  lost with the same treatment 18 2% and the residue gave up 2%  $\text{CaO}$  to  $\text{HCl} + \text{Aq}$  (Pelouze C R 43 117).

In the above case the fineness of the glass has an influence as well as its composition. When the same sample of glass was boiled 1 hour with  $\text{H}_2\text{O}$  amounts were dissolved in the proportion 1 4 28 according as the glass was in form of a coarse fine or very fine powder. Glass of the composition of the above samples as given by Pelouze lost 10 and 32% respectively.

If powdered glass is boiled with  $\text{H}_2\text{O}$  and  $\text{CO}_2$  conducted into the solution it is absorbed if boiled with  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$  is dissolved (Pelouze).

Glass tubes are converted into a white crystalline mass by heating with  $\text{H}_2\text{O}$  several months to  $75\text{--}150^\circ$  lead glass and Bohemian glass most easily. English crown glass least. A little  $\text{H}_2\text{O}$  attacks glass more than much  $\text{H}_2\text{O}$ .

The action of  $\text{H}_2\text{O}$  is greatly increased by finely pulverising the glass.

$\text{H}_2\text{O}$  dissolved 10% of a glass containing 12%  $\text{Na}_2\text{O}$ , 15 5%  $\text{CaO}$ , and 72 5%  $\text{SiO}_2$ , and 32% of another glass containing 16 3%  $\text{Na}_2\text{O}$ , 6 4%  $\text{CaO}$ , and 77 3%  $\text{SiO}_2$  (Vogel, B A Munchen, 1867 437).

Action of  $\text{H}_2\text{O}$  on a glass containing 74%  $\text{SiO}_2$ , 8 6%  $\text{CaO}$ , 14%  $\text{Na}_2\text{O}$ , 0 6%  $\text{K}_2\text{O}$ , with traces of  $\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{MnO}$ , and  $\text{MgO}$ .

By boiling with  $\text{H}_2\text{O}$  a decrease of 3 9 mg was observed for the first hour, which soon became constant at 2 2 mg per hour. The action was then proportional to the time, and also to the surface in contact with the liquid, but independent of the amount of liquid evaporating.

The action decreases rapidly with the temperature, so that at  $90\text{--}100^\circ$  only  $\frac{1}{4}$  as much glass is dissolved as by boiling  $\text{H}_2\text{O}$  (Emmerling, A 150 257).

When steam condenses in tubes of Na glass, they are so strongly attacked that the  $\text{H}_2\text{O}$  has an alkaline reaction, but tubes of hard or Bohemian K glass are not so strongly attacked (Tollens, B 9 1540).

The effect of  $\text{H}_2\text{O}$  is so great as to impart a distinctly alkaline reaction to water condensing in a tube of ordinary glass. By condensing water in long tubes of various kinds of glass the following results were obtained.

I Easily fusible Thuringian glass Surface exposed = 324 sq cm

After 2 hours, 620 mg KOH were dissolved

After 3 hours more, 360 mg KOH were dissolved

After 3 hours more, 332 mg KOH were dissolved

After 3 hours more, 208 mg KOH were dissolved

After 3 hours more, 208 mg KOH were dissolved

Or, in 14 hours, 1728 mg KOH were dissolved

II Less easily fusible Thuringian glass Surface exposed = 499 sq cm

After 3 hours, 192 mg KOH were dissolved

After 3 hours more, 152 mg KOH were dissolved

After 3 hours more, 124 mg KOH were dissolved

After 3 hours more, 112 mg KOH were dissolved

Or, after 12 hours, 580 mg KOH were dissolved

III Combustion tubing of very difficultly fusible Bohemian glass Surface exposed = 1130 sq cm

After 3 hours 416 mg KOH were dissolved

After 3 hours more 416 mg KOH were dissolved

After 3 hours more 416 mg KOH were dissolved

After 3 hours more 416 mg KOH were dissolved

Or, after 12 hours, 1664 mg KOH were dissolved

IV Easily fusible Bohemian glass Surface exposed = 1394 sq cm

After 3 hours, 788 mg KOH were dissolved

After 3 hours more, 856 mg KOH were dissolved

After 3 hours more, 197 mg KOH were dissolved

Or, after 9 hours, 2432 mg KOH were dissolved (Kreusler and Henzold, B 17 34)

From the above the following table has been calculated

50 ccm H<sub>2</sub>O dissolves from a surface of 1000 sq m in 1 hour —

960 mg from easily fusible Thuringian glass

128 mg from less fusible Thuringian glass

12 mg from combustion tube of Bohemian glass

20 mg from harder tube of Bohemian glass

(Kreusler and Henzold, B 17 34)

100 ccm H<sub>2</sub>O dissolves so much glass from a flask every 2 seconds when in contact therewith that 01 ccm  $\frac{1}{2}$  normal oxalic acid is neutralised thereby (Bohlig, Z anal 23 518)

Action of H<sub>2</sub>O on various kinds of Na glass  
1 g of finely powdered glass was boiled 10–15 minutes in a silver dish with 100 ccm H<sub>2</sub>O, and the per cent of Na<sub>2</sub>O (or K<sub>2</sub>O) in the solution was determined

	%Na <sub>2</sub> O (K <sub>2</sub> O)
Orthoclase feldspar	0 17
Glass of a Bohemian combustion tube	0 56
“ flask (German manuf)	0 69
“ champagne bottle	1 7
Natrolite	1 32
Glass of a wine bottle (Hungarian)	2 22
Glass which was attacked by H <sub>2</sub> O under pressure	3 7
Lead glass	3 8
Glass that broke easily	4 8
Glass tubing that became rough when fused	6 1
Glass tubing that became opaque by fusing	14 35
Solid water glass	26 97

(Wartha, Z anal 24 220)

The relative ease by which various kinds of glass are attacked by H<sub>2</sub>O is shown by the following table The glass was powdered and heated on a water bath with exclusion of atmospheric CO<sub>2</sub>

Potassium water glass	291
Sodium water glass	196
Yellow glass rich in alkali	34
Thuringian glass	19
Ditto from Tittel and Co	8
Window glass	8
Lead glass from Jena	6
Bohemian glass from Kavalier	2 4
Lead crystal glass	1 4
Thermometer glass, 16IV, from Jena	1 0
Zinc glass, 362, from Jena	0 8
Lead glass, 434, from Jena	0 6
Lead glass, 483, from Jena	0 2
Heaviest lead silicate, from Jena	0 0

(Mylus, C C 1888 1313)

Solubility of various kinds of glass in H<sub>2</sub>O

The amounts dissolved from various kinds of glass by heating 5 hours with H<sub>2</sub>O were as follows

Yellow glass rich in alkali (13% K <sub>2</sub> O, 15% Na <sub>2</sub> O)	249 mg
Poor Thuringian glass (6 6% K O, 16 5% Na <sub>2</sub> O)	91 4 “
Glass from Tittel and Co (7 1% K <sub>2</sub> O, 14 3% Na <sub>2</sub> O)	30 4 “
Bottle glass from Schilling (4 2% K <sub>2</sub> O, 11 9% Na <sub>2</sub> O)	13 0 “
Bohemian glass from Kavalier (13 3% K <sub>2</sub> O, 11 4% Na <sub>2</sub> O)	10 1 “
Rhenish window glass (13 5% Na <sub>2</sub> O)	8 4 “
Lead crystal glass from Ehrenfeld (12 1% K <sub>2</sub> O)	8 5 “
Green bottle glass (1 3% K <sub>2</sub> O, 9 5% Na <sub>2</sub> O)	6 5 “

Solubility of various kinds of glass in  $H_2O$ —*Continued*

Thermometer glass 16III from Jena (14.0% $Na_2O$ , 7% $ZnO$ )	6 4 mg
Lead glass, No 483, from Jena (47% $PbO$ , 7.3% $K_2O$ )	3 3 "
Lead silicate	0 6 "

(Mylus and Forster, B 22 1100)

By calculation from the electrical conductivity of the solutions formed, various data were obtained by Kohlrausch (B 24 3565), which showed that different varieties of glass were attacked in very different degree by cold  $H_2O$ , and, moreover, the amount dissolved was proportionately much greater during the first few minutes of treatment with  $H_2O$  than afterwards, and, furthermore, the rate of decrease was much faster for good glass than poor. Increase of temperature increased the rate of solubility to a very great degree, the increase for  $1^\circ C$  being about 17%. In 7 hours at  $80^\circ$  half as much was dissolved as in 6 months at  $18^\circ$ . Extensive tables are given (Kohlrausch, B 24 3651). See also Kohlrausch (W Ann 44 577).

A very extensive research on the action of  $H_2O$  on glass, with a historical review of the work previously done on the subject, has been published by Mylius and Forster (Z anal 31 241). The general results may be summed up as follows—

1 The solution of glass in  $H_2O$  is caused by a decomposition, by which free alkali is formed

2 The silicic acid of the glass is brought into solution by a secondary reaction of the free alkali in the solution

3 The constituents of the solution change according to the conditions of the digestion

4 The amount of alkali going into solution from a given surface under certain conditions is a measure for the resistance of a glass under those conditions

5 The rate of attack of glass surfaces by cold  $H_2O$  decreases rapidly with the length of time of digestion, and finally approaches a constant value

6 The solubility increases very rapidly with increase of temperature

7 The ratio of the solubility of several kinds of glass is dependent on the temperature

8 From glasses which show the same ease of attack unequal amounts of substance may be dissolved

9 The solubility of a glass is influenced by the condition of the surface from "weathering" by prolonged exposure to the  $CO_2$  and  $H_2O$  of the air

10 The poorer a glass is the less will its solubility decrease by prolonged treatment with  $H_2O$

11 A good glass is essentially less easily

attacked after having been previously treated with  $H_2O$

12 After treatment with  $H_2O$ , glass surfaces have the property of fixing alkali from the solutions formed, and giving it up again by a subsequent treatment with  $H_2O$

13 Potassium glass is much more sol than sodium glass (contrary to previous researches), but the difference decreases as the glass becomes richer in  $CaO$

14 In glass flasks which are to be only slightly attacked by cold or hot  $H_2O$ , the  $CaO$ , alkalis, and  $SiO_2$  must stand in a fixed relation to each other

15 Of the more common varieties of glass, lead flint glass is least sol in  $H_2O$ , but its surface is corroded, and it is easily decomposed by acids

(Mylus and Forster, Z anal 31 241)

Bottle glass containing much  $Al_2O_3$  is easily attacked by acids

From powdered flint glass boiling  $HCl + Aq$  extracts K but no Pb (Griffiths)

Bottles of flint glass with  $(NH_4)_2CO_3 + Aq$  became so fragile that on shaking pieces of glass were detached (Griffiths)

All glass is decomposed by  $HF$

Conc  $H_3PO_4$  also attacks all glass

Glass containing small amounts of  $SiO_2$  are attacked by  $H_2SO_4$  poorer glass by boiling  $HCl$   $HNO_3$  and aqua regia (Berzelius)

Conc  $HNO_3$  does not act on flint glass at  $145-150^\circ$  (Sorby C R 50 990)

Glass of ordinary chemical apparatus gives up traces of metals to  $HCl$  and  $HNO_3 + Aq$ , but hard Bohemian glass consisting of 75%  $SiO_2$ , 15%  $K_2O$ , 10%  $CaO$ , resists the action of warm conc acids, also an easily fusible Na K glass with 77%  $SiO_2$ , 77%  $K_2O$ , 5%  $Na_2O$ , 10.3%  $CaO$ , is not easily attacked (Stas)

$KOH$ , and  $NaOH + Aq$  dissolve  $SiO_2$  from glass the more easily the hotter and the more conc the solutions are (Muller)  $NH_4OH$ , and  $(NH_4)_2CO_3 + Aq$  attack many kinds of glass, especially flint glass.  $CaO \cdot H_2O$  attacks glass appreciably at  $45^\circ$  and lower, still more strongly on boiling (Lamy, A ch (5) 14 155)

The action of various solvents on the glass mentioned on page 359 in Emmerling's experiments is as follows

The action of  $HCl + Aq$  containing 0.2 to 3%  $HCl$  is practically null, but is increased either by dilution or concentration. A very small quantity (0.02%)  $HCl$  added to  $H_2O$  almost wholly prevents its action on glass. With  $HCl + Aq$  (11%  $HCl$ ) a decrease of 4.2 mg was noticed in the first hour, and only 3-4 mg afterwards. The same is the case for  $HNO_3 + Aq$  in still greater degree, 0.008%  $HNO_3$  sufficing to nearly counteract the solvent action of  $H_2O$

$H_2SO_4 + Aq$  has about double the solvent effect possessed by  $H_2O$

Oxalic and acetic acids both diminish the solvent action of  $H_2O$

The addition of even traces (0.04%) of

$\text{Na}_2\text{CO}_3$  increases the solvent action, and this is further rapidly increased by an increase in the amount of  $\text{Na}_2\text{CO}_3$ .  $\text{Na}_2\text{CO}_3 + \text{Aq}$  containing 1%  $\text{Na}_2\text{CO}_3$  dissolves about 10 times as much as pure  $\text{H}_2\text{O}$ , i.e. about 35 mg per hour.

The above is also the case with  $\text{KOH} + \text{Aq}$ , but in even greater degree.  $\text{KOH} + \text{Aq}$  containing 0.025%  $\text{KOH}$  dissolved three times as much as pure  $\text{H}_2\text{O}$ .

$(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  has about the same action as  $\text{H}_2\text{O}$ .

With  $\text{NH}_4\text{OH} + \text{Aq}$  (9%  $\text{NH}_3$ ) 7 mg decrease for the first hour, and 3 mg afterwards was noticed. The concentration of the  $\text{NH}_4\text{OH} + \text{Aq}$  was apparently without effect.

The addition of  $\text{NH}_4\text{Cl}$  decreases the solvent action of  $\text{H}_2\text{O}$  proportionately to the amount added, but with new flasks large amounts are dissolved.

With  $\text{NH}_4\text{Cl} + \text{Aq}$  (7%  $\text{NH}_4\text{Cl}$ ) 4.2 mg were dissolved in the first hour, and the amount dissolved gradually decreased to null after 24 hours on account of the liberation of  $\text{HCl}$  by the decomp. of  $\text{NH}_4\text{Cl}$ .

$\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{KNO}_3$ , and  $\text{Na}_2\text{SO}_4$  show a similar behaviour to that of  $\text{NH}_4\text{Cl}$ .

$\text{Na}_2\text{HPO}_4 + \text{Aq}$  containing 0.4%  $\text{Na}_2\text{HPO}_4$

has six times the solvent action of pure  $\text{H}_2\text{O}$  but the action is not increased by further concentration.

In general, those salts the acids of which form insol. Ca salts, as  $\text{Na}_2\text{CO}_3$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $(\text{NH}_4)_2\text{C}_2\text{O}_4$ , increase the solvent action of  $\text{H}_2\text{O}$ , and this effect is greater the more concentrated the solution.  $\text{KCl}$ ,  $\text{KNO}_3$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{CaCl}_2$  decrease the effect, and the stronger the solution the less is the action.

All Na glass with approximately the above composition has the same power of resistance against  $\text{H}_2\text{O}$ . Bohemian K glass shows a greater resistance, especially against acids (Emmerling, A 150 257).

Action of various reagents on hard Bohemian glass 100 ccm substance dissolved mg glass in 6 days at 100°

$\text{H}_2\text{O}$	10 0
$\text{H}_2\text{S} + \text{Aq}$	8 7
$\text{Dil } (\text{NH}_4)_2\text{S} + \text{Aq}$	52 5
$\text{Conc } (\text{NH}_4)_2\text{S} + \text{Aq}$	47 2
$\text{Conc } \text{NH}_4\text{OH} + \text{Aq}$	42 5
$\text{Dil } \text{NH}_4\text{OH} + \text{Aq}$	7 7
$\text{NH}_4\text{SH} + \text{Aq}$	51 2

(Cowper, Chem Soc 41 254)

Action of various solutions on glass of different composition (The figures denote decrease in weight in mg of a 100 ccm flask)

	Time	1	2	3	4	5	6	7	8	9	10
$\text{H}_2\text{O}$	5 hrs	62	31	29	17	13	9	7	7	5	4
$\text{H}_2\text{SO}_4 + \text{Aq}$ (25% $\text{H}_2\text{SO}_4$ )	3 "		43	35	8	7	6	5	5	5	3
$\text{HCl} + \text{Aq}$ (12% $\text{HCl}$ )	3 "	85		27	4	2	1	1	1	0	0
$\text{NH}_4\text{OH} + \text{Aq}$ (10% $\text{NH}_3$ )	3 "			62	11	8	7	7	6	5	5
$\text{Na}_2\text{HPO}_4 + \text{Aq}$ (12% $\text{Na}_2\text{HPO}_4$ )	3 "			81	64	40	35	34	30	15	12
$\text{Na}_2\text{CO}_3 + \text{Aq}$ (2% $\text{Na}_2\text{CO}_3$ )	3 "	283	160	130	124	50	45	42	42	26	25

#### Composition of above varieties of glass

	1	2	3	4	5	6	7	8	9	10
$\text{SiO}_2$	76 22	74 09	76 39	68 56	74 48	74 69	66 75	74 12	77 07	74 40
$\text{Al}_2\text{O}_3$		0 40	0 50	1 85	0 50	0 45	1 31	0 50	0 30	0 70
$\text{CaO}$	4 27	5 85	5 50	7 60	7 15	7 85	13 37	8 55	8 10	8 85
$\text{K}_2\text{O}$		7 32	4 94	2 24	6 64	8 64	05 50	4 86	3 75	4 40
$\text{Na}_2\text{O}$	19 51	12 34	12 67	19 75	11 23	8 37	3 07	11 97	10 78	11 65

It is seen that glass which resists the attack of  $\text{H}_2\text{O}$  also resists acids and alkalis, and that the relative resistance of all varieties to any of the solutions is the same. Therefore the action of  $\text{H}_2\text{O}$  may be accepted as a criterion for judging of the resistance of a glass to all solvents. Glass No 10, in which the molecular ratio of  $\text{SiO}_2$  :  $\text{CaO}$  :  $\text{K}_2\text{O}$  ( $\text{Na}_2\text{O}$ ) is 8 : 1 : 1.5, is recommended as best suited for chemical uses (Weber and Sauer, B 25 70).

Mylus and Forster (B 25 97) recommend a glass in which the molecular ratio of  $\text{SiO}_2$  :  $\text{CaO}$  :  $\text{K}_2\text{O}$  ( $\text{Na}_2\text{O}$ ) is 7 : 2 : 1.1 as the best suited for chemical apparatus.

In an exhaustive research on the action of aqueous solutions on glass, which cannot be given in full on account of its great length, the following conclusions are reached—

1 Solutions of caustic alkalis act on glass much more strongly than  $\text{H}_2\text{O}$ , dissolving all the constituents of the glass—that is, the glass as such. Very dilute solutions form an exception.

2 Of the caustic alkalis,  $\text{NaOH} + \text{Aq}$  has the strongest action, then come  $\text{KOH}$ ,  $\text{NH}_4\text{OH}$ , and  $\text{BaO}_2\text{H}_2 + \text{Aq}$  in the order named.

3 Increase in temperature increases the

strength of the attack of alkalis very considerably

4 At high temperatures, the ease with which glass is attacked increases at first rapidly with the concentration of the alkali, but afterwards more slowly

5 At ordinary temperatures very concentrated alkali solutions have less action on glass than dil solutions

6 Solutions of pure alkalis, if not too conc, act less on glass than when contaminated with small amounts of  $\text{SiO}_2$

7 Alkali carbonates + Aq attack glass much more than  $\text{H}_2\text{O}$ , even when they are very dilute The action corresponds less to that of the caustic alkalis than to that of other salts With equivalent concentration,  $\text{Na}_2\text{CO}_3$  + Aq has a stronger action than  $\text{K}_2\text{CO}_3$  + Aq

8 The action of salt solutions on glass is a compound one, depending both on the concentration and the kind of salt dissolved, and is made up of the action of the  $\text{H}_2\text{O}$  and the salt in solution

9 Each kind of attack is differently influenced by the composition of the glass

10 Solutions of those salts, the acids of which form insol Ca salts, have a stronger action than  $\text{H}_2\text{O}$ , and the action increases with the concentration

11 Solutions of those salts, the acids of which form sol Ca salts, have less action than  $\text{H}_2\text{O}$ , and the action decreases with the concentration (Forster, B 25 2494)

Data on this subject published since the first edition of this work have not been considered

### Glucinic acid

Potassium glucinate,  $\text{K}_2\text{GlcO}_2$

Very deliquescent Sol in  $\text{H}_2\text{O}$  and acids (Kruss and Moraht B 23 733)

### Glucinum (Beryllium), Gl

Not attacked by hot or cold  $\text{H}_2\text{O}$  Sol in cold dil  $\text{HNO}_3$  + Aq (Wohler, Pogg 13 577)

Sol only in boiling conc  $\text{HNO}_3$  + Aq (Debray, A ch (3) 44 5)

Sol in dil  $\text{HCl}$  + Aq dil and conc  $\text{H}_2\text{SO}_4$  + Aq, and  $\text{KOH}$  + Aq, but insol in  $\text{NH}_4\text{OH}$  + Aq (Wohler, Debray)

Sol in hot  $\text{HCl}$ , hot conc  $\text{HNO}_3$ , and hot conc  $\text{H}_2\text{SO}_4$  (Lebeau, A ch 1399, (7) 16 474)

### Glucinum azomide, $\text{GlcN}_3$

Decomp by hot  $\text{H}_2\text{O}$  (Curtius, J pr 1898, (2), 58 292)

### Glucinum borocarbide, $3\text{Glc}_2\text{C}$ , $\text{B}_3\text{C}$

Insol in  $\text{H}_2\text{O}$  Easily sol in mineral acids especially  $\text{HNO}_3$  (Lebeau, A ch 1899, (7) 16 481)

$\text{C}_4\text{B}_6\text{Gl}_6$  Stable in air

Easily sol in mineral acids, conc and dil (Lebeau, C R 1898, 126 1349)

### Glucinum bromide, $\text{GlcBr}_2$

Sol in  $\text{H}_2\text{O}$  with evolution of much heat (Wohler)

Sol in abs alcohol (Lebeau, A ch 1899, (7) 16 484)

### Glucinum carbide, $\text{Glc}_2\text{C}$

Decomp by  $\text{H}_2\text{O}$  Slowly attacked by cold or hot conc  $\text{HCl}$  and  $\text{HNO}_3$  Gradually but completely sol in dil acids (Lebeau, A ch 1899, (7), 16 476)

$\text{Glc}_2$  Not easily decomp by strong acids Easily sol with decomp in dil acids (Lebeau, C R 1895, 121 497)

### Glucinum chloride, $\text{GlcCl}_2$

Anhydrous Fumes and deliquesces in air Sol in  $\text{H}_2\text{O}$  with hissing and evolution of much heat Easily sol in alcohol

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 828)

Sol in alcohol and ether Sl sol in  $\text{C}_6\text{H}_6$ ,  $\text{CHCl}_3$ ,  $\text{Cl}_4$  and  $\text{CS}_2$  (Lebeau, A ch 1899, (7) 16 493)

Insol in acetone (Naumann, B 1904, 37 4329)

+  $4\text{H}_2\text{O}$  Very hygroscopic Easily sol in  $\text{H}_2\text{O}$  and in alcohol (Mieletner, Z anorg 1913, 80 73)

### Glucinum chloride ammonia, $\text{GlcCl}_2 \cdot 4\text{NH}_3$

(Mieletner, Z anorg 1913, 80 73)

### Glucinum chloride iodine trichloride,

$2\text{ICl}_3$ ,  $\text{GlcCl}_2 + 8\text{H}_2\text{O}$

Hygroscopic (Winland, Z anorg 1902, 30 140)

### Glucinum ferric chloride, $\text{GlcCl}_2$ , $\text{FeCl}_3 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Neumann, A 244 329)

### Glucinum mercuric chloride, $\text{GlcCl}_2$ , $3\text{HgCl}_2 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Atterberg, B 6 1288)

### Glucinum thallic chloride, $3\text{GlcCl}_2$ , $2\text{TlCl}_3$

Cryst from  $\text{HCl}$  solution (Neumann, A 244 348)

### Glucinum stannic chloride

See Chlorostannate, glucinum



**Glucinum fluoride, basic,  $2\text{GIO}$ ,  $5\text{GIF}_2$** 

Sol in  $\text{H}_2\text{O}$  (Lebeau, A ch 1899, (7) 16 484)

**Glucinum fluoride,  $\text{GIF}_2$** 

Deliquescent Sol in  $\text{H}_2\text{O}$  Insol in anhydrous HF Sol in alcohol (Lebeau, C R 1898, 126 1421)

Sol in  $\text{H}_2\text{O}$  in all proportions Somewhat sol in abs alcohol Easily sol in 90% alcohol, also in a mixture of alcohol and ether Insol in anhydrous HF (Lebeau, A ch 1899, (7) 16 484)

**Glucinum potassium fluoride,  $\text{GIF}_2$ , KF**

Sl sol in  $\text{H}_2\text{O}$  (Awdejew) Much more sol in hot than cold  $\text{H}_2\text{O}$  (Berzelius)

$\text{GIF}_2$ , 2KF Sol in about 50 pts  $\text{H}_2\text{O}$  at  $20^\circ$ , and 19 pts boiling  $\text{H}_2\text{O}$  (Marignac)

**Glucinum sodium fluoride,  $\text{GIF}_2$ ,  $2\text{NaF}$** 

Sol in 34 pts  $\text{H}_2\text{O}$  at  $100^\circ$ , and 68 pts at  $18^\circ$  (Marignac)

**Glucinum hydroxide,  $\text{GIO}_2\text{H}_2$** 

Easily sol in acids Sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$  Sol in  $\text{CO}_2 + \text{Aq}$ , 100 ccm sat  $\text{CO}_2 + \text{Aq}$  dissolve 0.0185 g GIO (Sestini, Gazz ch it 20 313)

Also sol in KOH, NaOH,  $\text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , especially when freshly precipitated, also in  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3 + \text{Aq}$  (Debray)

Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  containing  $\text{NH}_4\text{Cl} + \text{Aq}$

Very sl sol in  $\text{Li}_2\text{CO}_3 + \text{Aq}$  (Gmelin)

Sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Berthier)

Sol in  $\text{BaO}_2\text{H}_2 + \text{Aq}$ , from which it is pptd by  $\text{NH}_4$  salts, but not by boiling Sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$  when freshly pptd

Sol in  $\text{NH}_4\text{F} + \text{Aq}$  (Helmholtz, Z anorg 3 130)

**Solubility of  $\text{GIO}_2\text{H}_2$  in  $\text{NaOH} + \text{Aq}$** 

G Na in 20 ccm	G GI in 20 ccm
0 3358	0 0358
0 6717	0 0882
0 8725	0 1175
1 7346	0 2847

(Rubenbauer, Z anorg 1902, 30 334)

When glucinum hydroxide is treated with alkali, more dissolves at first than corresponds with the true equilibrium under the prevailing conditions, for such solutions spontaneously deposit more or less glucinum hydroxide according to the concentration (Rubenbauer)

**Solubility of freshly pptd  $\text{GIO}_2\text{H}_2$  in  $\text{NaOH} + \text{Aq}$  at room temperature**

millimols Na per l	G GIO dissolved in 1 l
649	3 6
540	2 92
540	2 53
483	1 69
383	1 64
388	1 53
386	1 45
390	1 24

In the first two cases the values were obtained by adding to  $\text{HCl}_2 + \text{Aq}$  at  $0^\circ$ , ice cold  $\text{NH}_4\text{OH}$  and treating the ppt with  $\text{NaOH} + \text{Aq}$  In the remaining cases by dissolving basic  $\text{GICO}_3$  in  $\text{HCl}$  and pouring into  $\text{NaOH} + \text{Aq}$  (Haber, Z anorg 1904, 38 386)

**Solubility of  $\text{GIO}_2\text{H}_2$ , which is one week old, in  $\text{NaOH} + \text{Aq}$  at  $t^\circ$** 

NaOH	$t^\circ$	G GIO in 1 l
$\frac{1}{2}$ -N	$20-23^\circ$	0 060
1-N	$20-23^\circ$	0 170
2-N	$20-23^\circ$	0 570
$\frac{1}{2}$ -N	$50-53^\circ$	0 080
1-N	$50-53^\circ$	0 230
2-N	$50-53^\circ$	0 900
$\frac{1}{2}$ -N	$100^\circ$	0 080
1-N	$100^\circ$	0 290
2-N	$100^\circ$	1 020

(Haber)

**Solubility of  $\text{GIO}_2\text{H}_2$  in  $\text{NaOH} + \text{Aq}$  at  $25^\circ$** 

G mols	
Na	GI
0 268	0 0330
0 318	0 0492
0 446	0 0841
0 526	0 089
0 563	0 101
0 801	0 143
0 854	0 202

(Wood, Chem Soc 1910, 97 884)

Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  and in alkyl amines (Renz, B 1903, 36 2753)

Sol in  $\text{GISO}_4 + \text{Aq}$  (Parsons, J phys Chem 1907, 11 658)

A form insol in acids and alkalis can be obtained by sufficiently long heating in boiling  $\text{H}_2\text{O}$ ,  $\text{Na}_2\text{CO}_3 + \text{Aq}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ , or solutions of NaOH or KOH so dil that the  $\text{GIO}_2\text{H}_2$  is either insol or very sl sol therein (van Oordt, C C 1906, 1 108)

100 ccm of glycerine + Aq containing about 60% by vol of glycerine dissolve 0.1 g GIO (Muller, Z anorg 1905, 43 322)

Contains  $\frac{1}{3}\text{H}_2\text{O}$  (Schaffgotsch),  $\frac{1}{4}\text{H}_2\text{O}$  (Atterberg)

Solubility of  $\text{GlO}_2\text{H}_2$ , which has been boiled with alkali in various solvents

Alkali used	Time	Solvent	Solubility
10-N NaOH	2½ hrs	0 106-N NaOH 0 39-N NaOH 0 97-N NaOH 2 0-N NaOH 2 0-N NaOH	1 mol $\text{GlO}_2\text{H}_2$ 331 mole NaOH 1 mol $\text{GlO}_2\text{H}_2$ 183 mole NaOH 1 mol $\text{GlO}_2\text{H}_2$ 91 8 mole NaOH 1 mol $\text{GlO}_2\text{H}_2$ 49 mole NaOH 1 mol $\text{GlO}_2\text{H}_2$ 49 mole NaOH
NaOH NaOH	Long time 2 hrs	10-N $\text{K}_2\text{CO}_3$ Dil HCl Hot conc HCl Dil acetic acid	Insol Sl sol Slowly sol Almost insol
KOH	Till flocculent ppt appeared	1-N KOH  1-N NaOH Warm dil HCl	Insol " Sol
½-N $\text{Na}_2\text{CO}_3$	3 hrs	1-N NaOH Dil HCl	Easily sol "
{ ½-N $\text{Na}_2\text{CO}_3$ for then 1/10-N $\text{Na}_2\text{CO}_3$ for	3 hrs and 4 hrs	1-N NaOH Dil HCl	Sl sol Slowly sol
½-N $\text{K}_2\text{CO}_3$ 10-N $\text{K}_2\text{CO}_3$	6 hrs Short time	10-N $\text{K}_2\text{CO}_3$ 1-N NaOH Cold 10-N $\text{K}_2\text{CO}_3$	Insol Easily sol Very slowly sol
$\text{NH}_4\text{OH}$	5 hrs	½-N NaOH	Very sl sol

(Haber)

**Glucinum iodide,  $\text{GlI}_2$** Sol in  $\text{H}_2\text{O}$  with evolution of much heat (Wohler)Decomp in moist air and by  $\text{H}_2\text{O}$ 

Sol in abs alcohol Insol in most neutral organic solvents, as benzene, toluene, etc (Lebeau, C R 1898, 126 1273)

Insol in  $\text{C}_6\text{H}_6$ ,  $\text{C}_7\text{H}_8$ , and oil of turpentine Easily sol in  $\text{CS}_2$  Sol in anhydrous alcohols without evolution of heat (Lebeau, A ch 1899, (7) 16 490)**Glucinum iodide ammonia,  $2\text{GlI}_2, 3\text{NH}_3$** 

Ppt (Lebeau, A ch 1899, (7) 16 492)

**Glucinum oxide,  $\text{GlO}$** *Crystalline* Insol in acids except conc  $\text{H}_2\text{SO}_4$  (Ebelmen, C R 32 710)*Amorphous* Absolutely insol in  $\text{H}_2\text{O}$  The higher the temp to which the substance has been heated the more insol is it in acids Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  Insol in conc  $\text{NH}_4\text{Cl} + \text{Aq}$ , or KOH, and  $\text{NaOH} + \text{Aq}$  (Rose)When obtained by ignition of  $\text{GlSO}_4$ , it is very slowly but completely sol in HCl, and  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Rose)Insol in hydracids Sol in conc  $\text{H}_2\text{SO}_4$  (Lebeau, C R 1896, 123 819)Insol in liquid  $\text{NH}_3$  (Gore, Am ch J 1898, 20 828)**Glucinum peroxide basic,  $2\text{GlO}_2, 3\text{GlO}$**  $+ 8\frac{1}{2}\text{H}_2\text{O}$  (Komarovskii, Chem Soc 1913, 104 (2) 707)**Glucinum oxybromides**Sol in  $\text{H}_2\text{O}$  if three or less equivalents of base are present to one of acid, insol if more of the base is present (Ordway, Am J Sci (2) 26 207)**Glucinum oxychloride,  $\text{Gl}_2\text{OCl}_2 = \text{GlO}, \text{GlCl}_2$** Insol in  $\text{H}_2\text{O}$   
 $3\text{GlCl}, 2\text{GlO} + 2\text{H}_2\text{O} (?)$  Sol in  $\text{H}_2\text{O}$  (Atterberg) $\text{GlCl}_2, 3\text{GlO} + 3\text{H}_2\text{O} (?)$  Sol in  $\text{H}_2\text{O}$ , but solution soon becomes cloudy and deposits a fine ppt By boiling the solution it is decomposed into above salt, and  $\text{GlCl}_2, 12\text{GlO}_2\text{H}_2 + 10\text{H}_2\text{O}$ , which is insol in  $\text{H}_2\text{O}$ , decomp into  $\text{GlO}_2\text{H}_2$  by washing Sol in acids (Atterberg)**Glucinum oxyfluoride,  $5\text{GlF}_2, 2\text{GlO}$** Readily sol in  $\text{H}_2\text{O}$  (Lebeau, C R 1898, 126 1419)**Glucinum phosphide**Decomp by  $\text{H}_2\text{O}$  (Wohler)**Glucinum selenide**Sl sol in  $\text{H}_2\text{O}$  (Berzelius)

**Glucinum sulphide**

Slowly sol without decomp in  $H_2O$ , but easily decomp by acids (Wohler)

**Gold, Au**

Gold which has been pptd from  $AuCl_3 + Aq$  by  $FeSO_4$  is sl sol in  $HCl$  (Awerkiew, Z anorg 1909, 61 10)

Not attacked by  $H_2O$  Insol in  $HNO_3$  or  $HCl + Aq$  Easily sol in aqua regia or any mixture evolving  $Cl$  or  $Br$  Sol in selenic acid, or antimonie acid +  $Aq$ , less easily in arsenic acid +  $Aq$  Sol in mixtures of  $HCl$  and nitrates, or  $HNO_3$  and chlorides, also in  $(NaCl + KNO_3 + K_2Al_2(SO_4)_4) + Aq$  (?) Insol in  $H_2SO_4$ , except in presence of  $KMnO_4$ ,  $HNO_3$ , or  $HIO_3$  Sol in a solution of  $I$  in ether in direct sunlight

Sol in solutions of ferric, and cupric salts Sol in  $HCl + Aq$  containing  $H_2CrO_4$ ,  $H_2MnO_4$ ,  $H_2SeO_4$ ,  $H_3AsO_4$ , or  $FeCl_3$  (Wurtz)

Attacked by fuming  $HCl$  (sp gr 1.178) at ord temp in direct light, especially in the presence of a trace of  $MnCl_2$ , but not attacked in the dark even in the presence of this salt (Berthelot, C R 1904, 138 1298)

100 ccm hot conc  $HCl$  dissolve 0.008 g yellow Au powder in 4 hours (Hanriot and Raoult, C R 1912, 155 1086)

Upon boiling 25 and 50 cc  $HCl + Aq$  (sp gr 1.178), dil to 125 cc with 250 mg sheet  $Au \frac{1}{8}$  in square, 0.009 in thick, weighing 250 mg for several hours, there was no loss of weight of  $Au$  (McCaughy, J Am Chem Soc 1909, 31 1263)

From 5 g finely divided ordinary yellow gold, 100 cc  $HNO_3$  of 22° B dissolve 0.002 g in 2 hrs

100 cc  $HNO_3$  of 32° B dissolve 0.0119 g in 2 hrs

100 cc  $HNO_3$  of 36° B dissolve 0.028 g in 2 hrs

100 cc  $HNO_3$  monohydrate dissolve 0.076 g in 2 hrs (Hanriot and Raoult, C R 1912, 155 1085)

From 5 g brown gold

100 ccm  $HNO_3$  of 22° Baume dissolve 0.006 g in 2 hrs

100 ccm  $HNO_3$  of 32° Baume dissolve 0.039 g in 2 hrs

100 ccm  $HNO_3$  of 36° Baume dissolve 0.078 g in 2 hrs

100 ccm  $HNO_3$  monohydrate dissolve 1.540 g in 2 hrs (Hanriot and Raoult)

Sl sol in boiling  $HNO_3$  (sp gr = 1.42) The solution deposits  $Au$  by standing several days (Dewey, J Am Chem Soc 1910, 32 320)

Best composition of aqua regia for dissolving  $Au$  is 200 cc  $HCl$  (sp gr 1.1946) 45 cc  $HNO_3$  (sp gr 1.4) and 245 cc  $H_2O$  1 pt  $Au$  is sol in 4.3 pts of such a mixture (Priwoznik, C C 1910, II 1743)

Sol in 1 pt  $HNO_3 + 4$  pts  $HCl$  as representing the most economical mixture (Priwoznik, Chem Soc 1911, 100 (2), 484)

Easily sol in nitrosulphonic acid from sulphuric acid manufacture, when mixed with equal parts conc  $HCl + Aq$  (Borntrager, Rep anal Ch 1887 741)

Sol in hot conc  $H_2SO_4$  in the presence of  $MnO_2$ ,  $Mn_2O_3$ ,  $Mn_3O_4$ ,  $PbO_2$ ,  $Pb_2O_3$ ,  $Pb_3O_4$ ,  $CrO_3$ ,  $CrO_4$  and  $Ni_2O_3$  Solution also takes place slowly in the cold Sol in hot  $H_2SO_4 + KMnO_4$  Slowly sol in cold, more rapidly in hot  $H_2SO_4 + HNO_3$  (Lenher, J Am Chem Soc 1904, 26 550)

Sol in a hot solution of crystalline telluric acid in  $H_2SO_4$  or  $H_3PO_4$

Sol in hot  $H_3PO_4$  in the presence of  $MnO_2$ ,  $Mn_2O_3$ ,  $Mn_3O_4$ , the higher oxides of lead,  $CrO_3$ , chromium tetroxide and nickel oxide Solution takes place more slowly in the cold Sol in hot  $H_3PO_4$  in the presence of  $KMnO_4$  Slowly sol in a cold, more rapidly sol in a hot mixture of  $H_3PO_4$  and  $HNO_3$

Sol in hot arsenic acid in the presence of  $MnO_2$ ,  $Mn_2O_3$  and  $Mn_3O_4$  (Lenher, J Am Chem Soc 1904, 26 550)

Gold leaf is not attacked by cold conc  $H_2SeO_4$ , when completely free from halogens, but is dissolved by conc  $H_2SeO_4$  at 300° (Lenher, J Am Chem Soc 1902, 24 354)

Solubility of thin sheet  $Au$  in  $HCl$  solution of non alum

Time hours	Mg Au dissolved			
	1 g Fe 25 cc HCl	1 g Fe 50 cc HCl	2 g Fe 25 cc HCl	2 g Fe 50 cc HCl

Temp 38–43°

16	1 00	1 30	1 08	1 47
22	1 12	1 55	1 20	1 81
40	1 52	2 15	1 82	2 75
46	1 71	2 34	2 02	2 95
64	1 96	3 10	2 60	3 79
72	2 12	3 30	2 83	4 05
89	2 32	3 65	3 22	4 65
100	2 40	3 76	3 38	4 81
113	2 45	3 95	3 51	5 12
124	2 60	4 09	3 63	5 39
161	2 78	4 36	3 95	5 96
185	2 90	4 49	4 11	6 22

Temp 98–100°

1	1 13	0 78	1 15	1 27
2	1 99	1 74	2 56	2 86
4	3 46	3 31	4 55	5 06
16	10 09	11 37	13 15	15 56
20	12 20	13 72	15 59	19 41
24	14 37	16 49	17 96	23 29
36	17 38	23 27	22 07	31 73
42	18 79	26 30	24 62	35 29
54	20 94	31 39	29 49	42 11
59½	21 64	33 12	30 64	44 43

The solution contained the given amounts of Fe as iron alum, the sp gr of the HCl was 1.178, and the solutions diluted to 125 cc (McCaughy, J Am Chem Soc 1909, 31 1263)

The solvent action of ferric salt occurs even in presence of a ferrous salt, but decreases with increase of concentration of ferrous salt (McCaughy)

Solubility of thin sheet Au in HCl solution of  $\text{CuCl}_2$

Time hours	Mg Au dissolved			
	1 g Cu 25 cc HCl	1 g Cu 50 cc HCl	2 g Cu 25 cc HCl	2 g Cu 50 cc HCl

Temp 38-43°

19	0 03	0 26	0 05	0 39
25	0 09	0 36	0 05	0 54
43	0 10	0 54	0 14	0 94
49½	0 12	0 61	0 15	1 07
66½	0 11	0 76	0 17	1 40
78	0 14	0 87	0 22	1 58
91	0 14	0 92	0 24	1 75
102	0 16	1 02	0 27	1 90
139	0 18	1 34	0 32	2 45
163	0 23	1 60	0 39	2 84

Temp 98-100°

1	0 15	0 34	0 17	0 46
4	0 55	1 23	0 55	1 35
16	1 34	5 00	2 12	8 80
20	1 63	6 57	2 78	11 86
26	2 17	9 13	3 59	15 70
38	3 13	13 98	5 07	23 14
43	3 61	16 54	5 77	26 62
48	4 07	19 26	6 26	30 80
60	4 82	26 37	7 47	39 09

Conditions the same as above for HCl+iron alum (McCaughy)

Finely powdered gold is sol in conc HCl in the presence of alcohol, etc

0.0302 g Au is sol in 100 cc HCl+100 cc  $\text{CH}_3\text{OH}$

0.0230 g Au is sol in 100 cc HCl+100 cc  $\text{CHCl}_3$

0.0066 g Au is sol in 100 cc HCl+100 cc  $\text{C}_2\text{H}_5\text{OH}$

0.0190 g Au is sol in 100 cc HCl+100 cc  $\text{C}_3\text{H}_7\text{OH}$

0.0125 g Au is sol in 100 cc HCl+50 cc  $\text{CCl}_3\text{CH}(\text{OH})_2$

(Awerkiew, C C 1908, II 1566)

Solubility of Au which has been pptd from  $\text{AuCl}_3+\text{Aq}$  by various precipitants in HCl+formaldehyde

HCHO (40%) ccm	HCl (1.19) ccm	Au dissolved g	Au used was pptd from $\text{AuCl}_3+\text{Aq}$ by
150	150	0 0007	$\text{FeSO}_4$
100	100	0 0006	"
125	25	0 0008	"
100	200	0 0009	sugar
150	150	0 0003	oxalic acid
250	250	0 0002	"
500	500	0 0008	$\text{FeSO}_4$
100	500	0	oxalic acid
100	200	0 0004	"
100	200	0	"
150	300	0 0006	sugar
250	125	0 001	"
150	75	0 0013	$\text{FeSO}_4$
100	200	0 0008	"
100	200	0 0006	HCHO
100	100	0 0005	"
180	540	0	
360	720	0 001	$\text{FeSO}_4$
360	720	0 0019	sugar
209	400	0 0013	$\text{FeSO}_4$

In the last four cases the solubility was determined at the ordinary temp, in the first sixteen the gold was boiled with the mixture of HCl and HCHO

(Awerkiew, Z anorg 1909, 61 3)

Solubility of Au in boiling HCl+paraformaldehyde

$(\text{CH}_2\text{O})_3$ g	HCl (1.19) g	Dissolved Au g	Au used was pptd from $\text{AuCl}_3+\text{Aq}$ by
5	25	0 0005	$\text{FeSO}_4$
5	25	0 0004	oxalic acid
25	125	0 006	sugar
20	400	0 0024	$\text{CHOH}$
20	400	0 0034	$\text{CH}_2\text{OH}$
20	400	0 003	"
20	400	0 0065	sugar
20	400	0 0044	formic acid
20	400	0 0005	"
40	400	0 001	$\text{CH}_3\text{OH}$
20	300	0 0024	$\text{FeSO}_4$
20	300	0 003	"
10	200	0 0008	$\text{CH}_3\text{OH}$
10	200	0 0006	oxalic acid
60	120	0 0015	$\text{FeSO}_4$

(Awerkiew)

## Solubility of Au in boiling HCl+methyl alcohol

CH <sub>3</sub> OH (99%) ccm	HCl (1 19) ccm	Dissolved Au g	Au used was pptd from AuCl <sub>3</sub> +Aq by
100	100	0 0302	FeSO <sub>4</sub>
150	150	0 0043	oxalic acid
150	150	0 028	sugar
25	25	0 001	CH <sub>3</sub> OH
50	50	0 0002	oxalic acid
50	50	0 0005	CH <sub>3</sub> OH
50	50	0 0002	oxalic acid
50	50	0 0015	FeSO <sub>4</sub>
50	50	0 002	"
100	100	0 0009	oxalic acid
500	500	0 0128	FeSO <sub>4</sub>
1000	1000	0 0281	"
50	100	0 0084	"
100	200	0 0006	"
100	300	0	"
75	25	0 005	HCOH
90	30	0 005	"
75	25	0 0014	"
80	20	0 0005	"
100	50	0 0018	FeSO <sub>4</sub>
100	50	0 0008	CH <sub>3</sub> OH
50	200	0 001	"

(Awerkiew)

## Solubility of Au in boiling HCl+ethyl alcohol

C <sub>2</sub> H <sub>5</sub> OH (95%) ccm	HCl (1 19) ccm	Dissolved Au g	Au used was pptd from AuCl <sub>3</sub> +Aq by
25	50	0 0006	FeSO <sub>4</sub>
100	200	0 0111	"
200	400	0 0017	"
150	50	0 0003	sugar
100	300	0 0004	"
100	100	0 0015	"
200	200	0 0055	C <sub>2</sub> H <sub>5</sub> OH
250	250	0 0021	sugar
300	300	0 0197	FeSO <sub>4</sub>
1000	1000	0 007	CH <sub>3</sub> OH
150	150	0 008	"

(Awerkiew)

## Solubility of Au in boiling HCl+amyl alcohol

C <sub>5</sub> H <sub>11</sub> OH g	HCl (1 19) g	Dissolved Au g	Au used was pptd from AuCl <sub>3</sub> +Aq by
100	100	0 019	FeSO <sub>4</sub>
100	200	0 0048	"
150	150	0 0024	sugar
100	100	0 0027	"
150	50	0 0032	"
300	100	0 0023	FeSO <sub>4</sub>
200	200	0 0067	C <sub>5</sub> H <sub>11</sub> OH
500	500	0 028	FeSO <sub>4</sub>

(Awerkiew)

## Solubility of Au in boiling HCl+phenol

C <sub>6</sub> H <sub>5</sub> OH g	HCl (1 19) g	Dissolved Au g	Au used was pptd from AuCl <sub>3</sub> +Aq by
10+25	100	0 001	C <sub>6</sub> H <sub>5</sub> OH
10	40	0 0004	oxalic acid
20	50	0 0003	"
25	100	0 0005	FeSO <sub>4</sub>
25	150	0	HCOH
50	200	0 0005	"
25	250	0 0005	FeSO <sub>4</sub>
25	250	0 0012	"

(Awerkiew)

## Solubility of Au in boiling HCl+chloroform

CHCl <sub>3</sub> g	HCl (1 19) g	Dissolved Au g	Au used was pptd from AuCl <sub>3</sub> +Aq by
50	100	0 0009	FeSO <sub>4</sub>
100	100	0 023	"
100	100	0 0017	"
150	50	0 0012	"
200	400	0 0024	sugar
250	250	0 002	"
300	300	0 0106	"

(Awerkiew)

Colloidal gold is sol in dil alkalis (Paal, B 1902, 35 2236)

Rather quickly sol in 10-15% solution I in KI+Aq

Very slowly sol in 5% solution of I in KI+Aq

Scarcely sol in more dil solution of I in KI+Aq

Easily sol in 10% NH<sub>4</sub>I+I Less easily sol in 5% NH<sub>4</sub>I+I (Doring)

Sol in cold Na<sub>2</sub>S+Aq when Na<sub>2</sub>S is present in proportion of 843 pts Na<sub>2</sub>S to 1 pt Au (Becker, Sil, Am J (3) 33 199)

In finely divided state Au is sol in boiling KCN+Aq Not attacked by boiling HgCl<sub>2</sub>+Aq (Vogel, J pr 20 366)

Solubility of Au (disks) in KCN+Aq with  
(A) oxygen passed through solution, and  
(B) agitated with oxygen

% KCN	g Au dissolved in 24 hours	
	A	B
1	0 00845	0 0187
5	0 01355	0 0472
20	0 0115	0 0314
50	0 00505	0 108

(Maclaurin, Chem Soc 1893, 63 729)

The solution of Au in KCN+Aq is essentially hastened by sunlight (Caldecott, Proc Chem Soc 1904, 20 199)

The presence of oxygen is necessary for the solution of Au in KCN+Aq. The rate of solution of Au in KCN+Aq varies with the strength of the solution, being small for conc solutions, increasing as the solution becomes more dilute, reaching a maximum at 0.25% KCN, and then again diminishing (Maclaurin, Chem Soc 1895, 67 211)

## Solubility of Au (strips) in dil KCN+Aq

% KCN	Mg Au dissolved in 24 hours
0	0 010
0 0005	0 043-0 07
0 001	0 10-0 23
0 0016	0 16
0 002	0 44
0 00325	1 77
0 004	4 29
0 008	48 43
0 016	74 96
0 0325	150 54
0 065	168 12

(Christy, Elektrochem Z 1901, 7 205)

Finely divided metallic gold is completely sol at the ord temp in solutions of potassium ferrocyanide. Solution takes place very slowly even when the potassium ferrocyanide solution is boiling (Beutel, Z anorg 1912, 78 158)

Sol in  $\text{RbCl}_4$ +Aq (Erdmann, Arch Pharm 1894, 232, 30)

Not attacked by  $\text{FeCl}_3$ +Aq when air is excluded but very energetically attacked in presence of HCl and oxygen (McIlhiney, Am J Sci, 1896, (4), 2 293)

Not attacked by several days heating with  $\text{SOCl}_2$  at  $150^\circ$ . At  $200^\circ$  there is action in 10 days (North, J Am Chem Soc 1912, 34 892)

$\text{SO}_2\text{Cl}_2$  in excess dissolves pulverulent Au by several hours heating at  $160^\circ$  (North, Bull Soc (4), 9 647)

Sol in  $\text{PCl}_3$  (Baudrimont, A ch (4) 2 416)

Easily sol in acid solutions of thiocarbamide especially in presence of suitable oxidizing compounds (Morr, Chem Soc 1906, 89 1345)

Gold arsenide,  $\text{AuAs}$ 

$\text{H}_2\text{O}$  or alcohol slowly extracts As,  $\text{HNO}_3$ +Aq converts into Au and  $\text{H}_3\text{AsO}_4$ . Sol in aqua regia. Not attacked by cold, decomp by hot conc  $\text{H}_2\text{SO}_4$  (Tivoli, C C 1887 778, J B 1887 610)

Gold bismuthide,  $\text{Au}_3\text{Bi}$ 

Min Maldonite Sol in aqua regia

Aurous bromide,  $\text{AuBr}$ 

Insol in  $\text{H}_2\text{O}$  (Thomsen, C C 1860 606)

Insol in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$

Sol in  $\text{NH}_4\text{OH}$ +Aq with decomp

Decomp by HBr and KBr+Aq Sol in KCN+Aq without decomp Slowly decomp by alcohol, ether, acetone and moist  $\text{CHCl}_3$  (Lengfeld, Am Ch J 1901, 26 325)

Gold (auroauric) bromide,  $\text{Au}_2\text{Br}_4$ 

Not deliquescent  $\text{H}_2\text{O}$  or ether dissolves out  $\text{AuBr}_3$  (Thomsen, C C 1860 606)

Does not exist (Kruss, B 20 640)

Existence is maintained by Petersen (J pr (2) 46 334)

Auric bromide,  $\text{AuBr}_3$ 

Not deliquescent Slowly sol in  $\text{H}_2\text{O}$ , more readily in ether

Can be recryst from  $\text{AsBr}_3$ ,  $\text{SbBr}_3$ ,  $\text{TiBr}_3$  or  $\text{SnBr}_2$  (Lindet, Bull Soc 1886, (2) 45 149)

Sol in methyl acetate (Naumann, B 1909, 42 3790)

Aurous phosphorus tribromide,  $\text{AuBr}$ ,  $\text{PBr}_3$ 

Decomp by  $\text{H}_2\text{O}$  (Lindet, J pr (2) 32 494)

Auric phosphorus pentabromide,  $\text{AuBr}_3$ ,  $\text{PBr}_5$ 

Decomp by  $\text{H}_2\text{O}$  (Lindet)

Aurous bromide phosphorus trichloride,  $\text{AuBr}$ ,  $\text{PCl}_3$ 

Decomp by  $\text{H}_2\text{O}$  (Lindet)

## Auric praseodymium bromide,

$\text{PrBr}_3$ ,  $\text{AuBr}_3$ + $10\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , sol in conc HBr (Von Schule, Z anorg 1898, 18 355)

## Aurous bromide ammonia,

$\text{AuBr}$ ,  $2\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  and dil HCl

Sol in aqua regia (Meyer, C R 1906, 143 281)

Gold carbide,  $\text{Au}_2\text{C}_2$ 

Ppt Decomp by boiling  $\text{H}_2\text{O}$  without evolution of  $\text{C}_2\text{H}_2$  Decomp by HCl with evolution of  $\text{C}_2\text{H}_2$  (Mathews, J Am Chem Soc 1900, 22 110)

Aurous chloride,  $\text{AuCl}$ 

Insol in  $\text{H}_2\text{O}$ , but gradually decomp thereby into Au and  $\text{AuCl}_3$  (Thomsen, J pr (2) 13 341)

Insol in  $\text{H}_2\text{O}$  and dil  $\text{HNO}_3$

Decomp by conc  $\text{HNO}_3$  to Au and  $\text{AuCl}_3$

Sol in HCl, HBr and in sol of alkali chloride and bromides, with decomp

Decomp by alcohol, ether and acetone (Lengfeld, Am Ch J 1901, 26 324)

**Gold (auric) chloride,  $\text{AuCl}_3$** 

Deliquescent Very sol in  $\text{H}_2\text{O}$  Sol in 147 pts  $\text{H}_2\text{O}$  (Abl) Sol in conc  $\text{HCl}$ , or  $\text{HNO}_3$ +Aq without decomp

$\text{AsCl}_3$  dissolves about 22% at  $160^\circ$  and 2.5% at  $15^\circ$  Solubility in  $\text{SbCl}_3$  is about the same Much less sol in  $\text{SnCl}_4$  or  $\text{TiCl}_4$ ,  $\text{SnCl}_4$  dissolving 4% at  $160^\circ$  and hardly a trace at  $0^\circ$  Very sl sol in hot or cold  $\text{SiCl}_4$  (Lindet, Bull Soc (2) 45 149)

Sl sol in liquid  $\text{NH}_3$  (Franklin and Kraus, Am Ch J 1898, 20 829)

Sol in alcohol with gradual decomp (Gmelin) Sol in ether with decomp in light or on long standing Ether extracts  $\text{AuCl}_3$  from  $\text{AuCl}_3$ +Aq (Proust) Sol in volatile oils with gradual decomp

Sol in ether (Myhus, Z anorg 1911, 70 207)

Very sol in ether (Willstätter, B 1903, 36 1830)

Completely sol in ether (Frank, C C 1913, II 541)

Insol in or decomp by alcohol, ether,  $\text{CS}_2$ ,  $\text{C}_6\text{H}_6$ , oil of turpentine, pentane, hexane,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , ethyl nitrate, nitrobenzol, ethyl acetate, ethyl propionate and pyridine (Lenher, J Am Chem Soc 1903, 25 1138)

+ $2\text{H}_2\text{O}$  (Thomsen)

**Auroauric chloride,  $\text{Au}_2\text{Cl}_4$** 

Decomp by  $\text{H}_2\text{O}$  into  $\text{AuCl}_3$  and  $\text{AuCl}$  (Thomsen, J pr (2) 13 357)

Does not exist (Kruss and Schmidt, J pr (2) 38 77)

Existence is maintained by Christensen (J pr (2) 46 323)

**Auric chloride with  $\text{MCl}$** 

See Chloraurate, M

**Auric nitrosyl chloride,  $\text{AuCl}_3$ ,  $\text{NOCl}$** 

Sol in  $\text{H}_2\text{O}$  with decomp (Sudborough, Chem Soc 59 662)

**Aurous phosphorus trichloride,  $\text{AuCl}$ ,  $\text{PCl}_3$** 

Decomp by  $\text{H}_2\text{O}$  Sol in about 100 pts  $\text{PCl}_3$  at  $15^\circ$ , and about 8 pts at  $120^\circ$  Sol in  $\text{AsCl}_3$  (Lindet, C R 101 1492)

**Auric phosphorus pentachloride,  $\text{AuCl}_3$ ,  $\text{PCl}_5$** 

Decomp by  $\text{H}_2\text{O}$  Nearly insol in  $\text{PCl}_5$  Sol in  $\text{AsCl}_3$  (Lindet)

**Aurous potassium chloride,  $\text{AuCl}$ ,  $\text{KCl}$** 

Decomp by  $\text{H}_2\text{O}$  or  $\text{HCl}$ +Aq into  $\text{KCl}$ ,  $\text{KAuCl}_4$ , and  $\text{Au}$  (Berzelius)

**Auric potassium chloride**

See Chloraurate, potassium

**Auric selenium chloride,  $\text{AuCl}_3$ ,  $\text{SeCl}_4$** 

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{AsCl}_3$  (Lindet, C R 101 1492)

**Gold (aurous) sodium chloride,  $\text{AuCl}$ ,  $\text{NaCl}$** 

Insol in  $\text{H}_2\text{O}$  Sol in alcohol (Meillet, J Pharm 3 447)

Formula is  $4\text{NaCl}$ ,  $\text{AuCl}$ ,  $\text{AuCl}_3$  (Jørgensen)

**Auric sodium chloride**

See Chloraurate, sodium

**Auric sulphur chloride,  $\text{AuCl}_3$ ,  $\text{SCl}_4$** 

Easily decomp by  $\text{H}_2\text{O}$  (Lindet, C R 101 1492)

**Aurous chloride ammonia,  $\text{AuCl}$ ,  $\text{NH}_3$** 

Ppt Unstable (Diemer, J Am Chem Soc 1913, 35 554)

$\text{AuCl}$ ,  $3\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$  and dil acids

Sol in aqua regia Sol in conc  $\text{H}_2\text{SO}_4$  with decomp (Meyer, C R 1906, 143 282)

$\text{AuCl}$ ,  $12\text{NH}_3$  (Meyer)

**Auric fluoride,  $\text{AuF}_3$** 

Very unstable

Is incapable of existence not only in presence of  $\text{H}_2\text{O}$  but under the ordinary conditions met with in the laboratory and in nature (Lenher, J Am Chem Soc 1903, 25 1138)

**Auric hydroxide,  $\text{Au}_2\text{O}_3\text{H}_2$** 

Nearly insol in most acids Easily sol in very conc  $\text{HNO}_3$ +Aq (Proust), from which all  $\text{Au}_2\text{O}_3\text{H}_2$  is separated by dilution (Fremy) Extremely sl sol in fuming  $\text{HNO}_3$  Sol in dil  $\text{HNO}_3$ +Aq when pure (Kruss, A 237 281) Not attacked by  $\text{H}_3\text{PO}_4$  Insol in  $\text{HF}$  Sol in  $\text{HCl}$ , or  $\text{HBr}$ +Aq (Fremy)

Sol in  $\text{H}_2\text{SeO}_4$ +Aq (Mitscherlich)

Sl sol in conc  $\text{H}_2\text{SO}_4$ , somewhat sol in  $\text{HC}_2\text{H}_3\text{O}_3$ +Aq (Rose)

Nearly insol in cold  $\text{KOH}$ +Aq, but dissolved on boiling Insol in  $\text{NH}_4\text{OH}$ +Aq or alkali carbonates + Aq (Rose) Sl sol in boiling  $\text{CaCl}_2$ +Aq,  $\text{NaCl}$ +Aq,  $\text{BaCl}_2$ +Aq (Pelletier) Sol in  $\text{NH}_4\text{CN}$ , and  $\text{KCN}$ +Aq (Himly)

Sl sol in  $\text{KCl}$ , or  $\text{NaCl}$ +Aq (Pelletier) Sol in  $\text{K}_4\text{Fe}(\text{CN})_6$ +Aq at ord temp rapidly on boiling (Beutel, Z anorg 1912, 78 154)

$\text{AuO}$ ,  $\text{OH}=\text{Au}_2\text{O}_3$ ,  $\text{H}_2\text{O}$  (Kruss)

**Auroauric hydroxide,  $\text{Au}_3\text{O}_2(\text{OH})_2=3\text{Au}_2\text{O}_2+2\text{H}_2\text{O}$** 

Insol in boiling conc  $\text{KOH}$ +Aq Decomp by conc  $\text{HCl}$  or  $\text{HNO}_3$ +Aq into  $\text{Au}$  and  $\text{Au}_2\text{O}_3$ , which dissolves (Schottlander, A 217 336)

**Aurous iodide,  $\text{AuI}$** 

Insol in cold, decomp by hot  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3$ +Aq, with separation of  $\text{Au}$  Decomp immediately by ether, more slowly by alcohol

Partially sol in KI,  $\text{FeI}_3$ , or  $\text{HI} + \text{Aq}$  (Pelletier) Sl attacked by  $\text{NH}_4\text{OH}$ , or  $\text{NaCl} + \text{Aq}$  at  $35^\circ$  (Fordos) Instantly decomp by  $\text{KOH} + \text{Aq}$

#### Gold (auric) iodide, $\text{AuI}_3$

Insol in  $\text{H}_2\text{O}$  Sol in alkali iodides, and  $\text{HI} + \text{Aq}$  Decomp on air or by alkalis (Johnston, Phil Mag J 9 266)

#### Aurous iodide ammonia, $\text{AuI}, \text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  or dil acids (Meyer, C R 1906, 143 281)

Sol in aqua regia

$\text{AuI}, 6\text{NH}_3$  (Meyer)

#### Aurous oxide, $\text{Au}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  or alcohol Decomp by boiling with  $\text{HCl} + \text{Aq}$  into Au and  $\text{AuCl}_3$   $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  do not attack Sol in cold aqua regia Sol in  $\text{HI} + \text{Aq}$  Sol in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  when freshly precipitated (Berzelius)

According to Kruss (A 237 281) all hitherto prepared  $\text{Au}_2\text{O}$  is impure Pure  $\text{Au}_2\text{O}$  is sol in cold  $\text{H}_2\text{O}$  when freshly precipitated, from which hydroxide is precipitated by boiling Partly sol in  $\text{HCl}$ , or  $\text{HBr} + \text{Aq}$  Sol in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  when freshly precipitated Not affected by any other acid or solvent (Kruss)

The so-called solution of  $\text{Au}_2\text{O}$  in  $\text{H}_2\text{O}$  is in reality a colloidal suspension (Vanino, B 1905, 38 462)

#### Auric oxide, $\text{Au}_2\text{O}_3$

See Auric hydroxide

#### Auroauric oxide, $\text{Au}_2\text{O}_2$

Sol in cold  $\text{HCl} + \text{Aq}$  forms insol comp with  $\text{HF}$  (Piat, C R 70 842)

Obtained pure by Kruss (A 237 296)

#### Gold phosphide, $\text{Au}_4\text{P}_6$

Not attacked by  $\text{HCl} + \text{Aq}$   $\text{HNO}_3$  forms  $\text{H}_3\text{PO}_4$  and leaves undissolved Au (Schrotter, J B 1849 247)

$\text{AuP}$  Decomp on air or with  $\text{H}_2\text{O}$  (Cavazzi, Gazz ch it 15 40)

$\text{Au}_3\text{P}_4$  Readily attacked by aqua regia or  $\text{Cl}_2 + \text{Aq}$  (Granger, C R 1897, 124 498)

#### Gold purple (mixture of Au and $\text{SnO}_2$ )

Insol in  $\text{H}_2\text{O}$  Easily sol in aqua regia  $\text{HCl} + \text{Aq}$  dissolves all Sn and leaves Au

Boiling  $\text{HNO}_3 + \text{Aq}$  dissolves a little Sn

Insol in boiling  $\text{KOH} + \text{Aq}$  (Berzelius)  $\text{KOH} + \text{Aq}$  extracts excess of  $\text{SnO}_2$ , and the residue becomes sol in  $\text{H}_2\text{O}$ , from which it is pptd by  $\text{NH}_4\text{Cl} + \text{Aq}$  (Figuer, A ch (3) 11 353)

Sol, when still moist, in  $\text{NH}_4\text{OH} + \text{Aq}$ , but insol if it has been dried

Obtained in colloidal state in aqueous solution containing 0.58 g Au and 5.41 g  $\text{SnO}_2$

in a litre This solution may be concentrated without coagulation The solution is coagulated by dil  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ , more easily by dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ , also by  $\text{KCl}$ ,  $\text{HgCl}_2$ ,  $\text{FeSO}_4 + \text{Aq}$ , and many other salts Not coagulated by alcohol, but easily when ether is added to the alcohol (Schneider, Z anorg 5 80)

#### Gold (auric) selenide, $\text{Au}_2\text{Se}_3$

$\text{HNO}_3 + \text{Aq}$  dissolves out Se Sol in aqua regia or alkali sulphides + Aq (Uelsmann, J B 1860 90)

#### Aurous sulphide, $\text{Au}_2\text{S}$

Easily sol in  $\text{H}_2\text{O}$  when freshly prepared, but precipitated from aqueous solution by  $\text{HCl}$ ,  $\text{KCl}$ , or  $\text{NaCl} + \text{Aq}$  When dried is insol in  $\text{H}_2\text{O}$

Insol in boiling dil or conc  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  Easily sol in aqua regia,  $\text{HCl} + \text{Aq}$  with  $\text{KClO}_4$ , etc Slowly sol in alkali monosulphides + Aq Easily sol in polysulphides + Aq

Insol in  $\text{KOH} + \text{Aq}$  Sol in  $\text{KCN} + \text{Aq}$  (Kruss, B 20 2369)

Known also in colloidal state in aqueous solution containing 1.74 g  $\text{Au}_2\text{S}$  per l (Schneider, B 24 2241)

#### Auric sulphide, $\text{Au}_2\text{S}_3$

Insol in  $\text{H}_2\text{O}$  and acids except aqua regia, sol in alkali sulphides, or  $\text{KOH} + \text{Aq}$  (Berzelius)

Does not exist (Kruss, B 22 2369), but has since been made by Antony and Lucchesi (Gazz ch it 20 601) Insol in  $\text{HCl}$ , or dil  $\text{HNO}_3 + \text{Aq}$  Decomp by conc  $\text{HNO}_3$ ,  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  with separation of Au Sl decomp by  $\text{NH}_4\text{OH} + \text{Aq}$  Easily sol in  $\text{KCN} + \text{Aq}$ , decomp by  $(\text{NH}_4)_2\text{S} + \text{Aq}$  Sol in cold  $\text{Na}_2\text{S}$  or  $\text{K}_2\text{S} + \text{Aq}$ , decomp on boiling (Antony and Lucchesi, Gazz ch it 21, 2 209)

Insol in ether (Hofmann, B 1904, 37 246)

#### Auroauric sulphide, $\text{Au}_2\text{S}_2$

Insol in  $\text{H}_2\text{O}$  or acids except aqua regia Sl sol in cold alkali monosulphides + Aq, but easily sol on warming Sol in cold polysulphides + Aq, but less in ammonium polysulphide than the other alkali polysulphides

Not attacked by cold, but easily sol in hot  $\text{KOH} + \text{Aq}$  Sol in  $\text{KCN} + \text{Aq}$  (Hoffmann and Kruss, B 20 2704)

Obtained also in colloidal state in aqueous solution containing 0.8 g per l (Schneider)

Insol in  $\text{Na}_2\text{S} + \text{Aq}$  sat with S (Ditte, A ch 1907, (8) 12 273)

#### Aurous potassium sulphide, $\text{Au}_2\text{S}, 3\text{K}_2\text{S}$

(Antony and Lucchesi, Gazz ch it 1896, 26 (2) 350)



$\text{Au}_2\text{S}_3, 4\text{K}_2\text{S} + 12\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$   
(Ditte, C R 1895, 120 322)

**Gold silver sulphide,  $\text{Ag}_3\text{AuS}_2$**

Ppt (Lucchesi, Gazz ch it 1896, 26 350-53)

**Aurous sodium sulphide,  $\text{NaAuS} + 4\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  and alcohol (Yorke, Chem Soc Q J 1 236)

$+5\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Ditte, C R 1895, 120 321)

$\text{Na}_3\text{AuS}_2$  Sol in  $\text{H}_2\text{O}$  (Lucchesi, Gazz ch it 1896, 26 350-53)

$\text{Au}_2\text{S}_3, 2\text{Na}_2\text{S} + 20\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$   
(Ditte, C R 1895, 120 321)

**Gold telluride**

Ppt (Berzelius, Pogg 8 178)

**Gold silver telluride,  $\text{Au}_2\text{Te}_2, \text{Ag}_2\text{Te}$**

Min *Sylvanite* Sol in  $\text{HNO}_3 + \text{Aq}$  with separation of Au, in aqua regia with separation of AgCl

$3\text{Ag}_2\text{Te}, \text{Au}_2\text{Te}$  Min *Petzite* |

**Hartshorn, salts of**

See Carbonate carbamate, ammonium hydrogen

of absorption for  $\text{H}_2\text{O}$  at  
(Ramsay, Z phys Ch 1906,

Absorption of helium by  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm pressure

$t^\circ$	Coefficient of absorption
0	0 01500
0 5	0 01487
5	0 01460
10	0 01442
15	0 01396
20	0 01386
25	0 01371
30	0 01382
35	0 01380
40	0 01387
45	0 01403
50	0 01404

(Estreicher, Z phys Ch 1899, 31 184)

Absorption by  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Coefficient of absorption
0	0 0134
10	0 0100
20	0 0138
30	0 0161
40	0 0191
50	0 0226

(Antropoff, Roy Soc Proc 1910, 83 A 480)

Completely insol in benzene and in alcohol  
(Ramsay, Chem Soc 1895, 67 684)

**Hexamine chromium compounds**

See Luteochromium compounds

**Hexamine cobaltic compounds,**

$\text{Co}_2(\text{NH}_3)_6\text{X}_3$

See Dichrochromic compounds

$\text{Co}(\text{NH}_3)_6\text{X}_3$

See Luteocobaltic compounds

**Hexamine iridium chloride,  $\text{Ir}_2(\text{NH}_3)_6\text{Cl}_6$**

See Iridotriamine chloride

**Hexathionic acid,  $\text{H}_2\text{S}_6\text{O}_6$**

Known only in aqueous solution, which decomposes rapidly, even in presence of free sulphuric acid (Debus, A 244 76)

**Potassium hexathionate,  $\text{K}_2\text{S}_6\text{O}_4$**

Sol in  $\text{H}_2\text{O}$ , with rapid decomp Not obtained in pure state (Debus, A 244 76)

**Holmium, Ho**

**Holmium oxide,  $\text{Ho}_2\text{O}_3$**

(Cleve, C R 89 478, 91 328)

Consists of at least two elements (Lecoq de Boisbaudran, C R 102 1005)

Consists of seven elements (Kruss and Nilson)

**Sesquihydraurylamine,  $(\text{AuOH})_3\text{N}, \text{NH}_3 = \text{Au}_3\text{N}_2 + 3\text{H}_2\text{O}$**

Decomp by boiling with  $\text{H}_2\text{O}$  (Raschig, A 235 341)

**Hydrazidophosphoric acid**

**Barium hydrazidophosphate,**

$\text{OP}(\text{N}_2\text{H}_3)_2\text{O}_2\text{Ba}$

(Ephraim, B 1911, 44 3420)

**Lead hydrazidophosphate,  $\text{OP}(\text{N}_2\text{H}_3)_2\text{O}_2\text{Pb}$**

Easily sol in  $\text{HNO}_3$  (Ephraim)

**Potassium hydrazidophosphate,**

$\text{OP}(\text{N}_2\text{H}_3)_2(\text{OK})_2$  (Ephraim)

**Sodium hydrazidophosphate,**

$\text{OP}(\text{N}_2\text{H}_3)_2(\text{ONa})_2$

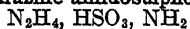
Can be cryst from dil alcohol (Ephraim)

**Hydrazine,  $\text{N}_2\text{H}_4 = \text{NH}_2 - \text{NH}_2$**

Very sol in  $\text{H}_2\text{O}$  (Curtius, B 20 1632)

Very hygroscopic, decomp by  $\text{H}_2\text{O}$ , solvent for sulphur, KCl, KBr,  $\text{KNO}_3$  (de Bruyn, R t c 1894, 13 433-40, Chem Soc 1895, 68 (2) 347)

Mixes in all proportions with alcohols, sl sol in organic solvents (Lobry de Bruyn, Chem Soc 1897, 72 (2) 22)

**Hydrazine amidosulphonate,**

Very sol in  $\text{H}_2\text{O}$  (Sabanejeff, Z anorg 1899, 20 22)

**Hydrazine azouimide,  $\text{N}_2\text{H}_4, \text{HN}_3$** 

Deliquescent Easily sol in  $\text{H}_2\text{O}$  Sl sol in alcohol, and can be crystallised therefrom (Curtius, B 24 2344)

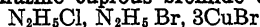
**Hydrazine borate,  $(\text{N}_2\text{H}_4)_2(\text{B}_2\text{O}_3)_3$** 

Sol in  $\text{H}_2\text{O}$  (Dschawachow, C C 1902, I 1394)

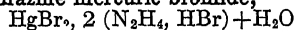
$(\text{N}_2\text{H}_4)_3(\text{H}_2\text{B}_2\text{O}_7)_2$  Sol in  $\text{H}_2\text{O}$  (Dschawachow, C C 1902, I 1394)

+5 $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Dschawachow, C C 1902 I 1394)

+10 $\text{H}_2\text{O}$  Ppt (Dschawachow, C C 1902 I 1394)

**Hydrazine cuprous bromide chloride,**

(Ranfaldi, Real Ac Linc 1906 (5) 15, II, 95)

**Hydrazine mercuric bromide,**

Very sol in  $\text{H}_2\text{O}$ , sol in alcohol and acetone Sl sol in acetic ether

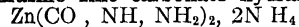
Insol in alcohol ether (Ferratin, C A 1912 1612)

**Hydrazine zinc bromide,  $2\text{N}_2\text{H}_4\text{HBr}, \text{ZnBr}_2 + \text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$ , sol in alcohol and acetone (Ferratin, C A 1912 1612)

**Hydrazine carbonate**

Very deliquescent, but only sl sol in  $\text{H}_2\text{O}$  Sl sol in alcohol (Curtius and Jay, J pr 1889, (2) 39 41)

**Hydrazine zinc carbonate hydrazine,**

Easily sol in  $\text{H}_2\text{O}$  (Ebler and Schott, J pr 1909, (2) 79, 72)

**Hydrazine chlorate,  $\text{N}_2\text{H}_4, \text{HClO}_3$** 

Very sol in  $\text{H}_2\text{O}$ , sl sol in alcohol Insol in ether,  $\text{CHCl}_3$  and benzol (Salvadori, Gazz ch it 1907, 37, (2) 32)

**Hydrazine dichlorate,  $\text{N}_2\text{H}_4, 2\text{HClO}_3$** 

Ppt Decomp in aq solution (Luricentine, J Am Chem Soc 1915, 37 1123)

**Hydrazine cupric chloride,  $\text{N}_2\text{H}_4\text{Cl}, \text{CuCl}_2 + \frac{1}{2}\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  (Ranfaldi, Real Ac Linc 1906, (5) 15, II 95)

+2 $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Ranfaldi)

**Hydrazine mercuric chloride,  $\text{N}_2\text{H}_4\text{Cl}, \text{HgCl}_2$** 

(Hoffmann and Marburg, A 1899, 305 221)

**Hydrazine dithionate,  $\text{N}_2\text{H}_4, \text{H}_2\text{S}_2\text{O}_6$** 

Sol in  $\text{H}_2\text{O}$ , decomp on standing in aq solution (Sabanejeff, Z anorg 1899, 20 21)

$2\text{N}_2\text{H}_4, \text{H}_2\text{S}_2\text{O}_6$  Sol in  $\text{H}_2\text{O}$  (Sabanejeff)

**Hydrazine fluosilicate,  $\text{N}_2\text{H}_4, \text{H}_2\text{SiF}_6$** 

Easily sol in  $\text{H}_2\text{O}$

Difficultly sol in ethyl and methyl alcohol (Ebler, J pr 1910, (2) 81 552)

**Hydrazine fluotitanate,  $(\text{N}_2\text{H}_4)_2, \text{H}_2\text{TiF}_6 + 2\text{H}_2\text{O}$** 

Ppt Sol in  $\text{H}_2\text{O}$  (Ebler, J pr 1910, (2) 81 555)

**Hydrazine monohydrobromide,  $\text{N}_2\text{H}_4, \text{HBr}$** 

Very easily sol in  $\text{H}_2\text{O}$  or hot alcohol (Curtius and Schultz, J pr (2) 42 537)

**Hydrazine dihydrobromide,  $\text{N}_2\text{H}_4, 2\text{HBr}$** 

Easily sol in  $\text{H}_2\text{O}$  Sl sol in alcohol (Curtius and Schulz, J pr (2) 42 535)

**Hydrazine monohydrochloride,  $\text{N}_2\text{H}_4, \text{HCl}$** 

Extremely sol in  $\text{H}_2\text{O}$  Sl sol in boiling absolute alcohol (Curtius and Jay, J pr (2) 39 38)

**Hydrazine dihydrochloride,  $\text{N}_2\text{H}_4, 2\text{HCl}$** 

Easily sol in cold  $\text{H}_2\text{O}$ , sl sol in hot alcohol (Curtius, l c)

Sol in 2 67 pts  $\text{H}_2\text{O}$  at  $23^\circ$  Sp gr of sat solution at  $20^\circ/4^\circ = 1.4226$  (Schiff, Z phys Ch 1896, 21 292)

Sp gr of aqueous solution at  $20^\circ$

% salt	Sp gr
25	1.1183
20	1.0923
15	1.0675
10	1.0436
5	1.0206

(Schiff, Z phys Ch 1896, 21 292)

Nearly insol in hot absolute alcohol (Curtius and Jay, J pr (2) 39 37)

**Hydrazine dihydrofluoride,  $\text{N}_2\text{H}_4, 2\text{HF}$** 

Easily sol in  $\text{H}_2\text{O}$  Nearly insol in alcohol (Curtius and Schulz, J pr (2) 42 533)

**Hydrazine monohydroiodide,  $\text{N}_2\text{H}_4, \text{HI}$** 

Easily sol in  $\text{H}_2\text{O}$  (Curtius and Schulz)

**Hydrazine dihydroiodide,  $\text{N}_2\text{H}_4, 2\text{HI}$** 

Very deliquescent Easily sol in  $\text{H}_2\text{O}$  Sl sol in alcohol (Curtius and Schulz, J pr (2) 42 536)

**Trihydrazine dihydroiodide**,  $3N_2H_4, 2HI$ 

Easily sol in  $H_2O$  and alcohol (Curtius and Schulz, J pr (2) 42 540)

**Hydrazine hydroxide**,  $N_2H_4, H_2O$ 

Miscible with  $H_2O$  or alcohol, but not with ether, chloroform, or benzene (Curtius and Schulz, J pr (2) 42 530)

**Hydrazine hypophosphate**,  $N_2H_4, H_4P_2O_6$ 

Sl sol in  $H_2O$  15 pts dissolve in 100 pts  $H_2O$  (Sabanejeff, Z anorg 1898, 17 490)

**Hydrazine hypophosphate ammonia**,

$N_2H_4, H_4P_2O_6, NH_3$   
Sol in  $H_2O$  (Sabanejeff, Z anorg 1899, 20 23)

**Hydrazine mercuric iodide**,

$2N_2H_4I, HgI_2 + H_2O$   
Very sol in  $H_2O$ , alcohol, acetone, acetate ether  
Insol in ether Excess of  $H_2O$  decomp (Ferratin, Gazz ch it 1912, 42 (1), 172)

**Hydrazine zinc iodide**,

$ZnI_2, 2N_2H_4, HI + \frac{1}{2}H_2O$   
Very sol in  $H_2O$ , sol in alcohol and acetone (Ferratin, C A 1912 1612)

**Hydrazine nitrate**,  $N_2H_4, HNO_3$ 

Very sol in  $H_2O$ , sl sol in abs alcohol (Sabanejeff, Z anorg 1899, 20 24)

Solubility in  $H_2O$  at  $t^\circ$

$t^\circ$	g $N_2H_4, HNO_3$ per 100 g	
	Sat solution	$H_2O$
10	63 63	174 9
15	68 47	217 2
20	72 70	266 3
25	76 61	327 5
30	80 09	402 2
35	83 06	490 3
40	85 86	607 2
45	88 06	737 6
50	91 18	1034
55	93 58	1458
60	95 51	2127

(Sommer, Z anorg 1914, 86 85)

 **$N_2H_4, 2HNO_3$**  Very unstable

Sol in  $H_2O$  but solution cannot be concentrated beyond 30% without decomp

Decomp by abs alcohol

Very sol in hydrazine hydroxide + Aq (Sabanejeff, Z anorg 1898, 20 25)

**Hydrazine nitrite**,  $N_2H_4, HNO_2$ 

Very sol in  $H_2O$  Pptd by ether from solution in alcohol, insol in ether

Very hygroscopic (Sommer, Z anorg 1913, 83 125)

**Hydrazine perchlorate**,  $N_2H_4, HClO_4 + 2H_2O$ 

Sol in 148 pts  $H_2O$  at  $30^\circ$  and 34 pts alcohol, crystallizes from boiling absolute alcohol (Salvadori, Ch Z 31 680)

+  $3H_2O$

Solubility in  $H_2O$  at  $t^\circ$

$t^\circ$	% $N_2H_4, HClO_4$	Sp gr
18	41 72	1 264
35	66 9	1 391

(Carlson, Dissert 1910)

**Hydrazine diperchlorate**,  $N_2H_4, 2HClO_4 + 2H_2O$ 

Efflorescent

Deliquescent

102 pts salt sol in 100 pts  $H_2O$  at  $29^\circ$

2 8 pts salt sol in 100 pts alcohol

1 0 pt " " " 100 " ether

(Turrentine, J Am Chem Soc 1915, 37 1123)

**Hydrazine phosphate**,  $N_2H_4, H_3PO_4$ 

Very sol in  $H_2O$  (Sabanejeff, Z anorg 1898, 17 488)

$N_2H_4, 2H_3PO_4$  Sol in  $H_2O$  (Sabanejeff)

**Hydrazine phosphite**,  $N_2H_4, H_3PO_3$ 

Sol in  $H_2O$  (Sabanejeff, Z anorg 1898, 17 468)

**Hydrazine hydrogen phosphite**,

$N_2H_4, 2H_3PO_3$   
Less sol in  $H_2O$  than the normal salt (Sabanejeff)

**Hydrazine selenate**,  $N_2H_4, H_2SeO_4$ 

Sol in  $H_2O$  with decomp (Rimini, C C 1907, I 86)

**Hydrazine zinc selenate**,

$(N_2H_4)_2SeO_4, ZnSeO_4$   
Sl sol in  $H_2O$  but more sol than Cu salt (Rimini and Malagnini, Gazz ch it 1907, 37 (1), 265)

**Hydrazine sulphocyanide**,  $N_2H_4, HSCN$ 

Very deliquescent Sol in  $H_2O$  and alcohol (Curtius and Herdenreich, J pr 1895, [2] 52 488)

**Hydrazine sulphate**,  $N_2H_4, H_2SO_4$ 

Sol with difficulty in cold, easily in hot  $H_2O$  Insol in alcohol (Curtius, l c)

100 pts  $H_2O$  dissolve 3 055 pts salt at  $22^\circ$  (Curtius and Jay, J pr (2) 39 39)

$2N_2H_4, H_2SO_4$  Very deliquescent, and

sol in  $H_2O$  Insol in alcohol (Curtius, J pr (2) 44 101)

**Hydrazine sulphite**,  $(N_2H_4)_2H_2SO_3$   
(Sabanejeff, Z anorg 1899, 20, 24)

**Hydrazine pyrosulphite**,  $2N_2H_4, H_2S_2O_5$   
Sol in  $H_2O$  with decomp, insol in alcohol  
(Sabanejeff, Z anorg 1899, 20 23)

**Hydrazine thiosulphate**,  $(N_2H_4)_2H_2S_2O_3$   
Ppt (Not pure) (Ferratin, Gazz ch it 1912, 42 (1) 138)

**Hydrazine lead thiosulphate**,  
 $PbS_2O_3, 2(N_2H_4)_2H_2S_2O_3 + H_2O$   
Insol in  $H_2O$  and alcohol  
Sol in  $HCl + Aq$  and in  $HNO_3 + Aq$   
(Ferratin, C A 1912 1612)

**Hydrazine silver thiosulphate**,  
 $Ag_2S_2O_3, (N_2H_4)_2H_2S_2O_3$   
Insol in  $H_2O$ , sol in  $NH_4OH + Aq$  and in  
 $HNO_3$  (Ferratin)

**Hydrazine sulphinic acid**

**Barium hydrazine disulphate**,  
 $Ba_2N_2(SO_2)_2$   
Insol in  $H_2O$ , sol in acids (Ephraim,  
B 1911, 44 390)

**Hydrazinesulphonic acid**,  $N_2H_3SO_2OH$   
Sol in about 24 pts  $H_2O$  at ord temp De-  
comp by mineral acids, nearly insol in  
alcohol and other organic solvents (Traube,  
B 1914, 47 941)

**Ammonium hydrazinesulphonate**,  
 $(N_2H_3SO_3)NH_4$   
Deliquescent, decomp by acids (Traube)

**Barium hydrazinesulphonate**,  
 $(N_2H_3SO_3)_2Ba + 2H_2O$   
Sol in  $H_2O$ , pptd by alcohol, decomp by  
acids (Traube)

**Calcium hydrazinesulphonate**,  
 $(N_2H_3SO_3)_2Ca + H_2O$   
Sol in  $H_2O$  Decomp by acids Insol in  
alcohol (Traube)

**Potassium hydrazinesulphonate**,  $N_2H_3SO_3K$   
Decomp by acids (Traube)

**Silver hydrazinesulphonate**,  $N_2H_3SO_3Ag$   
(Traube)

**Sodium hydrazinesulphonate**,  
 $N_2H_3SO_3Na + H_2O$   
Decomp by acids (Traube)

**Strontium hydrazinesulphonate**,  
 $(N_2H_3SO_3)_2Sr + 2H_2O$

Sol in  $H_2O$  Decomp by acids Insol in  
alcohol (Traube)

**Hydriodic acid**, HI  
See Iodhydric acid

**Hydrobromic acid**, HBr  
See Bromhydric acid

**Hydrochloric acid**, HCl  
See Chlorhydric acid

**Hydrofluorboric acid**,  $HBF_4$   
See Fluoborhydric acid

**Hydrofluoric acid**, HF  
See Fluorhydric acid

**Hydrogen**,  $H_2$   
Sl absorbed by  $H_2O$

Sol in 150 pts  $H_2O$  1 vol  $H_2O$  absorbs 0.016 vol H  
Recently boiled  $H_2O$  absorbs 1.53% H (Henry 1803)  
100 vols  $H_2O$  at  $18^\circ$  absorb 4.6 vols H (de Saussure  
1814)

1 vol  $H_2O$  absorbs 0.0193 vol H at 760 mm  
and all temperatures between  $0^\circ$  and  $23.6^\circ$   
(Bunsen)

Later work does not confirm the above state-  
ment

Absorption of H by  $H_2O$  at t and 760 mm  
 $\beta$  = coefficient of absorption,  $\beta_1$  = "solu-  
bility" (see under Oxygen)

$t^\circ$	$\beta$	$\beta_1$
0	0.02153	0.02140
1	0.02134	0.02120
2	0.02115	0.02100
3	0.02097	0.02081
4	0.02079	0.02062
5	0.02061	0.02043
6	0.02044	0.02025
7	0.02027	0.02207
8	0.02010	0.01989
9	0.01994	0.01971
10	0.01978	0.01954
11	0.01962	0.01937
12	0.01947	0.01920
13	0.01932	0.01904
14	0.01918	0.01888
15	0.01903	0.01872
16	0.01889	0.01856
17	0.01876	0.01840
18	0.01863	0.01825
19	0.01850	0.01810
20	0.01837	0.01795
21	0.01825	0.01781
22	0.01813	0.01767
23	0.01802	0.01753
24	0.01791	0.01739
25	0.01780	0.01725
26	0.01770	0.01712

(Timofejeff, Z phys Ch 6 147)

Absorption of H by  $H_2O$  at  $t^\circ$  and 760 mm  
 $\beta$  = coefficient of absorption

$t^\circ$	$\beta$	$t^\circ$	$\beta$	$t^\circ$	$\beta$
0	0 0203	16	0 0182	32	0 0161
1	0 0202	17	0 0180	33	0 0160
2	0 0200	18	0 0179	34	0 0159
3	0 0199	19	0 0178	35	0 0157
4	0 0198	20	0 0177	36	0 0156
5	0 0196	21	0 0175	37	0 0155
6	0 0195	22	0 0174	38	0 0154
7	0 0194	23	0 0172	39	0 0153
8	0 0192	24	0 0171	40	0 0152
9	0 0191	25	0 0170	45	0 0149
10	0 0190	26	0 0168	50	0 0146
11	0 0189	27	0 0167	60	0 0144
12	0 0187	28	0 0166	70	0 0146
13	0 0186	29	0 0164	80	0 0149
14	0 0184	30	0 0163	90	0 0155
15	0 0183	31	0 0162	100	0 0166

(Bohr and Bock, W Ann 44 318)

Absorption of hydrogen by  $H_2O$  at  $t^\circ$  and 760 mm pressure  $\beta$  = coefficient of absorption  $\beta_1$  = "solubility" (see under Oxygen)

$t^\circ$	$\beta$	$\beta_1$
0	0 02148	0 02135
1	0 02126	0 02112
2	0 02105	0 02090
3	0 02084	0 02068
4	0 02064	0 02047
5	0 02044	0 02026
6	0 02025	0 02006
7	0 02007	0 01987
8	0 01989	0 01968
9	0 01972	0 01950
10	0 01955	0 01932
11	0 01940	0 01915
12	0 01925	0 01899
13	0 01911	0 01883
14	0 01897	0 01867
15	0 01883	0 01851
16	0 01869	0 01836
17	0 01856	0 01821
18	0 01844	0 01706
19	0 01831	0 01792
20	0 01819	0 01777
21	0 01805	0 01761
22	0 01792	0 01746
23	0 01779	0 01730
24	0 01766	0 01715
25	0 01754	0 01700
26	0 01742	0 01685
27	0 01731	0 01670
28	0 01720	0 01656
29	0 01709	0 01642
30	0 01699	0 01630
31	0 01692	0 01618
32	0 01685	0 01606
33	0 01679	0 01596
34	0 01672	0 01585
35	0 01666	0 01574

Absorption of hydrogen by  $H_2O$  at  $t^\circ$  and 760 mm pressure — *Continued*

$t^\circ$	$\beta$	$\beta_1$
36	0 01661	0 01564
37	0 01657	0 01554
38	0 01652	0 01544
39	0 01648	0 01535
40	0 01644	0 01525
41	0 01640	0 01515
42	0 01635	0 01504
43	0 01631	0 01493
44	0 01627	0 01482
45	0 01624	0 01475
46	0 01620	0 01460
47	0 01617	0 01449
48	0 01614	0 01437
49	0 01611	0 01425
50	0 01608	0 01413
52	0 01606	0 01392
54	0 01605	0 01369
56	0 01603	0 01343
58	0 01602	0 01316
60	0 01600	0 01287
62	0 01600	0 01256
64	0 01600	0 01223
66	0 01600	0 01188
68	0 01600	0 01150
70	0 01600	0 01109
72	0 01600	0 01065
74	0 01660	0 01017
76	0 01600	0 00966
78	0 01600	0 00912
80	0 01600	0 00853
82	0 01600	0 00790
84	0 01600	0 00723
86	0 01600	0 00652
88	0 01600	0 00575
90	0 01600	0 00494
92	0 01600	0 00407
94	0 01600	0 00315
96	0 01600	0 00216
98	0 01600	0 00111
100	0 01600	0 0000

(Winkler, B 24 99)

Critical  $t_c$ —232° (Natanson, Z phys Ch 1895, 17 43–48)

Coefficient of absorption for  $H_2O$  = 0 01750 at 25°, 0 01905 at 20°, 0 02059 at 15°, 0 02213 at 10°, 0 02366 at 5° (Braun, Z phys Ch 1900, 33 734)

Solubility in  $H_2O$  at 25° = 0 01926 (Geffcken, Z phys Ch 1904, 49 267)

Coefficient of absorption for  $H_2O$  = 0 01810 at 20 11° (Hufner, Z phys Ch 1907, 57 623)

Solubility in  $H_2O$  at 25° = 0 01962 (Drucker and Moles, Z phys Ch 1910, 75 417)

Coefficient of absorption for  $H_2O$  at 15° = 0 01892, at 20° = 0 01829 (Muller, Z phys Ch 1912, 81 493)

Solubility of hydrogen in water at 25°  
 S = Solubility calculated according to formula, for which see original article  
 P = Pressure

P	S	P	S
756	0 0199	1095	0 0195
757	0 0198	1097	0 0197
850	0 0200	1244	0 0202
877	0 0193	1252	0 0196
986	0 0194	1380	0 0196
992	0 0198	1393	0 0198

(Findlay, Chem Soc 1912, 101 1465)

Absorption by H<sub>2</sub>O at different pressures

P = Hg-pressure in metres

λ = coefficient of solubility

Table I Volume of the absorbing liquid = 32.32 ccm T = 19.5°

P	λ	P	λ
0 9010	0 01798	3 3926	0 01789
0 9967	0 01796	4 1405	0 01776
1 0809	0 01799	4 6629	0 01761
1 2133	0 01800	5 4705	0 01748
1 3711	0 01794	5 9580	0 01725
1 5448	0 01791	6 6507	0 01706
1 8002	0 01793	7 4548	0 01674
2 5208	0 01793	7 8783	0 01652
2 9971	0 01795	8 2439	0 01632

Table II Volume of the absorbing liquid = 32.007 ccm T = 23°

P	λ	P	λ
1 1154	0 01736	4 6220	0 01716
1 3758	0 01739	5 1130	0 01702
1 7416	0 01733	5 9702	0 01687
2 1712	0 01731	7 1920	0 01649
2 8724	0 01734	7 4493	0 01631
3 4115	0 01732	7 8696	0 01618
4 0229	0 01728	8 1913	0 01603

(Cassuto, Phys Zeit 1904, 5 235)

Absorption of H<sub>2</sub> by acids + Aq

M = content in gram-equivalents per liter

S = solubility (See under Oxygen)

Absorption of H<sub>2</sub> by HNO<sub>3</sub> + Aq

M	S 25°
0 741	0 01851
0 753	0 01868
1 22	0 01812
1 45	0 01782
2 09	0 01739
2 96	0 01690
3 18	0 01667
3 22	0 01633
4 13	0 01611
4 23	0 01589

(Geffcken, Z phys Ch 1904, 49 267)

Absorption of H<sub>2</sub> by HCl + Aq

M	S 25°
0 426	0 01875
0 432	0 01868
1 063	0 01789
1 602	0 01732
1 802	0 01699
1 928	0 01688
2 338	0 01652
2 438	0 01627
2 836	0 01606

(Geffcken)

Absorption of H<sub>2</sub> by  $\frac{\text{H}_2\text{SO}_4}{2}$  + Aq

M	S 25°
0 527	0 01869
0 562	0 01838
0 985	0 01780
1 122	0 01768
1 866	0 01642
1 905	0 01632
2 605	0 01575
3 045	0 01496
3 174	0 01456
3 962	0 01422
3 989	0 01402

(Geffcken)

Solubility of H<sub>2</sub> in H<sub>2</sub>SO<sub>4</sub> + Aq at 20°

% H <sub>2</sub> SO <sub>4</sub>	λ 20°
0	0 0208
35.82	0 00954
61.62	0 00708
95.6	0 01097

(Christoff, Z phys Ch 1906, 55 627)

Solubility of H<sub>2</sub> in colloidal ferric hydroxide solution is practically the same as its solubility in pure H<sub>2</sub>O

Solubility of H<sub>2</sub> in a solution containing 18.11 g Fe(OH)<sub>3</sub> per liter at 25° = 0.3085

Solubility of H<sub>2</sub> in a solution containing 18.309 g Fe(OH)<sub>3</sub> per liter at 25° = 0.3083

(Geffcken, Z phys Ch 1904, 49 299)

Absorption of H<sub>2</sub> by bases + Aq

M = content in gram-equivalents per liter

S = solubility (See under Oxygen)

Absorption of H<sub>2</sub> by KOH + Aq

M	S 25°
0 536	0 01658
0 715	0 01539
1 059	0 01378
1 056	0 01389
1 480	0 01195

(Geffcken, Z phys Ch 1904, 49 267)



Solubility in salt solutions  
C = concentration of the solution in terms of normal

$\alpha$  = coefficient of absorption

Absorption of hydrogen by  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $20^\circ$

P	C	$\alpha$
1 037	0 1308	0 01872
2 167	0 2765	0 01845
3 378	0 4363	0 01823
4 823	0 6333	0 01773
6 773	0 9069	0 01744
11 550	1 6308	0 01647

(Knopp, Z phys Ch 1904, 48 103)

Absorption of hydrogen by  $\text{KNO}_3 + \text{Aq}$  at  $20^\circ$

P	C	$\alpha$
1 244	0 1245	0 01835
2 094	0 2114	0 01818
4 010	0 4127	0 01785
5 925	0 6225	0 01743
7 742	0 8293	0 01667
13 510	1 5436	0 01436

(Knopp)

Absorption of hydrogen by  $\text{NaNO}_3 + \text{Aq}$  at  $20^\circ$

P	C	$\alpha$
1 041	0 1236	0 01839
2 192	0 2634	0 01774
4 405	0 5416	0 01694
6 702	0 8442	0 01518
12 637	1 7394	0 01300

(Knopp)

Absorption of hydrogen by  $\text{KCl} + \text{Aq}$  at  $20^\circ$

P	C	$\alpha$
1 089	0 1475	0 01823
2 123	0 2907	0 01757
4 070	0 5687	0 01661
6 375	0 9127	0 01531
7 380	1 0682	0 01472
13 612	2 1222	0 01255

(Knopp)

Absorption of H by  $\text{NaCl} + \text{Aq}$   
 $\alpha t^\circ$  = coefficient of absorption at  $t^\circ$

Percent of NaCl in the solution	$\alpha_{25}$	$\alpha_{20}$	$\alpha_{15}$	$\alpha_{10}$	$\alpha_0$
5 999	0 01353	0 01280	0 01640	0 01749	0 01839
5 506	0 01395	0 01532	0 01660	0 01769	0 01861
4 496	0 01429	0 01587	0 01714	0 01817	0 01920
3 798	0 01476	0 01623	0 01760	0 01876	0 01977
1 523	0 01603	0 01754	0 01896	0 02030	0 02155
1 250	0 01621	0 01771	0 01914	0 02052	0 02180

(Braun, Z phys Ch 1900, 33 735)

Absorption of H by  $\text{BaCl}_2 + \text{Aq}$   
 $\alpha t^\circ$  = coefficient of absorption at  $t^\circ$

Percent of $\text{BaCl}_2$ in the solution	$\alpha_{25^\circ}$	$\alpha_{20^\circ}$	$\alpha_{15^\circ}$	$\alpha_{10^\circ}$	$\alpha_0$
7 002	0 01455	0 01591	0 01715	0 01833	0 01937
6 453	0 01474	0 01605	0 01734	0 01857	0 01957
3 600	0 01562	0 01700	0 01839	0 01971	0 02089
3 291	0 01570	0 01719	0 01847	0 01983	0 02110

(Braun)

1 vol alcohol at  $t^\circ$  and 760 mm absorbs V vols H gas reduced to  $0^\circ$  and 760 mm

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	0 06925	9	0 06799	18	0 06690
1	0 06910	10	0 06787	19	0 06679
2	0 06896	11	0 06774	20	0 06668
3	0 06881	12	0 06761	21	0 06657
4	0 06867	13	0 06749	22	0 06646
5	0 06853	14	0 06737	23	0 06636
6	0 06839	15	0 06725	24	0 06621
7	0 06826	16	0 06713		
8	0 06813	17	0 06701		

(Bunsen's Gasometry, p 286)

One vol alcohol absorbs 0 06925—  
0 000148t + 0 000001 $t^2$  vols H at  $t^\circ$   
(Bunsen)

Solubility in alcohol + Aq at  $20^\circ$  and 760 mm

Wt % alcohol	Vol H <sub>2</sub> absorbed	Wt % alcohol	Vol H <sub>2</sub> absorbed
0	1 93	28 57	1 04
9 09	1 43	33 33	1 17
16 67	1 29	50	2 02
23 08	1 17	66 67	2 55

(Iubarsch, W Ann 1889, (2) 37 525)

Absorption of hydrogen by alcohol

t	Coeff of absorption	$t^\circ$	Coeff of absorption
0	0 0676	13 4	0 0705
6 2	0 0693	18 8	0 0740

(Timofeeff)

Solubility of H<sub>2</sub> in ethyl ether at  $t^\circ$

t	Solubility
0	0 1115
5	0 1150
10	0 1195
15	0 1257

(Christoff, Z phys Ch 1912, 79 459)

Coefficient of absorption in petroleum =  
0 0582 at  $20^\circ$ , and 0 0652 at  $10^\circ$  (Griewasz  
and Walfisz, Z phys Ch 1 70)



## Absorption of hydrogen by chloralhydrate + Aq at 20°

P	C	$\alpha$
4 911	0 310	0 01839
7 69	0 504	0 01802
14 56	1 030	0 01712
18 77	1 397	0 01653
29 50	2 530	0 01542
32 00	2 845	0 01518
38 42	3 770	0 01440
49 79	6 000	0 01353
60 12	9 120	0 01324
63 90	10 700	0 01307

(Knopp, Z phys Ch 1904, 48 103)

Absorption of H<sub>2</sub> by chloralhydrate + Aq $t^\circ$  = temp of the solution

P = % chloralhydrate in the solution

 $\beta t^\circ$  = coefficient of absorption at  $t^\circ$  $\beta 15^\circ$  = coefficient of absorption at 15°

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
15 0	10 0	0 01740	0 01740
16 4	16 1	0 01719	0 01737
15 8	33 35	0 01475	0 01484
15 0	39 4	0 01470	0 01470
15 6	51 0	0 01300	0 01306
16 2	60 8	0 01281	0 01230
15 5	70 7	0 01282	0 01287
15 0	79 0	0 01320	0 01320

$t^\circ$	P	$\beta t^\circ$	$\beta 20^\circ$
19 4	15 5	0 01732	0 01724
17 4	28 3	0 01569	0 01540
18 7	46 56	0 01388	0 01375
16 5	52 0	0 01314	0 01280
17 0	63 0	0 01270	0 01243
17 2	66 0	0 01285	0 01260
17 9	68 0	0 01286	0 01270
18 3	78 4	0 01398	0 01380

(Muller, Z phys Ch 1912, 81 499)

Solubility of H<sub>2</sub> in glycerol + Aq

$t^\circ$	% glycerol	Coefficient of absorption
14	0	0 0193
	2 29	0 0189
	5 32	0 0186
	8 57	0 0182
	10 83	0 01815
	15 31	0 01765
21	0	0 0184
	2 29	0 0181
	5 68	0 0177
	6 46	0 0176
	10 40	0 0171
	18 20	0 0160

(Henkel, in Landolt-Börnstein, Tab 4th Ed 602)

Absorption of H<sub>2</sub> by glycerine + Aq $t^\circ$  = temp of the solution

P = % glycerine in the solution

 $\beta t^\circ$  = coefficient of absorption at  $t^\circ$  $\beta 15^\circ$  = coefficient of absorption at 15°

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
14 5	14 9	0 01654	0 01647
13 0	22 8	0 01532	0 01510
13 8	38 0	0 01226	0 01216
14 5	43 5	0 01117	0 01110
13 7	49 15	0 01019	0 01010
14 9	51 5	0 01026	0 01025
12 3	68 0	0 00822	0 00806
18 0	90 7	0 00853	0 00870

(Muller, Z phys Ch 1912, 81 496)

Solubility of H<sub>2</sub> in glycerine + Aq at 25°

G = % by wt glycerine in the solvent

S = Solubility of H<sub>2</sub>

P = corrected pressure at end of experiment in mm Hg at 0°

P	G	S
716 3	4 0	0 0186
736 1	10 5	0 0178
684 3	22 0	0 0154
709 9	49 8	0 0099
730 1	50 5	0 0097
672 2	52 6	0 0090
741 1	67 0	0 0067
708 0	80 0	0 0051
665 5	82 0	0 0051
662 3	88 0	0 0044
741 8	95 0	0 0034

(Drucker and Moles, Z phys 1910, 75 417)

Absorption of H<sub>2</sub> by glucose + Aq $t^\circ$  = temp of the solution

P = % glucose in the solution

 $\beta t^\circ$  = coefficient of absorption at  $t^\circ$  $\beta 20^\circ$  = coefficient of absorption at 20°

$t^\circ$	P	$\beta t$	$\beta 20$
20 5	12 2	0 01595	0 01600
20 5	20 7	0 01445	0 01450
21 1	32 56	0 01243	0 01250
21 8	45 8	0 01000	0 01015
21 2	59 0	0 00775	0 00780

(Muller, Z phys Ch 1912, 81 494)

## Solubility in sugar + Aq at 15°

% Sugar	Absorption Coefficient
16 67	0 01561
30 08	0 01284
47 65	0 00892

(Gordon, Z phys Ch 1895, 18 14)

Absorption of  $H_2$  by sucrose + Aq  
 $t^\circ$  = temp of the solution in the absorption vessel

P = % sucrose in the solution

$\beta_{t^\circ}$  = coefficient of absorption at  $t^\circ$

$\beta_{15^\circ}$  = coefficient of absorption at  $15^\circ$

$t^\circ$	P	$\beta_{t^\circ}$	$\beta_{15^\circ}$
12 7		0 01862	0 01892
19 3		0 01840	$\beta_{20^\circ}$ = 0 01829
15 2	5 04	0 01723	0 01726
11 6	14 7	0 01547	0 01510
12	20 26	0 01500	0 01462
12 7	29 86	0 01290	0 01257
11 8	31 74	0 01220	0 01185
13 3	39 65	0 01047	0 01033
12 6	42 94	0 00956	0 00939

(Muller)

Absorption of  $H_2$  by propionic acid + Aq  
 $\alpha_{t^\circ}$  = coefficient of absorption at  $t^\circ$

Percent of propionic acid in the solution	$\alpha_{25^\circ}$	$\alpha_{20^\circ}$	$\alpha_{15^\circ}$	$\alpha_{10^\circ}$	$\alpha_5^\circ$
9 910	0 01602	0 01782	0 01908	0 02029	0 02129
9 763	0 01638	0 01788	0 01929	0 02042	0 02120
6 500					
5 267					
3 373	0 01706	0 01866	0 01987	0 02120	0 02221
2 634	0 01722	0 01876	0 02003	0 02142	0 02245

(Braun, Z phys Ch 1900, 33 735)

Absorption of H by organic acids + Aq  
M = content in gram-equivalents per liter  
S = solubility

Absorption of  $H_2$  by  $CH_3COOH$  + Aq

M	S <sub>25</sub>
0 517	0 01925
0 523	0 01923
1 160	0 01903
1 20	0 01895
1 963	0 01885
1 980	0 01882
3 178	0 01862
3 220	0 01858
4 157	0 01849

(Geffcken, Z phys Ch 1904 49 267)

Absorption of  $H_2$  by  $CH_2ClCOOH$  + Aq

M	S <sub>25</sub>
0 527	0 01905
0 990	0 01852
1 773	0 01783

(Geffcken)

Absorption of H by organic substances + Aq at  $t^\circ$

V = absorbed volume reduced to  $0^\circ$  and 760 mm

a = coefficient of absorption

Substance	Grams in 1 liter	Vol of solution used in ccm	$t^\circ$	V ccm	x
Glucose	174	409 94	20 28°	5 48	0 01516
Glucose	80 8		20 16°	6 12	0 01649
Glucose	41 45		20 00°	6 36	0 01759
Urea	60		20 17°	6 26	0 01703
Acetamide	59		20 11°	6 51	0 01795
Alumina	89		20 08°	5 57	0 01550
Glycocol	75		20 16°	5 67	0 01577

(Hufner, Z phys Ch 1907, 57 623-4)

Solubility in organic solvents

Solvent	Solubility at $20^\circ C$	Solubility at $20^\circ C$	$\frac{ds}{dt}$
Glycerine	Not measurable		
Water	0 01992	0 02000	— 0 000016
Aniline	0 02849	0 03033	— 0 000368
Amyl alcohol	0 03708	0 03533	+ 0 00030
Nitrobenzene	0 03708	0 03533	+ 0 00030
Carbon bisulphide	0 03753	0 03358	+ 0 00079
Glacial acetic	0 03330	0 06172	+ 0 000316
Benzene	0 07560	0 07071	+ 0 000978
Acetone	0 07641	0 07027	+ 0 001228
Amyl acetate	0 07738	0 07432	+ 0 00061
Xylene	0 08195	0 07834	+ 0 000702
Ethyl acetate	0 08516	0 07877	+ 0 001278
Toluene	0 08742	0 08384	+ 0 000716
Ethyl alcohol (99.8%)	0 08935	0 08620	+ 0 00063
Methyl alcohol	0 09449	0 09016	+ 0 000866
Isobutyl acetate	0 09758	0 09287	+ 0 000942
Chloroform	no constant value		
Carbon tetrachloride			

(Just, Z phys Ch 1901, 37 359)

Extended investigations have been made by Findlay and Shen (Chem Soc 1912, 101 1465) on the effect of colloids on solubility of  $H_2$  in  $H_2O$ . See original article

Hydrogen arsenide  
See Arsenic hydride

Hydrogen peroxide,  $H_2O_2$

Miscible with  $H_2O$ . Not stable in conc solution. Aqueous solution gives up its  $H_2O_2$  to ether. Ethereal solution is more stable than an aqueous solution of the same strength, and may be distilled without decomp. Miscible with alcohol.

Very stable in aq solution of various conc if perfectly free from impurity such as compds of heavy metals, etc (Woffenstein, B 1894, 27 3307)

Coefficient of distribution between ether and  $H_2O$  determined at  $3^\circ$ ,  $7^\circ$ , and  $17.5^\circ$  with varying quantities (17—5%) of  $H_2O_2$  (Osipoff, C C 1903, II 1265)

As sol in ether as in  $H_2O$ . A 50% solution in  $H_2O$  still contained about 25%  $H_2O_2$  after

being shaken 6 times with large quantities of fresh ether

Insol in petroleum ether (Bruhl, B 1895, 28 2855)

+H<sub>2</sub>O, and +2H<sub>2</sub>O Does not solidify at -20° (Wolffenstein, B 1894, 27 3311)

**Hydrogen phosphide, gaseous (Phosphine), PH<sub>3</sub>**

Very slightly absorbed by H<sub>2</sub>O  
Statements as to solubility in H<sub>2</sub>O vary considerably

(a) *Difficultly inflammable gas*—  
1 vol H<sub>2</sub>O absorbs 0 1122 vol PH<sub>3</sub> (Dyb-kowsky, J B 1866 735)

1 vol H<sub>2</sub>O absorbs 0 125 vol PH<sub>3</sub> (H Davy)

(b) *Easily inflammable gas*—  
1 vol H<sub>2</sub>O absorbs 0 018 vol PH<sub>3</sub> (Gengembre, Crell Ann 1 450)

1 vol H<sub>2</sub>O absorbs 0 0214 vol PH<sub>3</sub> (Henry)

1 vol H<sub>2</sub>O absorbs 0 025 vol PH<sub>3</sub> (Davy)

1 vol H<sub>2</sub>O absorbs 0 125 vol PH<sub>3</sub> (Dalton, Ann Phil 11 7)

1 vol H<sub>2</sub>O absorbs 0 255 vol PH<sub>3</sub> (Raymond, Scher J 5 389)

1 vol H<sub>2</sub>O dissolves 0 26 vols PH<sub>3</sub> at 17° (Stock, Bottger and Lenger, B 1909, 42 2855)

Sol in conc H<sub>2</sub>SO<sub>4</sub> without immediate decomp (Buff, Pogg 16 363)

1 vol 50% H<sub>2</sub>SO<sub>4</sub> dissolves 0 05 vol PH<sub>3</sub> (S B and L)

Absorbed by CuSO<sub>4</sub>+Aq and by Br (Berthelot)

Absorbed rapidly by Cu<sub>2</sub>Cl<sub>2</sub>+Aq with formation of Cu<sub>2</sub>Cl<sub>2</sub>, 2PH<sub>3</sub>, and Cu<sub>2</sub>Cl<sub>2</sub>, 4PH<sub>3</sub> (Ruban, C R 88 581)

1 vol alcohol of 0 85 sp gr absorbs 0 5 vol, 1 vol ether absorbs 2 vols (Graham)

Sol in volatile oils, 1 vol oil of turpentine absorbs 3 25 vols (Graham)

Several varieties of blood absorb PH<sub>3</sub>

**Hydrogen phosphide, liquid, P H<sub>4</sub>**

Insol in H<sub>2</sub>O Apparently sol in alcohol and oil of turpentine, but solution is very quickly decomp (Thénard, A ch (3) 145)

**Hydrogen phosphide, solid, P<sub>4</sub>H**

Insol in H<sub>2</sub>O and alcohol (Leverrier, A ch 60 174)

Insol in all liquids except liquid PH<sub>2</sub> (Thénard, A ch (3) 14 5)

Instantly decomp by HNO<sub>3</sub>, or H SO<sub>4</sub>+Aq Sol with decomp in alcoholic solution of KOH (Thénard)

Somewhat sol in liquid phosphorus (Buck, Dissert 1904)

P<sub>4</sub>H<sub>2</sub> Insol in all solvents (Stock, Bottger and Lenger, B 1909, 42 2851)

P<sub>4</sub>H<sub>6</sub> Sol in liquid hydrogen phosphide and molten P There are no other solvents which appreciably dissolve it Insol in liquid PH<sub>3</sub> (S B and L)

**Hydrogen selenide, H<sub>2</sub>Se**

More sol in H<sub>2</sub>O than hydrogen sulphide (Berzelius)

Solubility coefficient of H<sub>2</sub>Se at t°

t°	Sol Coeff
4	3 77 vols
9 65	3 43
13 2	3 31
22 5	2 70

(Forcrand and Fonzes-Diacon, C R 1902, 134 171)

Sol in cold COCl<sub>2</sub> (Besson, C R 1869, 122 140)

**Hydrogen silicide**

See Silicon hydride

**Hydrogen sulphide, H<sub>2</sub>S**

(a) *Liquid* Dissolves S on warming, which separates on cooling

(b) *Gas*

1 vol H<sub>2</sub>O absorbs 1 08 vols H<sub>2</sub>S at 10° (Henry 1803)

1 vol H<sub>2</sub>O absorbs 2 53 vols H<sub>2</sub>S at 15° (de Sausure Ann Phil 6 340)

1 vol H<sub>2</sub>O absorbs 3 vols H<sub>2</sub>S at 11° (Gay Lussac and Thénard)

1 vol H<sub>2</sub>O absorbs 3 66 vols H<sub>2</sub>S at ord temp (Thompson)

1 vol H<sub>2</sub>O absorbs 2 5 vols H<sub>2</sub>S at ord temp (Dalton)

1 vol H<sub>2</sub>O absorbs 4 3706-0 083687t+0 0005213t<sup>2</sup> vols H<sub>2</sub>S at temperatures between 2 and 43 3° (Bunsen and Schonfeld, A 93 26)

At 0° and about 820 mm pressure, 1 ccm H<sub>2</sub>O absorbs 100 ccm H<sub>2</sub>S, while only about 4 ccm are absorbed at ord pressure (de Forcrand and Villard, C R 106 1402)

1 vol H<sub>2</sub>O at 760 mm pressure and t° absorbs V vols H<sub>2</sub>S, reduced to 0° and 760 mm

t	V	t°	V	t°	V
0	4 3706	14	3 3012	28	2 4357
1	4 2874	15	3 2326	29	2 3819
2	4 2053	16	3 1651	30	2 3290
3	4 1243	17	3 0986	31	2 2771
4	4 0442	18	3 0331	32	2 2262
5	3 9652	19	2 9687	33	2 1764
6	3 8872	20	2 9053	34	2 1277
7	3 8103	21	2 8430	35	2 0799
8	3 7345	22	1 7817	36	2 0332
9	3 6596	23	2 7215	37	1 9876
10	3 5858	24	2 6623	38	1 9430
11	3 5132	25	2 6091	39	1 8994
12	3 4415	26	2 5470	40	1 8569
13	3 3708	27	2 4909		

(Schonfeld, A 93 26)

Absorption coefficient of  $\text{H}_2\text{S}$  in  $\text{H}_2\text{O}$  at  $0^\circ = 4.6796$  (Prytz and Holst, W Ann 1895, **54**, 137)  
 1 l  $\text{H}_2\text{O}$  dissolves 0.1004 mol  $\text{H}_2\text{S}$  at  $25^\circ$  and 760 mm (Polltzer, Z anorg 1909, **64** 145)

Absorption of hydrogen sulphide by  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Coefficient of absorption
$0^\circ$	4.686
$10^\circ$	3.520
$20^\circ$	2.672

[Calc fr data of Fauser (C C 1889, 1 754)]

(Winkler, Z phys Ch 1906, **55** 350)

Absorption of hydrogen sulphide by  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Coefficient of absorption
0	4.621
10	3.362
20	2.554
30	2.014
40	1.642
50	1.376
60	1.176

(Winkler, Z phys Ch 1906, **55** 350)

Solubility of  $\text{H}_2\text{S}$  in  $\text{H}_2\text{O}$

Layer rich in $\text{H}_2\text{S}$	
t	Mols $\text{H}_2\text{S}$ per 100 mols $\text{H}_2\text{O}$
0	0.4
6	0.5
17	0.8
26	1.2
29.5	1.6

Layer rich in  $\text{H}_2\text{O}$

$t^\circ$	Mols $\text{H}_2\text{S}$ per 100 mols $\text{H}_2\text{O}$
29.4	96.3
28.5	96.9
26.9	97.3
26.3	97.5
23.8	98.1
23.3	98.1
22.9	98.2
17.2	98.8
13.7	99.1
11.4	99.25
5.3	99.5

(Scheffer, Proc K Ak Amsterdam, 1911, **14** 198)

Difficultly sol in conc  $\text{H}_2\text{SO}_4$  with decomp  
 Instantly decomp by fuming  $\text{HNO}_3$   
 Solubility of  $\text{H}_2\text{S}$  in  $\text{HI} + \text{Aq}$  at  $25^\circ$  and 760 mm

$\text{HI}$ Mol per l	$\text{H}_2\text{S}$ Mol per l
0.00	0.1004
1.01	0.111
1.51	0.113
1.93	0.125
2.65	0.130
2.64	0.138
3.42	0.142
4.38	0.163
5.005	0.165
5.695	0.181
6.935	0.197
* (9.21)	0.267

\* Not exact

(Polltzer, Z anorg 1909, **64** 145)

Solubility in acids + Aq

l = value of  $\text{H}_2\text{S}$  dissolved in acid + Aq as determined by titration

lo = value of  $\text{H}_2\text{S}$  dissolved in  $\text{H}_2\text{O}$  as determined by titration

$t^\circ = 25^\circ$

Acid	l/lo
$\frac{1}{2}\text{-N HCl}$	0.975
$\frac{1}{2}\text{-N H}_2\text{SO}_4$	0.905

(McLauchlan, Z phys Ch 1903, **44** 615)

Less sol in  $\text{NaCl}$ , or  $\text{CaCl}_2 + \text{Aq}$  than in  $\text{H}_2\text{O}$

Sol in  $\text{CdCl}_2 + \text{NH}_4\text{OH} + \text{Aq}$  (Crobaugh, Z anorg 1894, **5** 321)

Solubility in salts + Aq

l = value of  $\text{H}_2\text{S}$  dissolved in salt + Aq as determined by titration

lo = value of  $\text{H}_2\text{S}$  dissolved in  $\text{H}_2\text{O}$  as determined by titration

$t^\circ = 25^\circ$

Salt + Aq	l/lo	Salt + Aq	l/lo
$\frac{1}{2}\text{-N Na}_2\text{SO}_4$	0.73	$\frac{1}{4}\text{-N Na}_2\text{SO}_4$	0.855
$\frac{1}{2}\text{-N K}_2\text{SO}_4$	0.78	$\frac{1}{4}\text{-N K}_2\text{SO}_4$	0.890
$\frac{1}{2}\text{-N (NH}_4)_2\text{SO}_4$	0.82	$\frac{1}{4}\text{-N (NH}_4)_2\text{SO}_4$	0.91
N $\text{NaCl}$	0.847	$\frac{1}{2}\text{-N NaCl}$	0.930
N $\text{KCl}$	0.853	N $\text{NaBr}$	0.935
N $\text{NH}_4\text{Cl}$	0.960	N $\text{KBr}$	0.945
N $\text{NaNO}_3$	0.893	N $\text{NH}_4\text{Br}$	1.00
N $\text{KNO}_3$	0.913	N $\text{KI}$	0.98
N $\text{NH}_4\text{NO}_3$	0.990		

(McLauchlan, Z phys Ch 1903, **44** 615)

Solubility of  $H_2S$  in  $NaSH + Aq$   
(g mol  $H_2S$  dissolved in 1 l)

$t^\circ$	0.05 g mol $NaSH$ per l	0.1 g mol $NaSH$ per l	0.2 g mol $NaSH$ per l
15		0.132	0.129
25		0.104	0.1035
35	0.082	0.082	
45	0.064		

(Goldschmidt and Larsen, Z phys Ch 1910, 71 449)

At  $18^\circ$  and ord pressure 100 vols alcohol of 0.84 sp gr absorb 606 mols  $H_2S$  (de Saussure 1814)

1 vol alcohol absorbs 17 891-0 65598t+0 00661t<sup>2</sup> vols  $H_2S$  between 0 and  $22^\circ$  (Carius)

1 vol alcohol at  $t^\circ$  and 760 mm absorbs V vols  $H_2S$  reduced to  $0^\circ$  and 760 mm

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	17 891	9	12 523	18	8 225
1	17 242	10	11 992	19	7 814
2	16 606	11	11 475	20	7 415
3	15 983	12	10 971	21	7 030
4	15 373	13	10 480	22	6 659
5	14 776	14	10 003	23	6 300
6	14 193	15	9 539	24	5 955
7	13 623	16	9 088		
8	13 066	17	8 650		

(Carius, A 94 140)

Solubility in alcohol + Aq at  $25^\circ$

Molecules of $C_2H_5OH$ in 100 molecules $C_2H_5OH$ + H <sub>2</sub> O	Molecules $H_2O$ in 100 molecules $C_2H_5OH + H_2O$	1/10
0.00	100	1.00
1.60	98 (?)	0.96
5.18	94.82	0.933
9.25	90.75	0.91
23.60	76.40	1.28
47.75	52.25	1.95
* (100)	0	2.16

\* Carius

(McLauchlan)

Sol in methyl acetate (Marchand), ether (Higgins)

Insol in caoutchou

Sol in glycerine in less amount than in  $H_2O$ . If a certain vol of  $H_2O$  dissolves 100 pts  $H_2S$ , the same vol of glycerine (1 pt glycerine + 1 pt  $H_2O$ ) dissolves only 60 pts  $H_2S$ , but the solution is very stable. After standing a year there is no appreciable decomp (Lapage, J Pharm (4) 5 256)

According to Lindo (C N 57 173), the solution in glycerine is no more stable than that in  $H_2O$

Sol in  $CS_2$

Solubility in organic substances + Aq  
1 = value of  $H_2S$  dissolved in organic substance + Aq as determined by titration  
10 = value of  $H_2S$  dissolved in  $H_2O$  as determined by titration  
 $t^\circ = 25^\circ$

Solution	1/10
$N-NH_4C_2H_5O_2$	1.09
$N-C_4H_9O_6$	0.944
$3-N-C_4H_9O_6$	0.858
$N-(NH_2)_2CO$	1.02
pure $C_2H_5(OH)_3$	0.863

(McLauchlan, Z phys Ch 1903, 44 615)

Solubility in acetic acid + Aq at  $25^\circ$

Molecules of $CH_3COOH$ in 100 molecules $CH_3COOH + H_2O$	Molecules of $H_2O$ in 100 molecules $CH_3COOH + H_2O$	1/10
0	100	1.00
8.85	91.15	0.98
16.7	83.30	0.955
21.0	79	1.00
35.5	64.5	1.035
53.5	40.5	1.21
55.7		1.29
67.8	32.2	1.40
81.0	19.0	1.83
98.58	1.42	3.81

(McLauchlan)

Hydrogen persulphide,  $H_2S_2$  or  $H_2S_8$

Decomp by contact with  $H_2O$ , in which it is apparently insol. Sol in ether with subsequent decomp. Sol in  $CS_2$  (Thénard, A ch 48 79)

$H_2S_2$  Quickly decomp by ether, acetic ether, ethyl, or amyl alcohol.  $H_2S$  has no action

Conc  $HCl$ , or  $HC_2H_3O_2 + Aq$  have no action. Sol in a solution of S in  $CS_2$ , and in liquid hydrocarbons

Chloroform dissolves without decomp (Sabatier, C R 100 1346, 1585)

Alkalies, and  $K_2S + Aq$  decomp instantly

Decomp by  $H_2O$ , dil and conc  $HCl$ , conc  $H_2SO_4$ , alkali and alcohol. Sol in alcohol containing  $HCl$  but soon decomp in this solution. Miscible in all proportions and without decomp with benzene, ether and  $CS_2$  (Bloch, B 1908, 41 1977)

Formula is  $H_2S_8$  (Rebs, A 246 356)  
+  $7H_2O$ . Easily decomp by heat (de Forcrand and Villard, C R 106 1402)

Hydrogen trisulphide,  $H_2S_3$

Decomp by  $H_2O$ , dil and conc  $HCl$ , conc  $H_2SO_4$ , alkali and alcohol. Somewhat sol in alcohol containing  $HCl$ , but slowly decomp in this solution. Miscible with ether, benzene and  $CS_2$ , and these solutions are relatively stable (Bloch, B 1908, 41 1974)

**Hydrogen telluride,  $H_2Te$** 

Sl sol in  $H_2O$  Decomp in the air (Ernyei, Z anorg 1900, 25 313)

**Hydrosulphuric acid,  $H_2S$** 

See Hydrogen sulphide

**Hydrosulphurous acid,  $H_2SO_2$** 

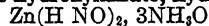
See Hyposulphurous acid

**Hydroxylamic acid**
**Calcium hydroxylamate,  $Ca(ONH_2)_2$** 

Very explosive, decomp by  $H_2O$  (Ebler and Schott, J pr 1908, (2) 78 323)

**Zinc hydroxylamate  $Zn(ONH_2)_2$** 

Decomp by  $H_2O$  (Ebler and Schott)

**Zinc hydroxylamate, hydroxylamme,**


Very unstable

Insol in abs alcohol (Ebler and Schott)

**Hydroxylamine,  $NH_2O=NH_2(OH)$** 

Known only in solution

Sol in alcohol (Lossen, J pr 96 462)

Prepared in free state by de Bruyn

Very deliquescent, and sol in  $H_2O$  and alcohol Sl sol or insol in  $CHCl_3$ ,  $C_6H_6$ , ether, or ethyl acetate

Methyl alcohol at 5° dissolves 35%, ethyl alcohol at 15°, 15%, boiling dry ether, 12%, boiling ethyl acetate, 16% (de Bruyn, R t c 11 18)

**Hydroxylamine arsenate,  $AsO_4H_3(NH_2O)_3$** 

Sl sol in cold  $H_2O$ , sol in hot  $H_2O$  from which it can be cryst (Hofmann, A 1899, 307 331)

**Hydroxylamine azouimide**

See Azouimide, hydroxylamine

**Hydroxylamine bromide,  $NH_2OH, HBr$** 

Very sol in  $H_2O$ , insol in ether by which it is pptd from solution in alcohol (Adams, Am Ch J 1902, 28 205)

$2NH_2OH, HBr$  Easily sol in  $H_2O$ , insol in ether and ligroin Sl sol in alcohol (Adams)

**Hydroxylamine mercuric bromide hydroxylamine,  $2NH_2OH, 2HBr, HgBr_2, 2NH_2OH$** 

Decomp by  $H_2O$  and methyl alcohol

Readily decomp by alkalis (Adams)

**Hydroxylamine calcium,  $HO Ca ONH_2$** 

Partially decomp by  $H_2O$  at ordinary temp (Hofmann, Z anorg 1898, 16 464)

**Hydroxylamine chloride, basic,  $NH_2(OH)Cl, NH_2OH$** 

Sol in  $H_2O$  Alcohol precipitates from aqueous solution Insol in ether (Lossen)  $2NH_2(OH)Cl, NH_2OH$  Deliquescent, very sol in  $H_2O$ , less in alcohol, and insol in ether (Lossen)

**Hydroxylamine chloride,  $NH_2(OH)Cl$** 

Not deliquescent Very sol in  $H_2O$  and hot ordinary alcohol Sl sol in absolute alcohol Insol in ether (Lossen)

Sol in 12 pts  $H_2O$  at 17° (Schiff, Z phys Ch 1896, 21 290)

Sp gr of aqueous solution at 17°

% salt	sp gr
40	1 1852
28	1 1260
20	1 0888
14	1 0616
10	1 0437
7	1 0303
5	1 0214
3 5	1 0147

(Schiff, Z phys Ch 1896, 21 290)

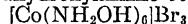
100 pts absolute methyl alcohol dissolve 164 pts at 1975°, 100 pts absolute ethyl alcohol dissolve 443 pts at 1975° (de Bruyn, Z phys Ch 10 783)

Somewhat sol in alcohol (Adams, Am Ch J 1902, 28 204)

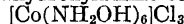
**Hydroxylamine mercuric chloride,  $NH_2OH, HCl, HgCl_2$** 

Very sol in  $H_2O$  and alcohol Less sol in ether (Adams, Am Ch J 1902, 28 213)

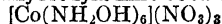
$5(NH_2OH)_2, HCl, 2HgCl_2$  Sol in cold  $H_2O$  alcohol and ether More easily sol in methyl alcohol Sol in  $HCl$  The slightest trace of alkali causes decomp (Adams)

**Hexahydroxylamine cobaltic bromide,**


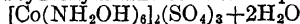
(Werner, B 1905, 38 897)

**Hexahydroxylamine cobaltic chloride,**


Very stable toward  $HCl$  (Werner, B 1905, 38 895)

**Hexahydroxylamine cobaltic nitrate,**


(Werner)

**Hexahydroxylamine cobaltic sulphate,**


Easily sol in  $H_2O$  (Werner)

**Hydroxylamine columbate,  $CbO_6N_3H_{10}$** 

Explosive Sl sol in  $H_2O$  (Hofmann, Z anorg 1898, 16 473)

**Hydroxylamine dithionate,  $(\text{NH}_2\text{OH})_2$ ,**

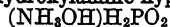
Sol in  $\text{H}_2\text{O}$ , decomp on heating the aq solution (Sabanejeff, Z anorg 1898, 17 485)

**Hydroxylamine fluosilicate,  $(\text{NH}_3\text{O})_2$ ,  $\text{H}_2\text{SiF}_6$  +  $2\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  Nearly insol in methyl and abs ethyl alcohol (Ebler, J pr 1908, (2), 78 338)

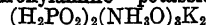
**Hydroxylamine fluotitanate,  $(\text{NH}_3\text{O})_2$ ,  $\text{H}_2\text{TiF}_6$** 

Sol in  $\text{H}_2\text{O}$  Sl sol in methyl alcohol (Ebler, J pr 1908, (2) 78 340)

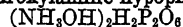
**Hydroxylamine hypophosphite,**

Very sol in  $\text{H}_2\text{O}$  (Sabanejeff, Z anorg 1898, 17 483)

Sol in  $\text{H}_2\text{O}$  and absolute alcohol Insol in ether (Hofmann and Kohlschutter, Z anorg 1898, 16 469)

**Hydroxylamine potassium hypophosphite,**

Easily sol in  $\text{H}_2\text{O}$ , decomp on heating, sol in hot abs alcohol (Hofmann and Kohlschutter, Z anorg 1898, 16 468)

**Hydroxylamine hypophosphate,**

Easily sol in  $\text{H}_2\text{O}$  (Sabanejeff, Z anorg 1898, 17 489)

**Hydroxylamine iodide,  $\text{NH}_2\text{OH}$ , HI**

Hygroscopic, sol in methyl alcohol Very explosive (Wolfenstein and Groll, B 1901, 34 2419)

**Dihydroxylamine iodide,  $(\text{NH}_2\text{OH})_2$ , HI**

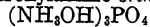
Deliquescent More sol in  $\text{H}_2\text{O}$ , methyl and ethyl alcohol than the tri compound Is decomp when recryst from these solvents Insol in ether (Dunstan, Chem Soc 1896, 69 841)

**Trihydroxylamine iodide,  $(\text{NH}_2\text{OH})_3$ , HI**

Deliquescent in moist air Sol in  $\text{H}_2\text{O}$ , methyl and ethyl alcohol Insol in ether (Dunstan)

**Hydroxylamine nitrate,  $\text{NH}_3(\text{OH})\text{NO}_3$** 

Very sol in  $\text{H}_2\text{O}$  and absolute alcohol (Lossen)

**Hydroxylamine orthophosphate,**

Sl sol in cold  $\text{H}_2\text{O}$  (Lossen)

Only sl sol in  $\text{H}_2\text{O}$  (Hofmann, A 1899, 307 330)

Moderately sol in  $\text{H}_2\text{O}$  (Ross, Chem Soc 1906, 90, (2) 19)

**Solubility in  $\text{H}_2\text{O}$** 

1 g of aqueous solution contains at

0°	10°	
0 012	0 015 g	hydroxylamine phosphate,
20°	30°	
0 019	0 027 g	hydroxylamine phosphate,
40°	50°	
0 040	0 055 g	hydroxylamine phosphate,
60°	70°	
0 077	0 102 g	hydroxylamine phosphate,
80°	90°	
0 133	0 168 g	hydroxylamine phosphate

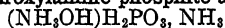
(Adams, Am Ch J 1902, 28 204)

$(\text{NH}_3\text{OH})\text{H}_2\text{PO}_4$  Hygroscopic Aq solution is decomp on heating (Sabanejeff, B 1897, 30 287)

**Hydroxylamine phosphite,  $(\text{NH}_3\text{OH})_2\text{HPO}_3$** 

Sol in  $\text{H}_2\text{O}$  and absolute alcohol (Hofmann and Kohlschutter, Z anorg 1898, 16 467)

$(\text{NH}_3\text{OH})\text{H}_2\text{PO}_3$  Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Sabanejeff, Chem Soc 1900, 78, (2), 14)

**Hydroxylamine phosphite ammonia,**

Sol in  $\text{H}_2\text{O}$  (Sabanejeff, Chem Soc 1900, 78, (2) 14)

**Hydroxylamine sodium,  $\text{NaONH}_2$** 

Very hygroscopic (de Bruyn, R t c 1892, 11 18)

**Hydroxylamine sulphate,  $(\text{NH}_3\text{OH})_2\text{SO}_4$** 

Easily sol in  $\text{H}_2\text{O}$  Precipitated from concentrated aqueous solution by alcohol (Lossen)

Sol in conc  $\text{NH}_4\text{OH}$  + Aq Insol in alcohol and ether (Preibisch, J pr 1873, (2) 7 480)

Not deliquescent Sol in  $\frac{3}{4}$  of its wt of  $\text{H}_2\text{O}$  at 20° (Divers and Haga, Chem Soc 1896, 69 1665)

1 g of aqueous solution contains at

-8°	0°	+10°	
0 307	0 329	0 366 g	hydroxylamine sulphate,
20°	30°	40°	
0 413	0 441	0 482 g	hydroxylamine sulphate,
50°	60°	90°	
0 522	0 560	0 685 g	hydroxylamine sulphate

(Adams, Am Ch J 1902, 28 203)

Dry hydroxylamine sulphate is insol in abs and almost insol in 95% alcohol (Adams)

For double salts, see under sulphuric acid  $\text{NH}_2\text{OH}$ ,  $\text{H}_2\text{SO}_4$  Deliquescent Sol in  $\text{H}_2\text{O}$  (Divers, Chem Soc 1895, 67 226)

**Hydroxylamine tungstate,  $4\text{NH}_2\text{OH}$ ,  $3\text{WO}_3$  +  $3\text{H}_2\text{O}$** 

Moderately sol in  $\text{H}_2\text{O}$  (Allen and Gottschalk, Am Ch J 1902, 27 338)

**Hydroxylamine uranate**,  $\text{UO}_4(\text{NH}_3\text{O})_2 + \text{H}_2\text{O}$

Decomp by heat (Hofmann, Z anorg 1897, 15 78)

**Hydroxylamine uranate ammonia**,

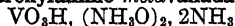


Decomp by  $\text{H}_2\text{O}$  (Hofmann, Z anorg 1897, 15 79)

**Hydroxylamine metavanadate**,  $\text{VO}_3\text{N}_5\text{H}_{15}$

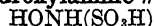
Decomp by moisture (Hofmann, Z anorg 1898, 16 472)

**Hydroxylamine metavanadate ammonia**,



Easily decomp by  $\text{H}_2\text{O}$  and  $\text{HCl}$  (Hofmann, Z anorg 1898, 16 471)

**Hydroxylamine monosulphonic acid**,

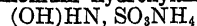


"Sulphazidic acid" of Fremy

"Sulphhydroxylamic acid" of Claus

Sol in  $\text{H}_2\text{O}$  Slowly decomp on boiling (Raschig, A 241 161)

**Ammonium hydroxylamine monosulphonate**,



(Sabanéjef, Z anorg 1898, 17 491)

**Monobarium** — — —,  $(\text{HONHSO}_3)_2\text{Ba} + \text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Divers and Haga, Chem Soc 55 760)

**Dibarium** — — —,  $\text{Ba}(\text{HONSO}_3)_2\text{Ba} + \text{H}_2\text{O}$

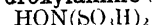
Nearly insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$  (Divers and Haga, Chem Soc 55 760)

**Potassium** — — —,  $\text{HONH}(\text{SO}_3\text{K})$

"Potassium sulphazidic acid" of Claus

Sol in cold  $\text{H}_2\text{O}$  Easily sol in hot  $\text{H}_2\text{O}$  without decomp Insol in alcohol (Raschig, A 241 161)

**Hydroxylamine disulphonic acid**,

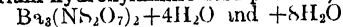


"Disulphhydroazotic acid" of Claus

"Sulphazotic acid" of Fremy

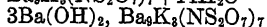
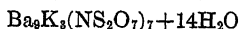
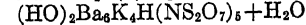
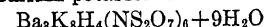
Not known in free state (Raschig, A 241 161)

**Barium hydroxylamine disulphonate**,



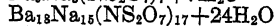
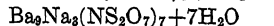
Practically insol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Divers, Chem Soc 1894, 65 559)

**Barium potassium** — — —



Above salts are all ppts (Divers, Chem Soc 1894, 65 561)

**Barium sodium hydroxylamine disulphonate**,



Above salts are ppts (Divers)

**Potassium** — — —,  $\text{HON}(\text{SO}_3\text{K})_2 + 2\text{H}_2\text{O}$

"Potassium disulphhydroxazotate" of Claus (A 158 75) Insol in cold  $\text{H}_2\text{O}$

Very unstable Very difficultly sol in  $\text{H}_2\text{O}$ , more easily in dil  $\text{KOH} + \text{Aq}$  (Raschig, A 241 161)

$\text{HON}(\text{SO}_3\text{K})_2, \text{KON}(\text{SO}_3\text{K})_2 + \text{H}_2\text{O}$  True composition of potassium sulphazotate of Fremy (Divers and Haga, Chem Soc 1900, 77 432)

**Potassium sodium** — — —

$3\text{K}_2\text{NS}_2\text{O}_7, 2\text{Na}_3\text{NS}_2\text{O}_7 + 2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

$6\text{K}_2\text{NS}_2\text{O}_7, \text{Na}_3\text{NS}_2\text{O}_7, \text{H}_3\text{NS}_2\text{O}_7 + 20\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

$\text{K}_2\text{Na}_{11}\text{H}_3(\text{NS}_2\text{O}_7)_7 + 5\text{H}_2\text{O}$  Less sol in  $\text{H}_2\text{O}$  than the others

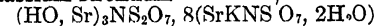
$\text{K}_{15}\text{Na}_5\text{H}_4(\text{NS}_2\text{O}_7)_8 + 9\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

$\text{KNa}_4\text{H}(\text{NS}_2\text{O}_7)_2 + \text{H}_2\text{O}$  Readily sol in  $\text{H}_2\text{O}$

$\text{K}_6\text{NaH}_2(\text{NS}_2\text{O}_7)_3 + 2\text{H}_2\text{O}$  Moderately sol in  $\text{H}_2\text{O}$

$\text{KNaHNS}_2\text{O}_7 + 3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Divers, Chem Soc 1894, 65 552)

**Potassium strontium** — — —



Ppt (Divers)

**Potassium hydroxylamine disulphonate nitrite**,  $\text{HON}(\text{SO}_3\text{K})_2, \text{KNO}_2$

Very sl in  $\text{H}_2\text{O}$  (Divers and Haga, Chem Soc 1900, 77 433)

$\text{K}_5\text{H}(\text{NS}_2\text{O}_7)_2, 3\text{KNO}_2 + \text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Divers and Haga)

$2\text{KON}(\text{SO}_3\text{K})_2, \text{KNO}_2 + 4\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  which decomp it into its constituent salts (Divers and Haga)

$+ 6\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  which decomp it into its constituent salts (Divers and Haga)

$2\text{K}_5\text{H}(\text{NS}_2\text{O}_7), 7\text{KNO}_2 + 3\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Divers and Haga)

$3\text{K}_5\text{H}(\text{NS}_2\text{O}_7)_2, 7\text{KNO}_2$  Decomp by  $\text{H}_2\text{O}$  (Divers and Haga)

**Potassium hydroxylamine disulphonate sodium chloride**,  $5\text{K}_2\text{HNS}_2\text{O}_7, 8\text{NaCl} + 3\text{H}_2\text{O}$

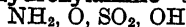
Decomp by  $\text{H}_2\text{O}$  (Divers, Chem Soc 1894, 65 551)



**Sodium hydroxylamine disulphonate,**

Sol in somewhat more than its own wt of  $\text{H}_2\text{O}$  at  $14^\circ$  (Divers, Chem Soc 1894, 65 546)

$\text{Na}_2\text{HNS}_2\text{O}_7$ ,  $2\text{Na}_2\text{NS}_2\text{O}_7 + 3\text{H}_2\text{O}$  Sol in less than 1.5 pts  $\text{H}_2\text{O}$  at  $14^\circ$  (Divers)

**Hydroxylamine isomonosulphonic acid,**

Very hygroscopic Sol in water, sol in alcohol (Sommer, B 1914, 47 1226)

[Compare Raschig, A 1887, 241 161]

**Hydroxylamine isodisulphonic acid****Ammonium hydroxylamine isodisulphonate,**

3 pts are sol in 2 pts  $\text{H}_2\text{O}$  at  $18^\circ$  Apt to form supersat solutions (Haga, Chem Soc 1906, 89 246)

**Dipotassium ———,  $\text{K}_2\text{HS}_2\text{O}_7\text{N}$** 

Only sl sol in cold  $\text{H}_2\text{O}$  Easily sol in boiling  $\text{H}_2\text{O}$  Decomp by hot dil HCl (Raschig, B 1906, 39 246)

6.44 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $16.4^\circ$

7.18 " " " " 100 "  $\text{H}_2\text{O}$  "  $17.8^\circ$

8.05 " " " " 100 "  $\text{H}_2\text{O}$  "  $20^\circ$

(Haga, Chem Soc 1906, 39 243)

**Tripotassium ———,  $(\text{SO}_3\text{K})\text{ONK}(\text{SO}_3\text{K}) + 2\text{H}_2\text{O}$** 

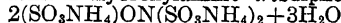
Very sol in  $\text{H}_2\text{O}$ , ppt by alcohol (Haga)

**Disodium ———,  $(\text{SO}_3\text{Na})\text{ONH}(\text{SO}_3\text{Na})$** 

Very sol in  $\text{H}_2\text{O}$ , insol in alcohol by which it is ppt from aqueous solution (Haga)

**Trisodium ———,  $(\text{SO}_3\text{Na})\text{ONNa}(\text{SO}_3\text{Na}) + 2\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$ , ppt by alcohol (Haga)  
 $+ 3\text{H}_2\text{O}$  Sol in 1.3 pts  $\text{H}_2\text{O}$  at  $20^\circ$  Less sol in  $\text{NaOH} + \text{Aq}$  (Divers, Chem Soc 1894, 65 546)

**Hydroxylamine trisulphonic acid****Ammonium hydroxylamine trisulphonate,**

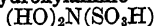
Sol in 0.61 pts  $\text{H}_2\text{O}$  at  $16^\circ$  (Haga, Chem Soc 1904, 85 84)

**Potassium ———,  $2(\text{SO}_3\text{K})\text{ON}(\text{SO}_3\text{K})_2 + 3\text{H}_2\text{O}$** 

1 pt is sol in 25.37 pts  $\text{H}_2\text{O}$  at  $18^\circ$  (Haga)

**Sodium ———,  $(\text{SO}_3\text{Na})\text{ON}(\text{SO}_3\text{Na})_2 + 2\text{H}_2\text{O}$** 

Sol in 2.84 pts  $\text{H}_2\text{O}$  at  $21.5^\circ$

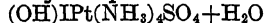
**Dihydroxylamine sulphonic acid,**

"Sulphazinous acid" of Fremy  
 Known only in its salts (Raschig, A 241 161)

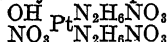
**Potassium dihydroxylamine sulphonate,**

Not obtained in pure state, forms basic salt  $\text{KO} \cdot \text{HO} \cdot \text{NSO}_3\text{K}$ , which is quite sol in  $\text{H}_2\text{O}$ , and corresponds to "sulfazite de potasse" of Fremy (A ch (3) 15 421)

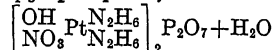
Sol in  $\text{H}_2\text{O}$ , insol in alcohol and ether (Fremy)

**Hydroxylodoplatindiamine sulphate,**

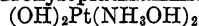
Very sl sol, even in boiling  $\text{H}_2\text{O}$  (Carl-gren, Sv V A F 47 312)

**Hydroxylonitratoplatindiamine nitrate,**

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$   
 Very sl sol in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$  (Cleve)

**—— pyrophosphate,**

Very sl sol in  $\text{H}_2\text{O}$  (Cleve)

**Hydroxyloplatinamine hydroxide,**

Insol in  $\text{H}_2\text{O}$  Easily sol in dil acids, even  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  Not decomp by boiling  $\text{KOH} + \text{Aq}$  (Gerhardt, Compt Chem 1849 490)

**Hydroxyloplatinamine nitrate,**

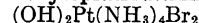
Sl sol in cold, easily in hot  $\text{H}_2\text{O}$ , not attacked by cold  $\text{HCl} + \text{Aq}$  (Cleve)

**—— oxalate,  $(\text{OH})_2\text{Pt}(\text{NH}_3)_2\text{C}_2\text{O}_4 + \text{H}_2\text{O}$** 

Sol in hot  $\text{H}_2\text{O}$

**—— sulphate,  $(\text{OH})_2\text{Pt}(\text{NH}_3)_2\text{SO}_4 + \text{H}_2\text{O}$** 

Difficultly sol in  $\text{H}_2\text{O}$  (Cleve)

**Hydroxyloplatinamine bromide,**

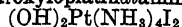
Sl sol, even in boiling  $\text{H}_2\text{O}$  (Carl-gren, Sv V A F 47 320)

**—— chloride,  $(\text{OH})_2\text{Pt}(\text{NH}_3)_2\text{Cl}_2$** 

Sol in 206 pts cold, and 49 pts boiling  $\text{H}_2\text{O}$  (Carl-gren, Sv V A F 47 316)

**—— chromate,  $(\text{OH})_2\text{Pt}(\text{NH}_3)_2\text{Cr}_2\text{O}_7$** 

Very sl sol in cold or hot  $\text{H}_2\text{O}$  (Carl-gren, Sv V A F 47 319)

**Hydroxyloplatindiamine iodide,**

Sl sol in hot or cold  $\text{H}_2\text{O}$  (Carlgrén)

— **nitrate,**  $(\text{OH})_2\text{Pt}(\text{NH}_3)_4(\text{NO}_3)_2$ 

Sl sol in cold, moderately sol in hot  $\text{H}_2\text{O}$  (Gerhardt, A 76 315)

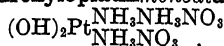
Sol in 343 pts cold, and 38 pts boiling  $\text{H}_2\text{O}$  (Carlgrén, Sv V A F 47 318)

— **nitrite,**  $(\text{OH})_2\text{Pt}(\text{NH}_3)_4(\text{NO}_2)_2$ 

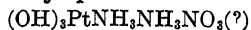
Easily sol in  $\text{H}_2\text{O}$  (Carlgrén)

— **sulphate,**  $(\text{OH})_2\text{Pt}(\text{NH}_3)_4\text{SO}_4$ 

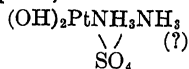
Very sl sol in boiling  $\text{H}_2\text{O}$  (Cleve)  
+  $4\text{H}_2\text{O}$  Efflorescent (Carlgrén, Sv V A F 47 313)

**Hydroxyloplatindiamine nitrate,**

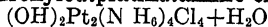
Very easily sol in  $\text{H}_2\text{O}$  (Cleve)

**Hydroxyloplatinsmidiamine nitrate,**

Easily sol in  $\text{H}_2\text{O}$  (Cleve)

— **sulphate,**

Sol in hot  $\text{H}_2\text{O}$

**Hydroxylodiplatindiamine chloride,**

Extremely sl sol in  $\text{H}_2\text{O}$

— **dichromate,**  $(\text{OH})_2\text{Pt}_2(\text{N}_2\text{H}_6)_4(\text{Cr}_2\text{O}_7)_2$ 

Ppt (Cleve)

— **nitrate,**  $(\text{OH})_2\text{Pt}_2(\text{N}_2\text{H}_6)_4(\text{NO}_3)_4$ 

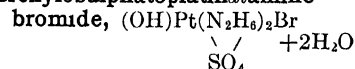
Very sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  (Cleve)

— **phosphate,**  $(\text{OH}) \text{Pt}_2(\text{N}_2\text{H}_6)_4(\text{PO}_4\text{H})_2$ 

Ppt

— **sulphate,**  $(\text{OH})_2\text{Pt}_2(\text{N}_2\text{H}_6)_4(\text{SO}_4)_2 + 2\text{H}_2\text{O}$ 

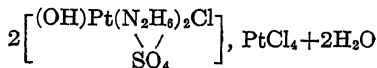
Ppt Nearly insol in  $\text{H}_2\text{O}$

**Hydroxylsulphatoplatindiamine**

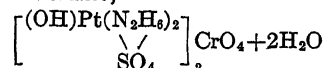
Easily sol in  $\text{H}_2\text{O}$  (Cleve)

— **chloride,**  $(\text{OH})\text{Pt}(\text{N}_2\text{H}_6)_2\text{Cl} \begin{array}{c} \text{SO}_4 \\ \text{SO}_4 \end{array} + 2\text{H}_2\text{O}$ 

Moderately sol in cold, very sol in hot  $\text{H}_2\text{O}$

**Hydroxylsulphatoplatindiamine chloroplatinate,**

Ppt

— **chromate,**

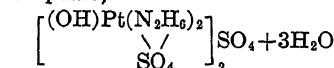
Sl sol in  $\text{H}_2\text{O}$

— **dichromate,**  $\left[ (\text{OH})\text{Pt}(\text{N}_2\text{H}_6)_2 \begin{array}{c} \text{SO}_4 \\ \text{SO}_4 \end{array} \right]_2 \text{Cr}_2\text{O}_7$ 

Sl sol in  $\text{H}_2\text{O}$

— **nitrate,**  $(\text{OH})\text{Pt}(\text{N}_2\text{H}_6)_2 \text{NO}_3 \begin{array}{c} \text{SO}_4 \\ \text{SO}_4 \end{array}$ 

Sol in hot  $\text{H}_2\text{O}$

— **sulphate,**

Sl sol in  $\text{H}_2\text{O}$  (Cleve)

**Hypoantimonic acid****Calcium hypoantimonate (?)**,  $\text{Ca}_2\text{Sb}_3\text{O}_8$ 

Min Romeite Insol in acids

**Potassium hypoantimonate,**  $\text{K}_2\text{Sb}_2\text{O}_5$ 

Sol in hot  $\text{H}_2\text{O}$  Sol in 425 pts boiling  $\text{H}_2\text{O}$  (Brandes) Sol in boiling  $\text{KOH} + \text{Aq}$  (Berzelius)

$\text{K}_2\text{Sb}_4\text{O}_9$  Ppt

**Hypoboric acid****Sodium hypoborate,**  $\text{NaOBH}_3$ 

Deliquescent, decomp in aq solution at room temp Decomp by acids Sl sol in alcohol with decomp (Stock, B 1914, 47 821)

**Hypobromous acid, HBrO**

Known only in aqueous solution

Solution containing 6.21 pts Br as  $\text{HBrO}$  in 100 ccm  $\text{H}_2\text{O}$  decomposes at  $30^\circ$  If dilute solution is distilled in vacuo, an acid containing 0.736 pt Br as  $\text{HBrO}$  in 100 ccm is obtained at first, but the distillate slowly grows weaker Dil solution, stable at ordinary temp, decomp by heating over  $60^\circ$  (Dancer A 125 237)

**Barium hypobromite**

Known only in solution

**Calcium hypobromite bromide**

Deliquescent, and sol in  $H_2O$  with partial decomp (Berzelius)

**Potassium hypobromite, KBrO**

Known only in solution

**Sodium hypobromite**

Known only in solution

**Strontium hypobromite**

Known only in solution

**Hypochlorous acid,  $HClO$** 

Miscible with  $H_2O$ . Decomposes at  $0^\circ$  in the dark, more rapidly at higher temp or in light. The stronger the solution the more rapid the decomposition. Moderately strong acid may be distilled without any considerable decomp, a stronger acid distilling over at first, and afterwards an acid weaker than the original acid. Very conc or very dil acids decomp by distillation.

**Ammonium hypochlorite**

Known only in aqueous solution, which decomposes at once

**Barium hypochlorite**

Known only in solution

**Calcium hypochlorite,  $Ca(OCl)_2 + 4H_2O$** 

Deliquescent, and sol in  $H_2O$  (Kinzgett, Chem Soc (2) 13 404)

**Calcium hypochlorite chloride, etc (bleaching powder),  $Ca(OCl)_2$ ,  $CaCl_2$ ,  $Ca(OH)_2 + H_2O$** 

Not deliquescent. Sol in  $H_2O$ . Alcohol does not dissolve out  $CaCl_2$ . Sol in 20 pts  $H_2O$  with a slight residue.

Correct formula is  $CaOCl_2$  (Lunge and Schappi, Kraut, A 214 354),  $Ca \overset{OCl}{OH}$  (Stahlschmidt, B 8 869),  $CaOCl$ ,  $Cl$  (Odling)

$CaCl_2$  is dissolved out by alcohol. Formula =  $2Ca \overset{OH}{OCl} CaCl + 2H_2O$  (Dreyfuss, Bull Soc (2) 41 600)

**Didymium hypochlorite,  $D_1(OCl)_3$** 

Difficultly sol in  $H_2O$ . Easily sol in acids (Frerichs and Smith, A 191 348)

**Lanthanum hypochlorite,  $La(OCl)_3$** 

Easily sol in  $H_2O$  (Frerichs and Smith)

**Lithium hypochlorite,  $LiClO$** 

Known only in solution (Kraut, A 1882, 214 356)

**Magnesium hypochlorite**

Known only in solution

**Potassium hypochlorite,  $KClO$** 

Known only in solution

**Silver hypochlorite,  $AgClO$** 

Very sol in  $H_2O$ , and decomp very quickly (Stas, Acad R de Belg 35 103)

**Sodium hypochlorite,  $NaClO$** 

Known only in solution

**Hypoiodic acid,  $I_2O_4$** 

See Iodine tetroxide

**Hypoiodous acid,  $HOI$** 

Known only in solution which decomp on standing (Taylor, C N 1897, 76 97)

**Calcium hypoiodite iodide,  $Ca(OI)_2$ ,  $CaI_2$** 

Not very unstable (Lunge and Shoch, B 15 1883)

**Hyponitric acid,  $N_2O_4$** 

See Nitrogen tetroxide

**Hyponitrous acid,  $HNO$ , or better  $H_2N_2O_2$** 

Known only in aqueous solution. Solution is quite stable (van der Plaats, B 10 1507)

Very deliquescent, sol in  $H_2O$  and alcohol, sol in ether, chloroform, benzene, sl sol in petroleum ether (Hantzsch and Kaufmann, A 1896, 292 323)

**Ammonium hyponitrite,  $(NH_4)_2N_2O_2$** 

Sol in  $H_2O$  and in alcohol (Jackson, C N 1893, 68 266)

**Ammonium hydrogen hyponitrite,  $NH_4.HN.O_2$** 

Easily sol in  $H_2O$ . The solid salt slowly decomp at ord temp into ammonia,  $H_2O$  and  $N_2O$  (Hantzsch and Kaufmann, A 1896, 292 328)

**Barium hyponitrite,  $Ba.N_2O_2$** 

Nearly insol in, but gradually decomp by  $H_2O$ . Sol in conc acids with evolution of  $N_2O$ , but sol in dil  $HCl_2H_3O_2 + Aq$  without decomp (Zorn, B 15 1007)

+ $4H_2O$  Sl sol in  $H_2O$ , insol in alcohol and ether (Kirschner, Z anorg 1898, 16 424)

+ $zH_2O$  Efflorescent (Maquenne, C R 108 1303)

**Barium hydrogen hyponitrite,  $BaH_2(N_2O_2)_2$** 

Easily sol in  $H_2O$  (Zorn, B 1882, 15 1011)

**Calcium hyponitrite,  $Ca.N_2O_2 + 4H_2O$** 

Nearly insol in  $H_2O$ , easily sol in dil acids (Maquenne, C R 108 1303)

Sl sol in  $H_2O$ , insol in alcohol (Kirschner, Z anorg 1898, 16 426)

**Cupric hyponitrite, basic,  $\text{CuN}_2\text{O}_2$ ,  $\text{Cu}(\text{OH})_2$** 

Insol in  $\text{H}_2\text{O}$ , not decomp by hot  $\text{H}_2\text{O}$   
Sol in dil acids and in ammonia. Decomp  
by  $\text{NaOH}$  (Divers, Chem Soc 1899, **75** 121)  
Insol in  $\text{H}_2\text{O}$  Sol in dil acids and in  
 $\text{NH}_4\text{OH} + \text{Aq}$  (Kirschner, Z anorg 1898,  
**16** 430)

**Cuprous hyponitrite,  $\text{Cu}_2\text{N}_2\text{O}_2 + 2\text{H}_2\text{O}$** 

Ppt (Kolotow, C C **1891**, I 1859)  
Cannot be formed (Divers, Chem Soc  
1899, **75** 121)

**Lead hyponitrite, basic,  $\text{PbN}_2\text{O}_2$ ,  $\text{PbO}$** 

Insol in  $\text{H}_2\text{O}$  Sol in dil acids from which  
it may be pptd by  $\text{NaOH} + \text{Aq}$  or  $\text{NH}_4\text{OH} +$   
 $\text{Aq}$  (Kirschner, Z anorg 1898, **16** 430)

**Lead hyponitrite,  $\text{PbN}_2\text{O}_2$** 

Insol in  $\text{H}_2\text{O}$ , sol in dil acids from which  
it may be pptd by  $\text{NaOH} + \text{Aq}$  or  $\text{NH}_3 + \text{Aq}$   
(Kirschner)

**Mercuric hyponitrite, basic,  $3\text{HgO}$ ,  $\text{HgN}_2\text{O}_2 + 3\text{H}_2\text{O}$** 

Ppt Sl sol even in boiling dil  $\text{HNO}_3$   
Scarcely sol in conc, very sol in warm dil  
 $\text{HCl}$  (Ray, Chem Soc 1897, **71** 349)

**Mercurous hyponitrite,  $\text{Hg}_2\text{N}_2\text{O}_2$** 

Sol in dil  $\text{HNO}_3$  with slow decomp (Ray,  
Chem Soc 1907, **91** 1404)

**Mercuric hyponitrite,  $\text{HgN}_2\text{O}_2$** 

Sol in  $\text{HCl}$ , and in  $\text{NaCl} + \text{Aq}$   
Sl sol in very dil alkali (Divers, Chem  
Soc 1899, **75** 119)

**Potassium hyponitrite,  $\text{K}_2\text{N}_2\text{O}_2$** 

Sol in  $\text{H}_2\text{O}$  (van der Plaats)  
Stable when dry  
Sol in 90% alcohol, and sl sol in abs  
alcohol (Divers, Chem Soc 1899, **75** 103)

**Silver hyponitrite (nitrosyl silver),  
 $\text{Ag}_2\text{N}_2\text{O}_2$** 

Insol in  $\text{H}_2\text{O}$  Easily sol in dil  $\text{HNO}_3 +$   
 $\text{Aq}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$

Decomp by  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{S}$ , and boiling  
 $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (van der Plaats)

Insol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , sol in  $\text{NH}_4\text{OH}$   
 $+ \text{Aq}$  (Divers, C N **23** 206)

Sol in dil  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  and in conc  
 $\text{NH}_4\text{OH} + \text{Aq}$ , decomp by  $\text{HCl}$  (Kirsch-  
ner, Z anorg 1898, **16** 431)

**Sodium hyponitrite,  $\text{Na}_2\text{N}_2\text{O}_2 + 6\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (van der Plaats)

**Strontium hyponitrite,  $\text{SrN}_2\text{O}_2$** 

Easily sol in  $\text{H}_2\text{O}$  (Roederer, Bull  
Soc 1906, (3) **35** 715)  
 $+ 5\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$ , easily sol

in dil acids (Maquenne, C R **108** 1303)

Sl sol in  $\text{H}_2\text{O}$ , insol in alcohol (Kirsch-  
ner, Z anorg 1898, **16** 426)

**Hypophosphomolybdic acid,  $\text{Mo}_5\text{O}_8$ ,  
 $7\text{H}_2\text{PO}_2 + 3\text{H}_2\text{O}$** 

Very sl sol in cold  $\text{H}_2\text{O}$  Scarcely sol  
in cold dil  $\text{H}_2\text{SO}_4$  Sol in cold conc  $\text{H}_2\text{SO}_4$   
Sol in warm conc  $\text{HCl}$  Warm  $\text{HNO}_3$   
oxidizes forming clear solution (Mawrow,  
Z anorg 1901, **28** 164)

**Ammonium hypophosphomolybdate,  
 $2(\text{NH}_4)_2\text{O}$ ,  $2\text{H}_3\text{PO}_2$ ,  $8\text{MoO}_3 + 2\text{H}_2\text{O}$** 

Not very sol in cold  $\text{H}_2\text{O}$ , readily in hot  
 $\text{H}_2\text{O}$  (Gibbs, Am Ch J **3** 402)

**Hypophosphoric acid,  $\text{H}_4\text{P}_2\text{O}_6$** 

Very deliquescent, and sol in the least  
amount of  $\text{H}_2\text{O}$  (Joly, C R **101** 1058)  
100 cc  $\text{H}_4\text{P}_2\text{O}_6 + \text{Aq}$ , containing 4 1%  $\text{P}_2\text{O}_4$   
has sp gr = 1 036

100 cc  $\text{H}_4\text{P}_2\text{O}_6 + \text{Aq}$ , containing 12 3%  
 $\text{P}_2\text{O}_4$  has sp gr = 1 122

(Salzer, A 1878, **194** 28)

$+ \text{H}_2\text{O}$  (Sanger, A **232** 14)

Does not exist (Joly)

$+ 2\text{H}_2\text{O}$  Appears to be the only stable  
hydrate between  $0^\circ$  and  $60^\circ$

Sanger's hydrate,  $\text{H}_4\text{P}_2\text{O}_6 + \text{H}_2\text{O}$ , and  
Joly's anhydride could not be obtained  
(Rosenheim, B 1908, **41** 2711)

**Aluminum hypophosphate,  $\text{Al}_4(\text{P}_2\text{O}_6)_3 +$   
 $23\text{H}_2\text{O}$** 

Easily sol in mineral acids Sol in  $\text{Na}_4\text{P}_2\text{O}_6$   
 $+ \text{Aq}$  (Palm, Dissertation, Rostock, **1890**)

**Ammonium hypophosphate,  $(\text{NH}_4)_4\text{P}_2\text{O}_6 +$   
 $\text{H}_2\text{O}$** 

Sol in 30 pts  $\text{H}_2\text{O}$  (Salzer, A **194** 32)

**Ammonium hydrogen hypophosphate,  
 $(\text{NH}_4)_2\text{H}_2\text{P}_2\text{O}_6$** 

Sol in 14 pts cold, and 4 pts boiling  $\text{H}_2\text{O}$   
(Salzer, A **194** 32)

**Ammonium trihydrogen hypophosphate,  
 $\text{NH}_4\text{H}_3\text{P}_2\text{O}_6$** 

Sol in  $\text{H}_2\text{O}$  (Salzer, A **211** 1)

**Ammonium magnesium hypophosphate,  
 $(\text{NH}_4)_2\text{MgP}_2\text{O}_6 + 6\text{H}_2\text{O}$** 

Precipitate (Salzer, A **232** 114)

**Barium hypophosphate,  $\text{Ba}_2\text{P}_2\text{O}_6$** 

Very slightly sol, but not wholly insol in  
 $\text{H}_2\text{O}$  Very slightly sol in acetic acid, but  
more soluble in hydrochloric, and hypophos-  
phoric acids (Salzer, A **194** 34)

**Barium hydrogen hypophosphate,  $\text{BaH}_2\text{P}_2\text{O}_6$   
 $+ 2\text{H}_2\text{O}$** 

Soluble in about 1000 pts  $\text{H}_2\text{O}$  Solution  
decomposes by heating (Salzer, A **194** 34)

**Bismuth hypophosphate**,  $\text{Bi}_4(\text{P}_2\text{O}_6)_3 + 8\frac{1}{2}\text{H}_2\text{O}$

Completely sol in  $\text{HCl} + \text{Aq}$ , also in warm  $\text{HNO}_3 + \text{Aq}$  Insol in boiling dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Sl sol by long boiling with conc  $\text{H}_2\text{SO}_4$  (Palm, Rostock, 1890)

**Cadmium hypophosphate**,  $\text{Cd}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in dil acids (Draue, B 21 3403)

**Cadmium potassium hydrogen hypophosphate**,  $\text{CdK}_3(\text{H}_2\text{P}_2\text{O}_6)_2 + 2\frac{1}{2}\text{H}_2\text{O}$

(Bausa, Z anorg 1894, 6 147)

**Cadmium sodium hypophosphate**,  $\text{CdNa}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , but decomp thereby Sol in dil acids (Draue)

**Calcium hypophosphate**,  $\text{Ca}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , difficultly sol in  $\text{HC}_2\text{H}_3\text{O}_2$ , easily sol in  $\text{H}_4\text{P}_2\text{O}_6$ , or  $\text{HCl} + \text{Aq}$  (Salzer, A 194 36)

**Calcium hydrogen hypophosphate**,  $\text{CaH}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$

Sol in 60 pts  $\text{H}_2\text{O}$  (Salzer, A 232 114)

**Chromic hypophosphate**,  $\text{Cr}_4(\text{P}_2\text{O}_6)_2 + 34\text{H}_2\text{O}$

Sol in  $\text{HCl} + \text{Aq}$  on sl warming, also in  $\text{HNO}_3 + \text{Aq}$  Not completely sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but completely sol in conc (Palm, Dissertation, Rostock, 1890)

**Cobaltous hypophosphate**,  $\text{Co}_2\text{P}_2\text{O}_6 + 8\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Easily sol in acids (Draue, B 21 3403)

**Cobaltous potassium hypophosphate**,  $\text{CoK}_2\text{P}_2\text{O}_6 + 5\text{H}_2\text{O}$

Ppt (Bausa, Z anorg 1894, 6 156)

**Cobaltous potassium hydrogen hypophosphate**,  $\text{CoH}_2\text{P}_2\text{O}_6, 3\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 15\text{H}_2\text{O}$

**Cobaltous sodium hypophosphate**,  $\text{CoNa}_2\text{P}_2\text{O}_6 + 1\frac{1}{2}\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , but decomp thereby Sol in dil acids (Draue, B 21 3403)

**Cupric hypophosphate**,  $\text{Cu}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in dil acids (Draue, B 21 3403)

Ppt (Bausa, Z anorg 1894, 6 145)

**Cupric potassium hydrogen hypophosphate**,  $\text{CuH}_2\text{P}_2\text{O}_6, 3\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 15\text{H}_2\text{O}$

Ppt (Bausa, Z anorg 1894, 6 152)

**Glucinum hypophosphate**,  $\text{Gl}_2\text{P}_2\text{O}_6 + 7\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Moderately sol in all mineral acids (Palm, Rostock, 1890)  $+ 3\text{H}_2\text{O}$  (Rammelsberg)

**Iron (ferrous) hypophosphate**,  $\text{Fe}_2\text{P}_2\text{O}_6 + 4\frac{1}{2}\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in cold  $\text{HCl} + \text{Aq}$  Decomp by hot  $\text{HNO}_3 + \text{Aq}$  into  $\text{Fe}_4(\text{P}_2\text{O}_6)_3$  Insol in  $\text{HNO}_3 + \text{Aq}$  Insol in boiling dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Somewhat sol in cold  $\text{H}_2\text{SO}_4$ , but a ppt separates out on heating (Palm, Rostock, 1890)

**Iron (ferric) hypophosphate**,  $\text{Fe}_4(\text{P}_2\text{O}_6)_3 + 20\text{H}_2\text{O}$

Easily sol in  $\text{HCl} + \text{Aq}$  Wholly insol in  $\text{HNO}_3$ , and dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Completely sol in conc  $\text{H}_2\text{SO}_4$  by warming a short time, but a ppt separates out on boiling (Palm)

**Lead hypophosphate**,  $\text{Pb}_2\text{P}_2\text{O}_6$

Insol in  $\text{H}_2\text{O}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_4\text{P}_2\text{O}_6 + \text{Aq}$ , sol in dil  $\text{HNO}_3 + \text{Aq}$  (Salzer)

**Lithium hypophosphate**,  $\text{Li}_4\text{P}_2\text{O}_6 + 7\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$  (Salzer, A 194 28)

Sol in 120 pts  $\text{H}_2\text{O}$  at ord temp (Rammelsberg, J pr (2) 45 153)

$\text{Li}_2\text{H}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$  Deliquescent (Rammelsberg)

**Magnesium hypophosphate**,  $\text{Mg}_2\text{P}_2\text{O}_6 + 12\text{H}_2\text{O}$

Sol in 15,000 pts  $\text{H}_2\text{O}$ , sl sol in acetic, easily in hypophosphoric, or mineral acids (Salzer, A 232 114)

$+ 24\text{H}_2\text{O}$  (Rammelsberg)

**Magnesium hydrogen hypophosphate**,

$\text{MgH}_2\text{P}_2\text{O}_6 + 4\text{H}_2\text{O}$

Sol in 200 pts  $\text{H}_2\text{O}$  (Salzer, A 232 114)

**Manganese hypophosphate**,  $\text{Mn}_2\text{P}_2\text{O}_6 + 2\frac{1}{2}\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , sol in mineral acids, insol in acetic acid (Palm, Dissertation, Rostock, 1890)

**Manganous potassium hydrogen hypophosphate**,  $\text{MnH}_2\text{P}_2\text{O}_6, \text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 3\text{H}_2\text{O}$

Ppt (Bausa, Z anorg 1894, 6 150)

**Manganous sodium hypophosphate**,  $\text{Mn}_2\text{P}_2\text{O}_6, \text{Na}_4\text{P}_2\text{O}_6 + 11\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , sol in mineral acids (Palm)

**Nickel hypophosphate**,  $\text{Ni}_2\text{P}_2\text{O}_6 + 12\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in dil acids (Draue, B 21 3401)

**Nickel potassium hypophosphate**,

$\text{NiK}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$

Ppt (Bausa, Z anorg 1894, 6 155)

**Nickel potassium hydrogen hypophosphate**,

$\text{NiH}_2\text{P}_2\text{O}_6, 3\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 15\text{H}_2\text{O}$

Ppt (Bausa, Z anorg 1894, 6 144)

**Nickel sodium hypophosphate**,  $\text{NiNa}_2\text{P}_2\text{O}_6 + 12\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , but decomp thereby Easily sol in dil acids (Draue)

**Potassium hypophosphate**,  $\text{K}_4\text{P}_2\text{O}_6 + 8\text{H}_2\text{O}$

Sol in  $\frac{1}{4}$  pt  $\text{H}_2\text{O}$ , insol in alcohol (Salzer, A 211 1)

**Potassium hydrogen hypophosphate**,  $\text{K}_3\text{HP}_2\text{O}_6 + 3\text{H}_2\text{O}$

Sol in  $\frac{1}{2}$  pt  $\text{H}_2\text{O}$  (Salzer, A 211 1)

**Potassium dihydrogen hypophosphate**,  $\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 3\text{H}_2\text{O}$ , and  $+2\text{H}_2\text{O}$

Sol in 3 pts cold, and 1 pt boiling  $\text{H}_2\text{O}$  (Salzer, A 211 1)

**Potassium trihydrogen hypophosphate**,  $\text{KH}_3\text{P}_2\text{O}_6$

Sol in  $1\frac{1}{2}$  pts cold, and  $\frac{1}{2}$  pt hot  $\text{H}_2\text{O}$  (Salzer, A 211 1)

**Potassium pentahydrogen dihypophosphate**,  $\text{K}_3\text{H}(\text{P}_2\text{O}_6)_2 + 2\text{H}_2\text{O}$

Sol in  $2\frac{1}{2}$  pts cold, and  $\frac{4}{5}$  pt boiling  $\text{H}_2\text{O}$  (Salzer, A 211 1)

**Potassium sodium hypophosphate**,  $\text{Na}_2\text{K}_2\text{P}_2\text{O}_6 + 9\text{H}_2\text{O}$

Sol in about 25 pts cold, and 3 pts hot  $\text{H}_2\text{O}$  (Bausa, Z anorg 1894, 6 158)

**Potassium zinc hypophosphate**,  $\text{ZnH}_2\text{P}_2\text{O}_6 \cdot 3\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 15\text{H}_2\text{O}$

Ppt (Bausa, Z anorg 1894, 6 148)

**Silver hypophosphate**,  $\text{Ag}_4\text{P}_2\text{O}_6$

Sl sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  Very sl sol in  $\text{H}_4\text{P}_2\text{O}_6 + \text{Aq}$  (Salzer, A 232 114)

**Sodium hypophosphate**,  $\text{Na}_4\text{P}_2\text{O}_6 + 10\text{H}_2\text{O}$

Sol in about 30 pts cold, much more easily in hot  $\text{H}_2\text{O}$  (Salzer)

**Sodium hydrogen hypophosphate**,  $\text{Na}_3\text{HP}_2\text{O}_6 + 9\text{H}_2\text{O}$

Sol in 22 pts  $\text{H}_2\text{O}$  (Salzer)

**Sodium dihydrogen hypophosphate**,  $\text{Na}_2\text{H}(\text{P}_2\text{O}_6) + 6\text{H}_2\text{O}$

Sol in 45 pts cold, and 5 pts boiling  $\text{H}_2\text{O}$  More sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Insol in alcohol (Salzer, A 187 331)

**Sodium trihydrogen hypophosphate**,  $\text{NaH}_3\text{P}_2\text{O}_6$

Sol in  $\text{H}_2\text{O}$  (Salzer, A 211 1)

**Sodium trihydrogen dihypophosphate**,

Very efflorescent Sol in 15 pts cold  $\text{H}_2\text{O}$  (Salzer, A 211 1)

**Thallium hypophosphate**,  $\text{Tl}_4\text{P}_2\text{O}_6$

Sl sol in  $\text{H}_2\text{O}$  Decomp in sunlight (Joly, C R 1894, 118 650)

**Thallium hydrogen hypophosphate**,  $\text{Tl}_2\text{H}_2\text{P}_2\text{O}_6$

Sol in  $\text{H}_2\text{O}$  (Joly)

**Zinc hypophosphate**,  $\text{Zn}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Easily sol in dil acids (Draue, B 21 3403)

**Hypophosphorosomolybdic acid**

**Barium hypophosphorosomolybdate**,

$\text{BaO}, \text{Mo}_7\text{O}_{20}, 3\text{H}_3\text{PO}_4 + 12\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  and  $\text{BaCl}_2 + \text{Aq}$  (Mawrow, Z anorg 1902, 29 156)

**Hypophosphorous acid**,  $\text{H}_3\text{PO}_2$

Very sol in  $\text{H}_2\text{O}$  and alcohol (Rose)

**Aluminum hypophosphite**

Not deliquescent, but very sol in  $\text{H}_2\text{O}$  (Rose, Pogg 12 86)

**Ammonium hypophosphite**,  $\text{NH}_4\text{H}_2\text{PO}_2$

Sol in  $\text{H}_2\text{O}$ , less deliquescent than the potassium salt (Wurtz, A ch (3) 7 193)  
Very sol in absolute alcohol (Dulong)  
Moderately sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 826)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4328)

**Barium hypophosphite**,  $\text{Ba}(\text{H}_2\text{PO}_2)_2 + \text{H}_2\text{O}$

Sol in 3 5 pts cold, and 3 pts boiling  $\text{H}_2\text{O}$   
Insol in alcohol (Wurtz, A 43 323)

**Bismuth hypophosphite**,  $\text{Bi}(\text{H}_2\text{PO}_2)_3$

Ppt (Vanino, J pr 1906, (2) 74 150)  
 $+ \text{H}_2\text{O}$  Sol in acid  $\text{Bi}(\text{NO}_3)_3 + \text{Aq}$  (Haga, Chem Soc 1895, 67 229)

**Cadmium hypophosphite**

Sol in  $\text{H}_2\text{O}$  (Rose, Pogg 12 91)

**Calcium hypophosphite**,  $\text{Ca}(\text{PH}_2\text{O}_2)_2$

Sol in 6 pts cold, and not much more sol in hot  $\text{H}_2\text{O}$  Insol in strong, very sol in weak alcohol (Rose, Pogg 9 361)

**Calcium cobaltous hypophosphite**

$2\text{Ca}(\text{PH}_2\text{O}_2)_2, \text{Co}(\text{PH}_2\text{O}_2)_2 + 2\text{H}_2\text{O}$   
Efflorescent (Rose, Pogg 12 295)

**Calcium ferrous hypophosphite**

Sol in  $\text{H}_2\text{O}$  (Rose, Pogg 12 294)

**Cerous hypophosphite**,  $\text{Ce}(\text{PH}_2\text{O}_2)_3 + \text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Rammelsberg, B A B 1872 437)

**Chromium hypophosphite**,  $\text{Cr}_2(\text{OH})_2(\text{H}_2\text{PO}_2)_4$

*Anhydrous* Insol in  $\text{H}_2\text{O}$  or dil acids  
+  $3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Wurtz, A ch (3) 16 196)

**Cobaltous hypophosphite**,  $\text{Co}(\text{PH}_2\text{O}_2)_2 + 6\text{H}_2\text{O}$

Efflorescent Easily sol in  $\text{H}_2\text{O}$  (Rose, Pogg 12 87)

**Cupric hypophosphite**,  $\text{Cu}(\text{PH}_2\text{O}_2)_2$

Very sol in  $\text{H}_2\text{O}$ , but very easily decomp on heating (Wurtz, A ch (3) 16 199)

**Glucinum hypophosphite**

Sol in  $\text{H}_2\text{O}$  (Rose, Pogg 12 86)

**Iron (ferrous) hypophosphite**,  $\text{Fe}(\text{PH}_2\text{O}_2)_2 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Rose, Pogg 12 294)

**Iron (ferric) hypophosphite**

Difficultly sol in  $\text{H}_2\text{O}$  or acids Decomp on boiling Sl sol in  $\text{H}_3\text{PO}_2 + \text{Aq}$  (Rose)

**Lead hypophosphite**,  $\text{Pb}(\text{PH}_2\text{O}_2)_2$

Difficultly sol in cold, more easily in hot  $\text{H}_2\text{O}$  Insol in alcohol (Rose, Pogg 12 288)

**Lithium hypophosphite**,  $\text{LiH}_2\text{PO}_2 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Rammelsberg, B A B 1872 416)

**Magnesium hypophosphite**,  $\text{Mg}(\text{PH}_2\text{O}_2)_2 + 6\text{H}_2\text{O}$

Efflorescent in dry air Sol in  $\text{H}_2\text{O}$  (Rose)

**Manganous hypophosphite**,  $\text{Mn}(\text{H}_2\text{PO}_2)_2 + \text{H}_2\text{O}$

Permanent Very sol in  $\text{H}_2\text{O}$  (Wurtz, A ch (3) 16 195)

**Mercurous hypophosphite nitrate**,

$\text{Hg}_2\text{H}_2\text{PO}_2, \text{HgNO}_3 + \text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  with rapid decomp  
Sol in hot conc  $\text{HNO}_3$  (Haga, Chem Soc 1895, 67 227)

**Nickel hypophosphite**,  $\text{Ni}(\text{PH}_2\text{O}_2)_2 + 6\text{H}_2\text{O}$

Efflorescent Sol in  $\text{H}_2\text{O}$  (Rammelsberg, B 5 494)

**Nickel hypophosphite ammonia**,

$\text{Ni}(\text{HPO}_2)_2, 6\text{NH}_3$   
(Ephraim, B 1913, 46 3111)

**Platinous hypophosphite**  $\text{Pt}(\text{PH}_2\text{O}_2)_2$

Insol in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4 + \text{Aq}$ , etc Sol in  $\text{HNO}_3 + \text{Aq}$  Insol in alcohol (Engel, C R 91 1068)

**Potassium hypophosphite**,  $\text{KH}_2\text{PO}_2$

Very deliquescent Very sol in  $\text{H}_2\text{O}$  sol in weak, less in absolute alcohol Insol in ether (Wurtz, A ch (3) 7 192)  
Sl sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

**Sodium hypophosphite**,  $\text{NaH}_2\text{PO}_2 + \text{H}_2\text{O}$

Very deliquescent Somewhat less sol than the K salt Very sol in absolute alcohol (Dulong)

Very sol in  $\text{H}_2\text{O}$ , and somewhat less sol in alcohol (Rammelsberg, B A B 1872 412)  
Sl sol in liquid  $\text{NH}_3$  (Franklin, Am Ch. J 1898, 20 829)

**Strontium hypophosphite**,  $\text{Sr}(\text{PH}_2\text{O}_2)_2$

Very easily sol in  $\text{H}_2\text{O}$  (Dulong)  
Insol in alcohol (Wurtz)

**Thallous hypophosphite**,  $\text{TlH}_2\text{PO}_2$

Sol in  $\text{H}_2\text{O}$  (Rammelsberg, B A B 1872 492)

**Uranyl hypophosphite**,  $\text{UO}_2(\text{H}_2\text{PO}_2)_2 + \text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg, Chem Soc (2) 11 1)

**Vanadyl hypophosphite**,  $\text{V}_2\text{O}_5(\text{H}_2\text{PO}_2)_4 + 2\text{H}_2\text{O}$

Insol in cold, sl sol in hot  $\text{H}_2\text{O}$   
Sol in hot dil  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  and in warm conc  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$   
Insol in oxalic acid (Mawrow, Z anorg 1907, 55 147)

**Zinc hypophosphite**,  $\text{Zn}(\text{H}_2\text{PO}_2)_2 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$   
+  $6\text{H}_2\text{O}$  Efflorescent (Wurtz, A ch (3) 16 195)

**Zirconium hypophosphite**,  $\text{Zr}(\text{OPH}_2\text{O})_4 + \text{H}_2\text{O}$

Sensitive to light Insol in alcohol, by which it is pptd from aqueous solution (Hauser, Z anorg 1913, 84 93)

**Hypophosphotungstic acid**

**Potassium hypophosphotungstate**,  $4\text{K}_2\text{O}, 6\text{H}_3\text{PO}_2, 18\text{WO}_3 + 7\text{H}_2\text{O}$

Precipitate Sol in hot, very sl sol in cold  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 5 361)

**Hyposulpharsemous acid**

**Hyposulpharsenites**,  $\text{As}_2\text{S}_2, \text{M}_2\text{S}$

Difficultly sol in  $\text{H}_2\text{O}$  (Berzelius)  
Do not exist (Nilson, B 4 989)

**Hyposulphuric acid**,  $\text{H}_2\text{S}_2\text{O}_6$

See Dithionic acid

**Hyposulphurous acid,  $\text{H}_2\text{S}_2\text{O}_3$** See **Thiosulphuric acid****Hyposulphurous (Hydrosulphurous) acid,  $\text{H}_2\text{SO}_2$** 

Known only in dil aqueous solution, which decomposes rapidly

Correct formula is  $\text{H}_2\text{S}_2\text{O}_4$ , according to Bernthsen (A 211 285)More sol in alcohol than in  $\text{H}_2\text{O}$  (Rossler, Arch Pharm (3) 25 845)**Ammonium hyposulphite,  $(\text{NH}_4)_2\text{S}_2\text{O}_4$** 

Known only in solution (Prudhomme, Bull Soc 1899, (3) 21 326)

**Ammonium hydrogen hyposulphite,  $\text{NH}_4\text{HS}_2\text{O}_4$** 

Known only in solution (Prudhomme, Bull Soc 1899, (3) 21 326)

**Calcium hyposulphite,  $\text{CaS}_2\text{O}_4 + 1.5\text{H}_2\text{O}$** Difficultly sol in  $\text{H}_2\text{O}$  (Bazlen, B 1905, 38 1059)**Magnesium hyposulphite,  $\text{MgS}_2\text{O}_4$** 

(Billv, C R 1905, 140 936)

**Potassium hyposulphite,  $\text{K}_2\text{S}_2\text{O}_4 + 3\text{H}_2\text{O}$** 

Easily decomp

Insol in alcohol (Bazlen, B 1905, 38 1058)

**Sodium hyposulphite,  $\text{Na}_2\text{S}_2\text{O}_4$** *Anhydrous* Stable in dry air (Bazlen, B 1905, 38 1061)100 g  $\text{H}_2\text{O}$  dissolve 24.1 g of the anhydrous salt at  $20^\circ$  (Jellinek, Z anorg 1911, 70 130) $+2\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$ 

11.6 g of the solution contain at

 $20^\circ$  1.91 g  $\text{Na}_2\text{S}_2\text{O}_4$  $10^\circ$  1.67 g $1^\circ$  1.49 g

(Jellinek, Z anorg 1911, 70 128)

Insol in alcohol (Bazlen, B 1905, 38 1058)

**Sodium zinc hyposulphite,  $\text{Na}_2\text{S}_2\text{O}_4, \text{ZnS}_2\text{O}_4$** Less sol in  $\text{H}_2\text{O}$  than  $\text{ZnS}_2\text{O}_4$  (Bazlen, B 1905, 38 1060)**Strontium hyposulphite,  $\text{SrS}_2\text{O}_4$** Sol in  $\text{H}_2\text{O}$  (Moissan, C R 1902, 135 653)**Zinc hyposulphite,  $\text{ZnS}_2\text{O}_4$** Easily sol in  $\text{H}_2\text{O}$ , about 1 pt in 7 pts  $\text{H}_2\text{O}$ . Forms supersat solutions readily (Bazlen, B 1905, 38 1060)**Hypovanadic acid,  $\text{V}_2\text{O}_2(\text{OH})_4$** See **Vanadium tetrhydroxide****Hypovanadic acid,  $\text{H}_2\text{V}_4\text{O}_9$** See **Vanadous acid****Hypovanadic acid with vanadic acid**See **Vanadicovanadic acid****Imidodimetaarsenic acid****Ammonium imidodimetaarsenate,** $(\text{NH}_4\text{O}_2\text{As}_2\text{O}_5\text{NH})$ 

(Rosenheim and Jacobsohn, Z anorg 1906, 50 307)

**Imidochromic acid****Ammonium imidochromate,** $\text{NHCrO}(\text{ONH}_4)_2$ Very sol in  $\text{H}_2\text{O}$  with decomp (Rosenheim and Jacobsohn, Z anorg 1906, 50 299)**Ammonium potassium imidochromate,** $\text{NH}_4\text{KCrO}_5\text{NH}$ Decomp on solution in  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1906, 50 302)**Imidodimidochromic acid****Ammonium imidodimido chromate,** $\text{NH}[\text{CrO}(\text{NH})\text{ONH}_4]_2$ 

(Rosenheim and Jacobsohn, Z anorg 1906, 50 303)

**Imidomolybdic acid****Potassium imidomolybdate,  $\text{KMoO}(\text{OK})_2$** 

Unstable in air

Very hygroscopic Very sol in  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1906, 50 305)**Dimidodiphosphorhormonic acid,** $\text{HO}-\text{PO} < \begin{smallmatrix} \text{NH} \\ \text{NH} \end{smallmatrix} > \text{PO}-\text{NH}_2$ Correct formula for *pyrophosphotriamic acid* of Gladstone (Mente, A 248 241)**Imidodiphosphoric acid,** $\text{HO}-\text{PO} < \begin{smallmatrix} \text{O} \\ \text{NH} \end{smallmatrix} > \text{PO}-\text{OH}$ Correct name for *pyrophosphamic acid* (Mente, A 248 251)**Barium imidodiphosphate,  $\text{Ba} \begin{smallmatrix} \text{O} \\ \text{O} \end{smallmatrix} \begin{smallmatrix} \text{PO} \\ \text{PO} \end{smallmatrix} > \text{NH}$** Sl sol in  $\text{H}_2\text{O}$  (Mente, A 248 243)**Barium imidodiphosphate, basic,** $\text{Ba} \begin{smallmatrix} \text{O} \\ \text{O} \end{smallmatrix} \begin{smallmatrix} \text{PO} \\ \text{PO} \end{smallmatrix} > \text{N}-\text{Ba}-\text{N} \begin{smallmatrix} \text{PO}-\text{O} \\ \text{PO}-\text{O} \end{smallmatrix} \text{Ba} +$  $2\text{H}_2\text{O}$ 

Ppt (Mente)



**Ferric imidodiphosphate**

Sl sol in conc acids (Mente, A 248 241)

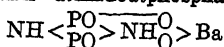
**Silver imidodiphosphate,  $\text{Ag}_3\text{H}_2\text{P}_2\text{NO}_6$** 

Insol in  $\text{H}_2\text{O}$  (Stokes, Am Ch J 1896, 18 660)

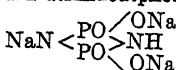
$\text{Ag}_4\text{HP}_2\text{NO}_6$  Ppt (Stokes)

**Dimidodiphosphoric acid,**

Correct name for *pyrophosphodiamic acid* (Mente, A 248 241)

**Barium dimidodiphosphate,**

Sl sol in dil acids (Mente, A 248 244)

**Sodium dimidodiphosphate, basic,**

Sl sol in  $\text{H}_2\text{O}$  (Mente, A 248 245)

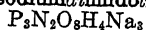
**Dimidotriphosphoric acid****Silver dimidotriphosphate,  $\text{Ag}_3\text{H}_4\text{P}_3\text{N}_2\text{O}_8$** 

Insol in  $\text{H}_2\text{O}$  Very sol in  $\text{NH}_4\text{OH} + \text{Aq}$

Rather sl sol in dil  $\text{HNO}_3$  (Stokes, Am Ch J 1896, 18 657)

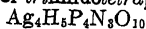
$\text{Ag}_3\text{H}_2\text{P}_3\text{N}_2\text{O}_8$  Insol in  $\text{H}_2\text{O}$  Very sol in  $\text{NH}_4\text{OH} + \text{Aq}$

Decomp by  $\text{HNO}_3$  (Stokes)

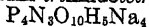
**Trisodiumdimidotriphosphate,**

Sol in  $\text{H}_2\text{O}$

Insol in alcohol (Stokes)

**Trumidotetraphosphoric acid****Silver trumidotetraphosphate**

Ppt (Stokes, Am Ch J 1898, 20 755)

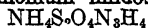
**Sodium trumidotetraphosphate,**

Easily sol in  $\text{H}_2\text{O}$ , insol in sodium acetate solution and dil alcohol (Stokes, Am Ch J 1898, 20 754)

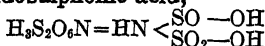
**Imidosulphamide,  $\text{NH}_2\text{SO}_2\text{NH}\text{SO}_2\text{NH}_2$** 

"Sulphamide" of Traube

Very sol in  $\text{H}_2\text{O}$  with decomp appreciably sol in cold, easily sol in hot methyl and ethyl alcohol Insol in  $\text{C}_6\text{H}_6$ , and  $\text{CHCl}_3$  Sl sol in ether, cold and hot acetic ether and glacial acetic acid Moderately stable toward alkalis (Hantzsch and Stuer, B 1905, 38 1022)

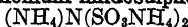
**Ammonium imidosulphamide,**

(Hantzsch and Stuer)

**Imidosulphonic acid,**

Ammondisulphonic acid of Claus Known only in aqueous solution (Divers and Haga, Chem Soc 61 943)

Very unstable (Berglund, B 9 252)

**Ammonium imidosulphonate, basic,**

Sol in 9 pts of  $\text{H}_2\text{O}$  Solution is stable

Insol in alcohol

Sl sol in warm conc  $\text{H}_2\text{SO}_4$  without decomp (Rose, Pogg 1834, 32 81)

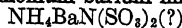
Much less sol than the neutral salt (Berglund, B 9 255)

"Parasulphatammon"

+ $\text{H}_2\text{O}$  Gradually efflorescent Sol in  $\text{H}_2\text{O}$  with subsequent decomp (Divers and Haga)

**Ammonium imidosulphonate,  $\text{HN}(\text{SO}_3\text{NH}_4)_2$** 

Sol in  $\text{H}_2\text{O}$  (Raschig, A 241 161)

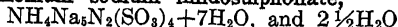
**Ammonium barium imidosulphonate,**

Very sl sol in  $\text{H}_2\text{O}$  (Divers and Haga)

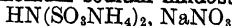
$(\text{NH}_4)_2\text{Ba}_5\text{N}_4(\text{SO}_3)_8 + 8\text{H}_2\text{O}$  (D and H)

**Ammonium calcium imidosulphonate**

(Divers, Chem Soc 1892, 61 968)

**Ammonium sodium imidosulphonate,**

Very sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Divers and Haga)

**Ammonium sodium imidosulphonate nitrate,**

Very sol in  $\text{H}_2\text{O}$  (Divers and Haga)

**Barium imidosulphonate,  $\text{Ba}[\text{N}(\text{SO}_3)_2\text{Ba}]_2 + 5\text{H}_2\text{O}$** 

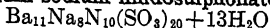
Sl sol in  $\text{H}_2\text{O}$  (Berglund, B 9 255)

Sol in dil  $\text{HNO}_3 + \text{Aq}$  without decomp (Divers and Haga)

$\text{HN}(\text{SO}_3)_2\text{Ba} + \text{H}_2\text{O}$  Moderately sol in  $\text{H}_2\text{O}$  (D and H)

**Barium mercury imidosulphonate,**

Almost insol in cold  $\text{H}_2\text{O}$  (Divers and Haga, Chem Soc 1892, 61 977)

**Barium sodium imidosulphonate,**

Sparsely sol in  $\text{H}_2\text{O}$  Readily sol in  $\text{HNO}_3$  or  $\text{HCl}$  (Divers, Chem Soc 1892, 61 967)

**Calcium imidosulphonate**,  $\text{Ca}[\text{N}(\text{SO}_3)_2\text{Ca}]_2 + 6\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Berglund)

**Calcium mercury imidosulphonate**,  
 $\text{N}_2\text{Hg}[(\text{SO}_3)_2\text{Ca}]_2$

Very sol in  $\text{H}_2\text{O}$  (Divers and Haga, Chem Soc 1896, 69 1629)

**Calcium mercury imidosulphonate chloride**,  
 $(\text{NS}_2\text{O}_6\text{Ca})_2\text{Hg}_2\text{Cl} + 12\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Divers and Haga, Chem Soc 1896, 69 1629)

**Calcium sodium imidosulphonate**,  
 $\text{NaN}(\text{SO}_3)_2\text{Ca} + 3\text{H}_2\text{O}$

Sl sol in cold  $\text{H}_2\text{O}$  (Divers and Haga, Chem Soc 61 968)

**Lead imidosulphonate**,  $(\text{PbOHSO}_3)_2\text{NPbOH}$

Ppt (Berglund)

Insol in  $\text{H}_2\text{O}$  (Divers and Haga)

$(\text{PbOH})_3\text{N}(\text{SO}_3)_2$ ,  $\text{PbO}$  Insol in  $\text{H}_2\text{O}$ , easily sol in dil  $\text{HNO}_3 + \text{Aq}$  (D and H)

**Mercurous imidosulphonate, basic**,  
 $[\text{Hg}_2\text{N}(\text{SO}_3)_2\text{Hg}_2]\text{O} + 6\text{H}_2\text{O}$

Much more sol in dil  $\text{HNO}_3$  than mercuric salt Sol in cold conc  $\text{KI} + \text{Aq}$ , leaving half  $\text{Hg}$  as metal (Divers and Haga, Chem Soc 1896, 69 1631)

**Mercuric imidosulphonate, basic**,  
 $\text{NH}(\text{SO}_3)_2\text{Hg}$

Easily decomp (Divers and Haga)

**Mercuriomercuric imidosulphonate**,  
 $[\text{Hg}^{\text{II}}\text{N}(\text{SO}_3)_2\text{Hg}^{\text{I}}]\text{O} + 3\text{H}_2\text{O}$

(Divers and Haga)

$[\text{Hg}^{\text{II}}\text{N}(\text{SO}_3)_2\text{Hg}^{\text{I}}]\text{O}$ ,  $[\text{Hg}^{\text{II}}\text{N}(\text{SO}_3)_2\text{Hg}_2]$ ,  $\text{Hg}^{\text{II}}\text{N}(\text{SO}_3)_2\text{Hg}^{\text{I}}\text{O} + 6\text{H}_2\text{O}$  (Divers and Haga)

**Mercury sodium imidosulphonate, basic**,  
 $\text{Hg}_2\text{ON}(\text{SO}_3)_2\text{Na} + 2\text{H}_2\text{O}$

Slightly efflorescent Decomp by long washing with  $\text{H}_2\text{O}$  Much more readily sol in  $\text{HCl}$  than in  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$  and is wholly decomp thereby (Divers and Haga, Chem Soc 1892, 61 983)

**Mercury sodium imidosulphonate**,  
 $\text{HgN}_2(\text{SO}_3)_2\text{Na} + 6\text{H}_2\text{O}$

Sparsely sol in cold  $\text{H}_2\text{O}$

Readily sol in  $\text{HNO}_3$  and in  $\text{HCl}$

Decomp by  $\text{HCl}$  immediately, but not by  $\text{HNO}_3$  (Divers and Haga, Chem Soc 1892, 61 951)

**Potassium imidosulphonate, basic**,  
 $\text{KN}(\text{SO}_3\text{K})_2 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Raschig, A 241 161)

Less sol than neutral salt (Berglund)

**Potassium imidosulphonate**,  $\text{HN}(\text{SO}_3\text{K})_2$

Sol in  $\text{H}_2\text{O}$  (Raschig, A 241 161)

= Potassium ammoniumsulphonate of Claus  
Difficultly sol in cold  $\text{H}_2\text{O}$ , sol in 64 pts  $\text{H}_2\text{O}$  at  $23^\circ$  (Fremy) Gradually decomp by boiling (Claus)

Sl sol in  $\text{H}_2\text{O}$  (Berglund, B 9 255)

**Potassium mercury imidosulphonate**,  
 $\text{N}_2\text{Hg}(\text{SO}_3\text{K})_4 + 4\text{H}_2\text{O}$

See Mercurimidosulphonic acid.

**Silver imidosulphonate**,  $\text{AgN}(\text{SO}_3\text{Ag})_2$

Sl sol in  $\text{H}_2\text{O}$  (Berglund)

**Silver sodium imidosulphonate**,  
 $\text{NaN}(\text{SO}_3\text{Ag})_2$

Sl sol in  $\text{H}_2\text{O}$  (Divers and Haga)

$\text{AgNa}_2\text{N}(\text{SO}_3)_2$  Sl sol in  $\text{H}_2\text{O}$ , but more sol than the two preceding salts (D and H)

**Sodium imidosulphonate**,  $\text{HN}(\text{SO}_3\text{Na})_2 + 2\text{H}_2\text{O}$

Not efflorescent Very sol in  $\text{H}_2\text{O}$  (Diver and Haga)

$\text{NaN}(\text{SO}_3\text{Na})_2 + 12\text{H}_2\text{O}$  Efflorescent Sl sol in cold  $\text{H}_2\text{O}$ , but very sol in hot  $\text{H}_2\text{O}$  Sol in 5.4 pts  $\text{H}_2\text{O}$  at  $27.5^\circ$  (Divers and Haga)

**Sodium strontium imidosulphonate**,  
 $\text{SrNaNS}_2\text{O}_6 + 3\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Divers, Chem Soc 1896, 69 1625)

**Strontium imidosulphonate**,  
 $\text{Sr}[\text{N}(\text{SO}_3)_2\text{Sr}]_2 + 6\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Berglund)

+  $12\text{H}_2\text{O}$  Somewhat sol in hot  $\text{H}_2\text{O}$  (Divers, Chem Soc 1896, 69 1623)

**Imidotrisulphoorthophosphoric acid**,  
 $\text{NH}_4\text{P}(\text{SH})_3$

Insol in  $\text{CS}_2$  and readily decomp by  $\text{H}_2\text{O}$  (Stock, B 1906, 39 1991)

**Ammonium imidotrisulphoorthophosphate**,  
 $\text{NH}_4\text{P}(\text{SNH}_2)_3$

Very hygroscopic

Loses  $\text{NH}_3$  in the air

Somewhat sol in liquid  $\text{NH}_3$

Decomp by any other solvent in which it is sol (Stock, B 1906, 39 1983)

**Diammonium hydrogen imidotrisulphoorthophosphate**,  $\text{SHP}(\text{SNH}_2)_2\text{NH}_4$

(Stock, B 1906, 39 1983)

**Ammonium dihydrogen ———**,  
 $\text{SNH}_4\text{P}(\text{SH})_2\text{NH}_4$

(Stock)

**Dissodium hydrogen imidosulphocorthophosphate**,  $\text{SHP}(\text{SNa})_2\text{NH}$

Very easily sol in  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$   
Somewhat sol in methyl and ethyl alcohol (Stock)

**Diamidopentasilphopyrophosphoric acid**,  
 $\text{P}_2\text{S}_5\text{N}_2\text{H}_8$

Not known in pure state (Stock, B 1906, 39 1967)

**Ammonium diamidopentasilphopyrophosphate**,  $\text{S}[\text{P}(\text{SNH}_4)_2\text{NH}]_2$

Very hygroscopic  
Sol in cold  $\text{H}_2\text{O}$  with decomp (Stock, B 1906, 39 1978)

### Indosulphurous acid

**Ammonium imidosulphite**,  $\text{HN}(\text{SO}_2\text{NH}_4)_2$

Somewhat deliquescent  
Very unstable Easily sol in  $\text{H}_2\text{O}$  with decomp into thiosulphate and amidosulphate  
Insol in alcohol (Divers and Ogawa, Chem Soc 1901, 79 1100)

**Ammonium barium imidosulphite**,  
 $\text{Ba}(\text{SO}_2\text{NH}\text{SO}_2\text{NH}_4)_2$

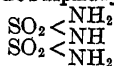
$\text{H}_2\text{O}$  (Divers, Chem Soc 1901,

**Potassium imidosulphite**,  $\text{NH}(\text{SO}_2\text{K})_2$

(Divers and Owaga, Proc Chem Soc 1900, 16 113)

Very sol in  $\text{H}_2\text{O}$  (Divers, Chem Soc 1901, 79 1101)

**Imidosulphuryl amide**,  $\text{S}_2\text{O}_4\text{N}_3\text{H}_5 =$



Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp by conc  $\text{HCl}$  Insol in alcohol sat with  $\text{NH}_3$  (Mente, A 248 265)

### Indic acid

**Magnesium indate**,  $\text{MgIn}_2\text{O}_4 + 3\text{H}_2\text{O}$

Ppt Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  (Renz, B 1901, 34 2764)

### Indium, In

Does not decomp hot  $\text{H}_2\text{O}$   
Sol in dil  $\text{HCl}$ , and  $\text{H}_2\text{SO}_4 + \text{Aq}$  Decomp by conc  $\text{H}_2\text{SO}_4$  Easily sol in  $\text{HNO}_3 + \text{Aq}$  Insol in acetic acid Insol in  $\text{KOH} + \text{Aq}$  (Winkler, J pr 102 273)  
Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 830)

$\frac{1}{2}$  ccm oleic acid dissolves 0.0039 g In in 6 days (Gates, J phys Chem 1911, 15 143)

**Indium monobromide**,  $\text{InBr}$

Decomp by hot  $\text{H}_2\text{O}$  Easily sol in acids  
Easily sol in cold conc  $\text{HCl}$  (Thiel, Z anorg 1904, 40 328)

**Indium dibromide**,  $\text{InBr}_2$

Decomp by hot  $\text{H}_2\text{O}$  Easily sol in acids (Thiel, Z anorg 1904, 40 329)

**Indium tribromide**,  $\text{InBr}_3$

Deliquescent Very sol in  $\text{H}_2\text{O}$

**Indium monochloride**,  $\text{InCl}$

Deliquescent Decomp by  $\text{H}_2\text{O}$  into  $\text{InCl}_3$  and In (Nilson and Pettersson, Chem Soc 43 820)

**Indium dichloride**,  $\text{InCl}_2$

Deliquescent in moist air, decomp by  $\text{H}_2\text{O}$  into  $\text{InCl}_3$  and In (Nilson and Pettersson, Chem Soc 43 818)

**Indium trichloride**,  $\text{InCl}_3$

Very deliquescent, sol in  $\text{H}_2\text{O}$  with hissing and great evolution of heat

**Indium lithium chloride**

Extremely deliquescent Sol in  $\text{H}_2\text{O}$  (Meyer, A 150 144)

**Indium potassium chloride**,  $3\text{KCl}$ ,  $\text{InCl}_3 + 1\frac{1}{2}\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Meyer)

**Indium trifluoride**,  $\text{InF}_3 + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , readily decomp (Thiel, B 1904, 37 175)

1 l  $\text{H}_2\text{O}$  dissolves 86.4 g at  $25^\circ$  Decomp on boiling (Thiel, Z anorg 1904, 40 331)

$+9\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$   
Sol in  $\text{HCl}$  and in  $\text{HNO}_3$   
Insol in alcohol and ether (Chabré, C R 1905, 140 90)

**Indium hydrosulphide**

Decomp by acids (Meyer)

**Indium hydroxide**,  $\text{In}_2\text{O}_3\text{H}_6$

Sol in acids, also in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  but the solution clouds up on standing or boiling, with separation of  $\text{In}_2\text{O}_3\text{H}_6$  Insol in  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4\text{Cl} + \text{Aq}$

Sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Renz, B 1904, 37 2110)

Sl sol in alkylamines but completely ppt by addition of the hydrochloride of the base (Renz, B 1903, 36 2754)

**Indium moniodide**,  $\text{InI}$

Slowly decomp in moist air Not attacked by boiling  $\text{H}_2\text{O}$

Sol in dil  $\text{HNO}_3$  in presence of  $\text{AgNO}_3$   
Very slowly sol in cold, more rapidly sol in

hot acids with evolution of  $H_2$  Very sol in sulphurous acid

Insol in alcohol ether and chloroform (Thiel, Z anorg 1910, 66 302)

**Indium diiodide,  $InI_2$**

(Thiel, Z anorg 1910, 66 302)

**Indium triiodide,  $InI_3$**

Deliquescent (Meyer)

Sol in  $CHCl_3$  Decomp by xylene (Thiel, Z anorg 1904, 40 330)

**Indium nitride,  $InN$**

Decomp by heat (Franz Fischer, B 1910, 43 1469)

**Indium monoxide,  $InO$**

Gradually sol in  $HCl + Aq$  (Winkler, J pr 94 1)

**Indium sesquioxide,  $In_2O_3$**

Slowly sol in cold, easily in hot acids

Four modifications

(1) Yellow Amorphous Sol in acids Its hydroxide is insol in ammonia and  $NH_4Cl$

(2) White Amorphous Insol in acids

(3) White Amorphous Sol in acids Its hydroxide is sol in ammonia, but pptd by  $NH_4Cl$

(4) Crystallized Crystalline modification is insol in acids (Renz, B 1904, 37 2112) Insol in liquid  $NH_3$  (Gore, Am Ch J 1898, 20 830)

**Indium oxide,  $In_2O_3 = 3InO, 2In_2O_3 (?)$**

(Winkler)

$In_4O_6 = 2InO, In_2O_3 (?)$  (Winkler)

**Indium oxybromide (?)**

Not decomp by hot acids or alkalies (Meyer, A 150 137)

**Indium oxychloride,  $InOCl$**

Very sl sol in  $H_2O$  (Thiel, B 1904, 37 176)

Very sl sol in cold or hot dil acids Quickly sol in hot conc acids (Thiel, Z anorg 1904, 40 327)

**Indium triselenide,  $In_2Se_3$**

Sol in strong acids with evolution of  $H_2Se$  (Thiel, Z anorg 1910, 66 315)

**Indium sulphide,  $In_2S$**

Sol in acids (Thiel, Z anorg 1904, 40 326)

**Indium monosulphide,  $InS$**

Easily sol in  $HCl$  with evolution of  $H_2S$  Sol in  $HNO_3$  with evolution of oxides of nitrogen (Thiel, Z anorg 1910, 66 314)

**Indium sesquisulphide,  $In_2S_3$**

Partially sol in  $(NH_4)_2S + Aq$

**Indium potassium sulphide,  $In_2S_3, K_2S$**

Insol in  $H_2O$ , decomp by weak acids with separation of  $In_2S_3$ , sol in conc acids (Schneider, J pr (2) 9 209)

**Indium silver sulphide,  $In_2S_3, Ag_2S$**

Insol in  $H_2O$  (Schneider, l c)

**Indium sodium sulphide,  $In_2S_3, Na_2S + 2H_2O$**

Insol in  $H_2O$  (Schneider, l c)

**Indium monotelluride,  $InTe$**

Sol in  $HNO_3$ , insol in  $HCl + Aq$  (Thiel, Z anorg 1910, 66 318)

**Infusible white precipitate**

**Diiodamine,  $NHI_2$**

Decomp by  $H_2O$

**Iodammonium iodide,  $NIH_3I$**

Decomp by  $H_2O$ , caustic alkalies, and acids Sol in  $KI + Aq$ , alcohol, ether  $CS_2$ ,  $CHCl_3$  (Guthrie, Chem Soc (2) 1 239)

**Iodauric acid,  $HAuI_4 (?)$**

Not known with certainty

**Ammonium iodaurate**

Deliquescent Decomp by  $H_2O$  (Johnston, Phil Mag (3) 9 266)

**Barium iodaurate**

Sol in  $BaI_2 + Aq$

**Cæsium iodaurate,  $CsAuI_4$**

(Gupta, J Am Chem Soc 1914, 36 748)

**Ferrous iodaurate**

Sol in  $H_2O$  (Johnston)

**Potassium iodaurate,  $KAuI_4$**

Decomp by  $H_2O$  Sol in  $KI$ , and  $HI + A$  (Johnston)

**Sodium iodaurate**

Very deliquescent (Johnston)

**Iodauricyanhydric acid,  $HAu(CN)_2I$**

Known only in its salts

**Barium iodauricyanide,  $Ba[Au(CN)_2I]_2 + 10H_2O$**

Sl sol in cold, easily in hot  $H_2O$  Easily sol in alcohol (Lindbom, Lund Univ Arsk 12 No 6)

**Calcium iodauryanide**,  $\text{Ca}[\text{Au}(\text{CN})_2\text{I}_2]_2 + 10\text{H}_2\text{O}$

Not stable (L)

**Cobalt iodauryanide**,  $\text{Co}[\text{Au}(\text{CN})_2\text{I}_2]_2 + 10\text{H}_2\text{O}$

Most insol of all iodauryanides, and only sl sol in warm  $\text{H}_2\text{O}$  Easily sol in alcohol

**Potassium iodauryanide**,  $\text{KAu}(\text{CN})_2\text{I}_2 + \text{H}_2\text{O}$

Sl sol in cold, easily sol in warm  $\text{H}_2\text{O}$  and alcohol (L)

**Strontium iodauryanide**,  $\text{Sr}[\text{Au}(\text{CN})_2\text{I}_2]_2 + 10\text{H}_2\text{O}$

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$

### Iodhydric Acid, HI

Very easily and quickly absorbed by  $\text{H}_2\text{O}$ , with evolution of much heat

Solution is decomp on exposure to the air  
1 vol  $\text{H}_2\text{O}$  absorbs 450 vols HI at  $10^\circ$  (Thomson)

1 vol  $\text{H}_2\text{O}$  absorbs 425 vols HI at  $10^\circ$  (Berthelot, C R 76 679)

Weak or strong solutions when boiled in an atmosphere of H leave a residue of constant composition, which distils unchanged at  $126^\circ$  (de Luynes), at  $127^\circ$  (Roscoe, Chem Soc 13 146, Naumann, Topsoe), at  $128^\circ$  (Bineau, A ch (3) 7 266), and has a sp gr of 1.67 (Naumann), of 1.70 (Bineau, de Luynes), of 1.708 (Topsoe), and contains 56.26 % HI (Bineau), 57.0% HI (Roscoe), 57.75% HI (Topsoe).

By conducting dry H gas through the aqueous solution of HI, a constant residue is obtained, containing 60.3-60.7% HI if temp is  $15-19^\circ$ , and 58.2-58.5% HI if temp is  $100^\circ$  (Roscoe)

### Solubility of HI in $\text{H}_2\text{O}$ at $t^\circ$

t	% HI	Solid Phase
-10	20.3	Ice
-20	29.3	
-30	35.1	
-40	39	
-50	42	
-60	44.4	Ice + HI, $4\text{H}_2\text{O}$
-70	46.2	
-80	47.9	HI, $4\text{H}_2\text{O}$
-60	52.6	
-40	59	"
-35.5	64	
-40	65.5	"
-49	66.3	
-48	70.3	HI, $4\text{H}_2\text{O}$ + HI, $3\text{H}_2\text{O}$
-56	73.5	HI, $3\text{H}_2\text{O}$ + HI, $2\text{H}_2\text{O}$
-52	74	HI, $2\text{H}_2\text{O}$

(Pickering, B 1893, 26 2307)

Solution in  $\text{H}_2\text{O}$  sat at  $0^\circ$  has sp gr = 1.99 (de Luynes, A ch (4) 2 385), 2.0 (Vigier)

### Sp gr of HI + Aq

Sp gr	% HI	Temp
1.017	2.286	$13.5^\circ$
1.0524	7.019	$13.5$
1.077	10.15	$13.5$
1.095	12.21	$13$
1.102	13.09	$13.5$
1.126	15.73	$13.5$
1.164	19.97	$13.5$
1.191	22.63	$13.8$
1.225	25.86	$13.8$
1.2535	28.41	$13.5$
1.274	30.20	$13.5$
1.309	33.07	$13$
1.347	36.07	$13$
1.382	38.68	$13$
1.413	40.45	$13$
1.451	43.39	$13$
1.4865	45.71	$13$
1.528	48.22	$13$
1.542	49.13	$13.5$
1.5727	50.75	$13$
1.603	52.43	$12.5$
1.630	53.93	$14$
1.674	56.15	$13.7$
1.696	57.28	$13$
1.703	57.42	$12.5$
1.706	57.64	$13.7$
1.708	57.74	$12$

(Topsoe, B 3 403)

### Sp gr of HI + Aq at $15^\circ$

% HI	Sp gr	% HI	Sp gr	% HI	Sp gr
1	1.008	21	1.175	41	1.414
2	1.015	22	1.185	42	1.429
3	1.022	23	1.195	43	1.444
4	1.029	24	1.205	44	1.459
5	1.037	25	1.216	45	1.475
6	1.045	26	1.227	46	1.491
7	1.053	27	1.238	47	1.508
8	1.061	28	1.249	48	1.525
9	1.069	29	1.260	49	1.543
10	1.077	30	1.271	50	1.561
11	1.085	31	1.283	51	1.579
12	1.093	32	1.295	52	1.597
13	1.102	33	1.307	53	1.615
14	1.110	34	1.320	54	1.634
15	1.118	35	1.333	55	1.654
16	1.127	36	1.346	56	1.674
17	1.137	37	1.359	57	1.694
18	1.146	38	1.372	58	1.713
19	1.155	39	1.386		
20	1.165	40	1.400		

(Topsoe, calculated by Gerlach, Z anal 27 316)

Sp gr of HI+Aq at 15°

% HI	Sp gr	% HI	Sp gr	% HI	Sp gr
5	1 045	25	1 239	45	1 533
10	1 091	30	1 296	50	1 650
15	1 138	35	1 361	52	1 700
20	1 187	40	1 438		

Only a "moderate degree of accuracy" is claimed for this table (Wright, C N 23 253)

+2H<sub>2</sub>O Mpt—43° (Pickering, B 1893, 26 2308)  
 +3H<sub>2</sub>O Mpt—48° (Pickering)  
 +4H<sub>2</sub>O Mpt—36 5° (Pickering)

Iodic acid, HIO<sub>3</sub>

Very sol in H<sub>2</sub>O and alcohol  
 100 g H<sub>2</sub>O dissolve 286 1 g HIO<sub>3</sub> at 13 5°  
 Sp gr of HIO<sub>3</sub>+Aq = 2 4256  
 100 g H<sub>2</sub>O dissolve 293 g HIO<sub>3</sub> at 18°  
 Sp gr of HIO<sub>3</sub>+Aq = 2 4711  
 (Groschuff, Z anorg 1905, 47 337)

Solubility of HIO<sub>3</sub> in H<sub>2</sub>O at t°

Solid phase	t°	G HIO <sub>3</sub> in 100 g of the solution	G I <sub>2</sub> O <sub>5</sub> in 100 g of the solution
ice	— 0 30	1 78	1 69
"	— 0 67	4 35	4 13
"	— 1 01	7 17	6 81
"	— 1 90	17 66	16 75
"	— 2 38	27 65	26 22
"	— 4 72	54 19	51 42
"	— 6 32	60 72	57 61
"	—12 25	71 04	67 40
"	—13 5	72 2	68 5
"	—15	73 8	70 0
"	—19	76 2	72 3
ice+HIO <sub>3</sub>	—14	72 8	69 1
HIO <sub>3</sub>	0	74 1	70 3
"	+16	75 6	71 7
"	40	77 7	73 7
"	60	80 0	75 9
"	50	82 5	78 3
"	55	83 0	78 7
"	101	85 2	80 8
HIO <sub>3</sub> +HI <sub>3</sub> O <sub>8</sub>	110	86 5	82 1
HI <sub>3</sub> O <sub>8</sub>	125	87 2	82 7
"	140	88 3	83 8
"	160	90 5	85 9

(Groschuff, Z anorg 1905, 47 343)

Sat solution has sp gr 2 842 at 12 5°, and boils at 104° (Ditte, B 6 1533) Sat solution has sp gr 2 1629 (1 874 pts I<sub>2</sub>O<sub>5</sub> in 1 pt H<sub>2</sub>O) at 13°, and boils at 100° (Kammerer, Pogg 138 400)

Sp gr of HIO<sub>3</sub>+Aq at 15°

% I <sub>2</sub> O <sub>5</sub>	Sp gr	% I <sub>2</sub> O <sub>5</sub>	Sp gr
1	1 0053	35	1 4428
5	1 0263	40	1 5371
10	1 0525	45	1 6315
15	1 1223	50	1 7356
20	1 2093	55	1 8689
25	1 2773	60	1 9954
30	1 3484	65	2 1269

(Kammerer)

According to Thomsen (B 7 71) solutions of HIO<sub>3</sub> have sp gr —

HIO<sub>3</sub>+ 10H<sub>2</sub>O = 1 6609  
 HIO<sub>3</sub>+ 20H<sub>2</sub>O = 1 3660  
 HIO<sub>3</sub>+ 40H<sub>2</sub>O = 1 1945  
 HIO<sub>3</sub>+ 80H<sub>2</sub>O = 1 1004  
 HIO<sub>3</sub>+160H<sub>2</sub>O = 1 0512  
 HIO<sub>3</sub>+320H<sub>2</sub>O = 1 0258

H<sub>2</sub>SO<sub>4</sub> at nearly boiling temp dissolves 1/3 its weight of iodic acid (Millon)

Solubility in HNO<sub>3</sub> containing 27 73% HNO<sub>3</sub>

100 g of the sat solution contain at  
 0° 20° 40° 60°  
 18 21 27 38 g HIO<sub>3</sub>

Solubility in HNO<sub>3</sub> containing 40 88% HNO<sub>3</sub>

100 g of the sat solution contain at  
 0° 20° 40° 60°  
 9 10 14 18 g HIO<sub>3</sub>

(Groschuff, Z anorg 1905, 47 344)

Less sol in HNO<sub>3</sub> than H<sub>2</sub>O, nearly insol in anhydrous HNO<sub>3</sub> (Groschuff, Z anorg 1905, 47 347)

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 830)

Unattacked and undissolved by liquid NO<sub>2</sub> (Frankland, Chem Soc 1901, 79 1362)

Insol in absolute alcohol Alcohol of 35° B dissolves half its weight in HIO<sub>3</sub> (Kammerer)

+4 1/2 H<sub>2</sub>O  
 HIO<sub>3</sub>, I O<sub>3</sub> (Groschuff, Z anorg 1905, 47 343)

Iodates

The alkali iodates are sol in H<sub>2</sub>O, the others are sol or insol therein

Aluminum iodate, Al(IO<sub>3</sub>)<sub>3</sub> (?)

Deliquescent (Berzelius)

Ammonium iodate, NH<sub>4</sub>IO<sub>3</sub>

Sl sol in H<sub>2</sub>O Sol in 38 5 pts H<sub>2</sub>O at 15°, 6 9 pts at 100° (Rammelsberg, Pogg 44 555)

# IODATE, AMMONIUM

of  $\text{NH}_4\text{IO}_3$  in  $\text{HIO}_3 + \text{Aq}$  at  $30^\circ$

$\text{NH}_4\text{IO}_3$ in the solution	Solid phase
20	$\text{NH}_4\text{IO}_3$
89	"
83	$\text{NH}_4\text{IO}_3 + \text{NH}_4\text{IO}_3 \cdot 2\text{HIO}_3$
86	"
75	"
53	$\text{NH}_4\text{IO}_3 \cdot 2\text{HIO}_3$
94	"
09	"
89	"
62	"
41	"
39	"
37	"
31	$\text{NH}_4\text{IO}_3 \cdot 2\text{HIO}_3 + \text{HIO}_3$ $\text{HIO}_3$

urg, Z anorg 1905, 45 341 )

Ditte, A ch (6) 21 146 )

iodate,  $\text{NH}_4\text{H}(\text{IO}_3)_2$   
old  $\text{H}_2\text{O}$  (Ditte, A ch (6) 21

iodate,  $\text{NH}_4\text{H}_2(\text{IO}_3)_3$   
O (Blomstrand, J pr (2) 42

solubility in  $\text{HIO}_3$ , under Am-  
te (Meerburg )

obalt iodate  
by  $\text{H}_2\text{O}$  Insol in alcohol  
(rg )

manganic iodate,  $\text{Mn}(\text{IO}_3)_4$

l in  $\text{H}_2\text{O}$  Insol in  $\text{HIO}_3$  (Berg,  
28 675 )

oxydmercuriammonium iodate  
mercuriammonium ammonium

ellurium iodate  
llurate, ammonium

odate selenate  
lenate, ammonium

e,  $\text{Ba}(\text{IO}_3)_2$   
salt is sol in 1746 pts  $\text{H}_2\text{O}$  at  
pts  $\text{H}_2\text{O}$  at  $100^\circ$  (Rammelsberg,  
, in 3018 pts  $\text{H}_2\text{O}$  at  $13.5^\circ$ , and  
) at  $100^\circ$  (Kremers, Pogg 84

Solubility of  $\text{Ba}(\text{IO}_3)_2$  in  $\text{H}_2\text{O}$  100 g sat  
 $\text{Ba}(\text{IO}_3)_2 + \text{Aq}$  at  $t^\circ$  contain g anhydrous  
 $\text{Ba}(\text{IO}_3)_2$

$t^\circ$	Grams $\text{Ba}(\text{IO}_3)_2$	$t^\circ$	Grams $\text{Ba}(\text{IO}_3)_2$	$t^\circ$	Grams $\text{Ba}(\text{IO}_3)_2$
Eutectic point $-0.046^\circ \pm 0.002^\circ$	0.008	$30^\circ$	0.031	$70^\circ$	0.093
$+10^\circ$	0.014	$40^\circ$	0.041	$80^\circ$	0.115
$20^\circ$	0.022	$50^\circ$	0.056	$90^\circ$	0.141
$25^\circ$	0.028	$60^\circ$	0.074	$*99.2^\circ$	0.197

\*Bpt at 735 mm pressure = about  $100^\circ$  at  
760 mm pressure

(Anschutz, Z phys Ch 1906, 56 241 )

1 l sat aq solution contains 0.284 g  
 $\text{Ba}(\text{IO}_3)_2$  at room temp (Hill and Zink, J  
Am Chem Soc 1909, 31 44 )

1 l  $\text{H}_2\text{O}$  dissolves 0.3845 g  $\text{Ba}(\text{IO}_3)_2$  at  
 $25^\circ$  (Harkins and Winnighof, J Am  
Chem Soc 1911, 33 1828 )

Easily sol in cold  $\text{HCl} + \text{Aq}$ , difficultly sol  
in warm  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg )

Insol in  $\text{H}_2\text{SO}_4$  (Ditte)  
100 cc  $\text{NH}_4\text{OH} + \text{Aq}$  (sp gr = 0.90) dis-  
solve 0.0199 g  $\text{Ba}(\text{IO}_3)_2$  (Hill and Zink )

Solubility in salts +  $\text{Aq}$  at  $25^\circ$

C = concentration of salt in salt solution  
expressed in equivalents per l

S = solubility of  $\text{Ba}(\text{IO}_3)_2$  in salts +  $\text{Aq}$  ex-  
pressed in equivalents per l

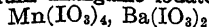
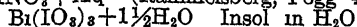
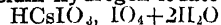
Salt	C	S
$\text{Ba}(\text{NO}_3)_2$	0.001	0.001362
	0.002	0.001212
	0.005	0.0009753
	0.020	0.0006744
	0.050	0.0006131
	0.100	0.0005659
	0.200	0.0005580
$\text{KNO}_3$	0.002	0.001624
	0.010	0.001820
	0.050	0.002640
	0.200	0.003190
$\text{KIO}_3$	0.00010608	0.001510
	0.0005304	0.001242
	0.0010608	0.0009418

(Harkins and Winnighof, J Am Chem Soc  
1911, 33 1829 )

Insol in alcohol  
100 cc 95% alcohol dissolve 0.0011 g  
 $\text{Ba}(\text{IO}_3)_2$  at room temp (Hill and Zink )  
Insol in acetone (Eidmann, C C 1899,  
II 1014 )

+  $\text{H}_2\text{O}$  Sol in 3333 pts  $\text{H}_2\text{O}$  at  $18^\circ$ , and  
625 pts  $\text{H}_2\text{O}$  at  $100^\circ$  (Gay-Lussac, A ch  
91 5 )

Insol in acetone (Naumann, B 1904,  
37 4329 )

**Barium manganic iodate,**Insol in  $\text{H}_2\text{O}$ Insol in  $\text{HIO}_3$  (Berg, C R 1899, 128 675)**Bismuth iodate, basic**Insol in  $\text{H}_2\text{O}$  Very difficultly sol in  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg, Pogg 44 568)**Cadmium iodate,  $\text{Cd}(\text{IO}_3)_2$** Very sl sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in  $\text{Cd}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  (Rammelsberg, Pogg 44 566) $+ \text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  Very sol in dil  $\text{HNO}_3 + \text{Aq}$  (Ditte, A ch (6) 21 145)**Cadmium iodate ammonia,  $\text{Cd}(\text{IO}_3)_2, 2\text{NH}_3$** Insol in  $\text{H}_2\text{O}$ , sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Ditte) A ch (6) 21 145)**Cæsium iodate,  $\text{CsIO}_3$** 100 pts  $\text{H}_2\text{O}$  dissolve 2.6 pts  $\text{CsIO}_3$  at  $24^\circ$  Insol in alcohol (Wheeler, Sill Am J 144 123) $2\text{CsIO}_3, \text{I}_2\text{O}_5$  100 pts  $\text{H}_2\text{O}$  dissolve 2.5 pts at  $21^\circ$  Not decomp by hot  $\text{H}_2\text{O}$  (Wheeler) $2\text{CsIO}_3, \text{I}_2\text{O}_5, 2\text{HIO}_3$  Sl sol in cold  $\text{H}_2\text{O}$  and decomp thereby into  $2\text{CsIO}_3, \text{I}_2\text{O}_5$  (Wheeler)**Cæsium iodate chloride,  $\text{CsCl}, \text{HIO}_3$** Decomp by  $\text{H}_2\text{O}$  into  $2\text{CsIO}_3, \text{I}_2\text{O}_5$  (Wheeler)**Cæsium hydrogen iodate periodate,**Ppt Sol in dil  $\text{HNO}_3$  (Wells, Am Ch J 1901, 26 250)**Calcium iodate,  $\text{Ca}(\text{IO}_3)_2$** 100 pts dissolve 0.22 pt at  $18^\circ$ , and 0.986 pt at  $100^\circ$  (Gray-Iussac) Sol in conc  $\text{HCl} + \text{Aq}$  (Ethol) Much more sol in  $\text{HNO}_3 + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Rammelsberg) Insol in  $\text{H}_2\text{SO}_4$  (Ditte) Scarcely sol in sat  $\text{KIO}_3 + \text{Aq}$  (Sonstadt, C N 29 209) $+ \text{H}_2\text{O}$  Sat solution contains at

21°	35°	40°	45°
0.37	0.48	0.52	0.54%

50°	60°	80°	100°
0.59	0.65	0.79	0.94%

(Mylius and Funk, B 1897, 30 1724)

 $+ 6\text{H}_2\text{O}$  EfflorescentSol in 253 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and 75 pts at  $100^\circ$  (Rammelsberg)

Sat solution contains at

0°	10°	18°	30°
0.1	0.17	0.25	0.42%
40°	50°	54°	60°
0.61	0.89	0.14	1.36%

(Mylius and Funk, B 1897, 30 1724)

Much more sol in  $\text{HNO}_3 + \text{Aq}$  Pptd by alcohol from  $\text{Ca}(\text{IO}_3)_2 + \text{Aq}$ Insol in  $\text{H}_2\text{SO}_4$  (Ditte)

Pptd by alcohol from aqueous solution (Henry)

**Cerous iodate,  $\text{Ce}(\text{IO}_3)_3 + 2\text{H}_2\text{O}$** Sl sol in cold, easily sol in hot  $\text{H}_2\text{O}$  and in acids (Holzmann, J pr 75 321)Solubility in  $\text{H}_2\text{O}$  100 cc of the sat solution contain 0.1456 g at  $25^\circ$  (Rimbach, Z phys Ch 1909, 67 199)Calc from electrical conductivity of  $\text{Ce}(\text{IO}_3)_3 + \text{Aq}$ , 100 cc of the sat solution contain 0.1636 g  $\text{Ce}(\text{IO}_3)_3$  at  $25^\circ$  (Rimbach, Z phys Ch 1909, 67 199)**Ceric iodate,  $\text{Ce}(\text{IO}_3)_4$** Slightly hydrolyzed by  $\text{H}_2\text{O}$ 0.34 g is sol in 100 cc hot conc  $\text{HNO}_3$  (Barbieri, Chem Soc 1907, 92 (2) 467)**Cobaltous iodate,  $\text{Co}(\text{IO}_3)_2$** *Anhydrous* Sol in warm dil  $\text{H}_3\text{PO}_4$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Ditte, A ch (6) 21 14)Solubility in  $\text{H}_2\text{O}$ 

Form	Temp	% $\text{Co}(\text{IO}_3)_2$	Mols of water free salt to 100 mols $\text{H}_2\text{O}$
$\text{Co}(\text{IO}_3)_2 + 4\text{H}_2\text{O}$	0°	0.54	0.028
"	18°	0.83	0.038
"	30°	1.03	0.046
"	50°	1.46	0.065
"	60°	1.86	0.084
"	65°	2.17	0.098
$\text{Co}(\text{IO}_3)_2 + 2\text{H}_2\text{O}$	0°	0.32	0.014
"	18°	0.45	0.020
"	30°	0.52	0.023
"	50°	0.67	0.030
"	75°	0.84	0.038
"	100°	1.02	0.045
$\text{Co}(\text{IO}_3)_2$	18°	1.03	0.046
"	30°	0.89	0.040
"	50°	0.85	0.036
"	75°	0.75	0.033
"	100°	0.69	0.031

(Meusser, B 1901, 34 2435)

 $+ \text{H}_2\text{O}$  Sol in 148 pts  $\text{H}_2\text{O}$  at  $15^\circ$  and 90 pts at  $100^\circ$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Rammelsberg, Pogg 44 561)

Does not exist (Meusser, B 1901, 34 2434)

 $+ 2\text{H}_2\text{O}$  (Meusser) $+ 4\text{H}_2\text{O}$  (Meusser)



**Cupric iodate, basic,  $6\text{CuO}$ ,  $3\text{I}_2\text{O}_5 + 2\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Millon, A ch (3) 9 400)  
 Mixture of  $\text{CuO}$  and  $\text{Cu}(\text{IO}_3)_2$  (Ditte, A ch (6) 21 175)  
 $2\text{CuO}$ ,  $\text{I}_2\text{O}_5 + \text{H}_2\text{O}$  Slowly sol in dil  $\text{H}_2\text{SO}_4$  (Granger and de Schulten, Bull Soc 1904, (3) 31 1027)

**Cupric iodate,  $\text{Cu}(\text{IO}_3)_2$** 

1 l  $\text{H}_2\text{O}$  dissolves  $3.32 \times 10^{-3}$  mol  $\text{Cu}(\text{IO}_3)_2$  at  $25^\circ$  (Spencer, Z phys Ch 1913, 83 295)

Solubility in  $\text{CuSO}_4 + \text{Aq} = 3.28 \times 10^{-3}$  mol per l at  $25^\circ$

Solubility in  $\text{KIO}_3 + \text{Aq} = 3.29 \times 10^{-3}$  mol per l at  $25^\circ$  (Spencer)

+  $\text{H}_2\text{O}$  (Ditte)  
 +  $2\text{H}_2\text{O}$  Sol in 302 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and 154 pts at  $100^\circ$  Sol in  $\text{HCl} + \text{Aq}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  (Millon)

**Cupric iodate ammonia,  $\text{Cu}(\text{IO}_3)_2$ ,  $2\text{NH}_3 + \text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Ditte, A ch (6) 21 145)  
 $\text{Cu}(\text{IO}_3)_2$ ,  $4\text{NH}_3 + 2\text{H}_2\text{O}$  Ppt (Ephraim, B 1915, 48 52)

+  $3\text{H}_2\text{O}$  Partially sol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Insol in alcohol (Rammels-

$\text{IO}_3)_2$ ,  $5\text{NH}_3$  (Ephraim)

$\text{IO}_3)_2$ ,  $8\text{NH}_3 + 4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Insol in alcohol (Ditte, A ch (6) 21 145)

**Decupium iodate,  $\text{Dp}(\text{IO}_3)_3 + 3\text{H}_2\text{O} (?)$** 

Precipitate, scarcely sol in  $\text{H}_2\text{O}$  (Dela-fontaine)

**Didymium iodate,  $\text{Di}(\text{IO}_3)_3 + 2\text{H}_2\text{O}$** 

Ppt (Cleve)

**Erbium iodate,  $\text{Er}(\text{IO}_3)_3 + 3\text{H}_2\text{O}$** 

Very sl sol in  $\text{H}_2\text{O}$  (Hoglund)

**Glucinum iodate**

Deliquescent

**Indrium iodate,  $\text{In}(\text{IO}_3)_3$** 

1 pt is sol in 1500 pts  $\text{H}_2\text{O}$  at  $20^\circ$   
 1 pt is sol in 150 pts  $\text{HNO}_3$  (1 5) at  $80^\circ$   
 Sol in  $\text{HCl}$  with decomp Sol in dil  $\text{H}_2\text{SO}_4$  (Mathers, J Am Chem Soc 1908, 30 213)

**Iodine iodate,  $\text{I}(\text{IO}_3)_3$** 

Decomp by  $\text{H}_2\text{O}$  or by alcohol (Fichter, Z anorg 1915, 91 142)

**Iron (ferrous) iodate**

Ppt Sl sol in  $\text{H}_2\text{O}$ , more sol in  $\text{FeSO}_4 + \text{Aq}$  (Geiger, Mag Pharm 29 252)

**Iron (ferric) iodate,  $\text{Fe}_2\text{O}_3$ ,  $\text{I}_2\text{O}_5$** 

Insol in acids (Ditte, A ch (6) 21 145)  
 $\text{Fe}_2\text{O}_3$ ,  $2\text{I}_2\text{O}_5 + 8\text{H}_2\text{O}$  Sol in 500 pts  $\text{H}_2\text{O}$   
 Difficultly sol in  $\text{HNO}_3 + \text{Aq}$  Sol in  $\text{FeCl}_3 + \text{Aq}$  (Geiger)  
 $3\text{Fe}_2\text{O}_3$ ,  $5\text{I}_2\text{O}_5 + 15\text{H}_2\text{O}$  Sol in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg)

**Lanthanum iodate,  $\text{La}(\text{IO}_3)_3 + 1\frac{1}{2}\text{H}_2\text{O}$** 

Sl sol in cold, easily sol in hot  $\text{H}_2\text{O}$   
 Very sol in warm  $\text{HCl} + \text{Aq}$  (Holzmann, J pr 75 349)

100 cc of the sat solution in  $\text{H}_2\text{O}$  contain 0.1681 g at  $25^\circ$  (Rumbach, Z phys Ch 1909, 67 199)

Calc from electrical conductivity of  $\text{La}(\text{IO}_3)_3 + \text{Aq}$ , 100 cc of the sat solution contain 0.1871 g  $\text{La}(\text{IO}_3)_3$  at  $25^\circ$  (Rumbach)

**Lead iodate, basic,  $3\text{PbO}$ ,  $\text{Pb}(\text{IO}_3)_2 + 2\text{H}_2\text{O}$** 

Ppt (Strömholm, Z anorg 1904, 38 442)

**Lead iodate,  $\text{Pb}(\text{IO}_3)_2$** 

Very sl sol in  $\text{H}_2\text{O}$  (Pleschl), and difficultly sol in  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg)

Insol in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4 + \text{Aq}$  Very sl sol in  $\text{HNO}_3 + \text{Aq}$ , and wholly insol therein after being heated to  $100^\circ$  (Ditte, A ch (6) 21 169)

Sl sol in  $\text{H}_2\text{O}$   $1.83 \times 10^{-2}$  are dissolved in 1 liter of sat solution at  $20^\circ$  (Böttger, Z phys Ch 1903, 46 603)

1 l  $\text{H}_2\text{O}$  dissolves 19 mg  $\text{Pb}(\text{IO}_3)_2$  at  $18^\circ$  (Kohlrausch, Z phys Ch 1904, 50 356)

178 mg are dissolved in 1 l sat solution at  $18^\circ$  (Kohlrausch, Z phys Ch 1908, 64 168)

1 l  $\text{H}_2\text{O}$  dissolves 0.0307 g  $\text{Pb}(\text{IO}_3)_2$  at  $25^\circ$  (Harkins, J Am Chem Soc 1911, 33 1830)

Solubility of  $\text{Pb}(\text{IO}_3)_2$  in salts +  $\text{Aq}$  at  $25^\circ$

C = concentration of salt in salt solution expressed in equivalents per l

S = solubility of  $\text{Pb}(\text{IO}_3)_2$  in salt solution expressed in equivalents per l

Salt	C	S
$\text{Pb}(\text{NO}_3)_2$	0 0001	0 0000870
	0 001	0 0000411
	0 010	0 0000185
	0 100	0 000016
	0 500	0 000028
	3 0	0 000015
$\text{KNO}_3$	0 002	0 0001141
	0 010	0 0001334
	0 050	0 0002037
	0 200	0 0002544
$\text{KIO}_3$	0 00005304	0 0000697
	0 0001061	0 0000437

(Harkins and Winnighof, J Am Chem Soc 1911, 33 1830)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 828)

**Lithium iodate,  $\text{LiIO}_3 + \frac{1}{2}\text{H}_2\text{O}$**

Deliquescent, and very sol in  $\text{H}_2\text{O}$   
Sol in 2 pts cold, and not much less hot  $\text{H}_2\text{O}$  Insol in alcohol (Rammelsberg, Pogg 44 555)

Sp gr of solution sat at  $18^\circ = 1.568$ , containing 44.6%  $\text{LiIO}_3$  100 g  $\text{H}_2\text{O}$  dissolve 80.3 pts  $\text{LiIO}_3$  (Mylus and Funk, B 1897, 30 1718)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

+ $\text{H}_2\text{O}$  Very deliquescent (Ditte, A ch (6) 21 145)

**Magnesium iodate,  $\text{Mg}(\text{IO}_3)_2$**

Anhydrous Insol in  $\text{H}_2\text{O}$  (Millon, A ch (3) 9 422)

+ $4\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Ditte)  
Sol in 9.43 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and 3.04 pts at  $100^\circ$  (Berzelius) Very sl sol in  $\text{H}_2\text{O}$  (Serullas, A ch 45 279) Easily sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Ditte)

Sat solution contains at

$0^\circ$	$10^\circ$	$20^\circ$
6.8	6.4	7.7%
		$\text{Mg}(\text{IO}_3)_2$
$35^\circ$	$63^\circ$	$100^\circ$
8.9	12.6	19.3%
		$\text{Mg}(\text{IO}_3)_2$

(Mylus and Funk, B 1897, 30 1722)

Sat aq solution at  $18^\circ$  contains 6.44%  $\text{Mg}(\text{IO}_3)_2$ , or 6.88 g arc sol in 100 g  $\text{H}_2\text{O}$   
Sp gr of sat solution = 1.078 (Mylus and Funk, B 1897, 30 1718)

+ $10\text{H}_2\text{O}$  Sat aq solution contains at

$0^\circ$	$20^\circ$	$30^\circ$	$35^\circ$	$50^\circ$ (m pt)
3.1	10.2	17.4	21.9	67.5%
				$\text{Mg}(\text{IO}_3)_2$

(Mylus and Funk, B 1897, 30 1723)

**Manganous iodate,  $\text{Mn}(\text{IO}_3)_2 + \text{H}_2\text{O}$**

Sol in about 200 pts  $\text{H}_2\text{O}$  (Rammelsberg)

Insol in  $\text{H}_2\text{O}$  and  $\text{HNO}_3 + \text{Aq}$ , even on boiling Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Ditte)

**Manganous manganic iodate,**

$\text{Mn}(\text{IO}_3)_4 \text{ Mn}(\text{IO}_3)_2$

Insol in  $\text{H}_2\text{O}$  (Berg, C R 1899, 128 675)

**Manganic potassium iodate,**

$\text{Mn}(\text{IO}_3)_4, 2\text{KIO}_3$

Insol in and only sl attacked by  $\text{H}_2\text{O}$   
Insol in  $\text{HIO}_3$  (Berg, C R 1899, 128 674)

**Mercurous iodate,  $\text{Hg}_2(\text{IO}_3)_2$**

Insol in boiling  $\text{H}_2\text{O}$ , or cold  $\text{HNO}_3 + \text{Aq}$   
Easily sol in dil  $\text{HCl} + \text{Aq}$  Sol in very

conc  $\text{HIO}_3 + \text{Aq}$  (Lefort, J Pharm 1845 5)

**Mercuric iodate,  $\text{Hg}(\text{IO}_3)_2$**

Insol in  $\text{H}_2\text{O}$  or alcohol (Millon, A ch (3) 18 367) Sol in  $\text{H}_2\text{O}$  (Berzelius) Sol in dil  $\text{HCl} + \text{Aq}$  (Rammelsberg)

Nearly insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HCl}$ ,  $\text{HBr}$ , or  $\text{HI} + \text{Aq}$ , very sl sol in  $\text{HNO}_3 + \text{Aq}$ , insol in  $\text{HF}$ ,  $\text{H}_2\text{SiF}_6$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  Sol in alkali chlorides, bromides, iodides, cyanides, and cyanates +  $\text{Aq}$ , also in  $\text{Na}_2\text{S}_2\text{O}_3$ , dil  $\text{MnCl}_2$ , and  $\text{ZnCl}_2 + \text{Aq}$  Insol in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ ,  $\text{Na}_2\text{S}$ ,  $\text{Na}_2\text{B}_4\text{O}_7$ ,  $\text{Na}_2\text{HPO}_4$ , and the alkali chlorates, bromates, and iodates +  $\text{Aq}$  (Cameron, C N 33 253)

**Nickel iodate,  $\text{Ni}(\text{IO}_3)_2$**

Solubility in  $\text{H}_2\text{O}$

Form	Temp	Percent of $\text{Ni}(\text{IO}_3)_2$ in solution	Mols water free salt to 100 mols $\text{H}_2\text{O}$
$\text{Ni}(\text{IO}_3)_2 + 4\text{H}_2\text{O}$	$0^\circ$	0.73	0.033
"	$18^\circ$	1.01	0.045
"	$30^\circ$	1.41	0.063
$\alpha\text{Ni}(\text{IO}_3)_2 + 2\text{H}_2\text{O}$	$0^\circ$	0.53	0.023
"	$18^\circ$	0.68	0.030
"	$30^\circ$	0.86	0.039
"	$50^\circ$	1.78	0.080
$\beta\text{Ni}(\text{IO}_3)_2 + 2\text{H}_2\text{O}$	$8^\circ$	0.52	0.023
"	$18^\circ$	0.55	0.0245
"	$50^\circ$	0.81	0.035
"	$75^\circ$	1.03	0.045
"	$100^\circ$	1.12	0.049
$\text{Ni}(\text{IO}_3)_2$	$30^\circ$	1.135	0.050
"	$50^\circ$	1.07	0.046
"	$75^\circ$	1.02	0.045
"	$100^\circ$	0.988	0.044

(Meusser, B 1901, 34 2440)

+ $\text{H}_2\text{O}$  Sol in 120.3 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and 77.35 pts at  $100^\circ$  (Rammelsberg, Pogg 44 562)

Sol in  $\text{HNO}_3$ , and dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Ditte)

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

Does not exist (Meusser)

+ $2\text{H}_2\text{O}$  See Meusser above

+ $3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  (Ditte, A ch 1890, (6) 21 160)

+ $4\text{H}_2\text{O}$  See Meusser above

**Nickel iodate ammonia,  $\text{Ni}(\text{IO}_3)_2, 4\text{NH}_3$**

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Insol in alcohol (Rammelsberg, Pogg 44 562)

$\text{Ni}(\text{IO}_3)_2, 5\text{NH}_3$  Ppt (Ephraim, B 1915, 48 53)

+ $3\text{H}_2\text{O}$  (Ephraim)

**Potassium iodate,  $\text{KIO}_3$**

1 pt  $\text{KIO}_3$  dissolves in 13 pts  $\text{H}_2\text{O}$  at  $14^\circ$  (Gay-Lussac)

1 pt  $\text{KIO}_3$  dissolves at  
 $0^\circ$  in 21 11 pts  $\text{H}_2\text{O}$   
 $20^\circ$  " 12 29 "  
 $40^\circ$  " 7 76 "  
 $60^\circ$  " 5 40 "  
 $80^\circ$  " 4 02 "  
 $100^\circ$  " 3 10 "

Sat solution boils at  $102^\circ$  (Kremers, Pogg 97 5)

Sp gr of  $\text{KIO}_3 + \text{Aq}$  containing  
 1 2 3 4 5 % $\text{KIO}_3$   
 1 010 1 019 1 027 1 035 1 044  
 6 7 8 9 10 % $\text{KIO}_3$   
 1 052 1 061 1 071 1 080 1 090  
 (Kremers, Pogg 96 62)

Stable at  $10^\circ$  in  $\text{H}_2\text{O}$  or potassium acetate  
 +  $\text{Aq}$  (Eakle, C C 1896, II 649)

Solubility of  $\text{KIO}_3$  in  $\text{HIO}_3 + \text{Aq}$  at  $30^\circ$

% $\text{HIO}_3$ in the solution	% $\text{KIO}_3$ in the solution	Solid phase
0	9 51	$\text{KIO}_3$
0 64	9 48	$\text{KIO}_3 + \text{KIO}_3, \text{HIO}_3$
0 66	9 52	"
0 65	9 46	"
0 65	8 90	$\text{KIO}_3, \text{HIO}_3$
0 67	6 6	"
1 14	4 57	"
1 69	3 63	"
2 02	3 10	"
3 34	2 14	"
5 00	1 32	"
7 09	1 0	"
8 04	0 85	$\text{KIO}_3, \text{HIO}_3 + \text{KIO}_3, 2\text{HIO}_3$
3 47	3 57	$\text{KIO}_3, 2\text{HIO}_3$ (labile)
4 80	2 90	"
6 45	1 35	"
9 35	0 64	$\text{KIO}_3, 2\text{HIO}_3$
12 04	0 44	"
17 50	0 30	"
31 20	0 52	"
53 64	0 68	"
62 52	0 72	"
76 40	0 80	$\text{KIO}_3, 2\text{HIO}_3 + \text{HIO}_3$
76 70	0	$\text{HIO}_3$

(Meerburg, Z anorg 1905, 45 330)

More sol in  $\text{KI} + \text{Aq}$  than in  $\text{H}_2\text{O}$  Sol in  
 warm  $\text{H}_2\text{SO}_4 + \text{Aq}$

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch  
 J 1898, 20 829)

Insol in alcohol

Insol in methyl acetate (Naumann, B  
 1909, 42 3790), ethyl acetate (Naumann,  
 B 1910, 43 314)

+  $\frac{1}{2}\text{H}_2\text{O}$  (Ditte, C R 70 621)

Potassium hydrogen iodate,  $\text{KH}(\text{IO}_3)_2$

Sol in 18 65 pts  $\text{H}_2\text{O}$  at  $17^\circ$  (Meineke, A  
 261 360)

Sol in 75 pts  $\text{H}_2\text{O}$  at  $15^\circ$  Insol in  
 alcohol (Serullas, A ch 22 181)  
 See also Meerburg under  $\text{KIO}_3$

Potassium dihydrogen iodate,  $\text{KH}_2(\text{IO}_3)_2$   
 Sol in 25 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Serullas, A ch  
 43 117)

See also Meerburg under  $\text{KIO}_3$

Potassium tellurium iodate

See Iodotellurate, potassium

Potassium uranyl iodate,

$\text{KUO}_2(\text{IO}_3)_3 + 3\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$ , dil salt solutions and  
 $\text{UO}_2(\text{NO}_3)_2 + \text{Aq}$  (Artmann, Z anorg 1913,  
 79 340)

Potassium iodate chloride,  $\text{KH}(\text{IO}_3)_2, 2\text{KCl}$

Sol in 19 pts  $\text{H}_2\text{O}$  at  $15^\circ$  with decomp  
 Cold alcohol dissolves out  $\text{KCl}$

Potassium iodate molybdate,  $\text{KIO}_3, \text{MoO}_3 +$   
 $2\text{H}_2\text{O}$

See Molybdatiodate, potassium

Potassium iodate selenate

See Iodoselenate, potassium

Potassium iodate sulphate,  $\text{KIO}_3, \text{KHSO}_4$

Decomp by  $\text{H}_2\text{O}$  (Maignac, J B 1856  
 299)

$\text{KHIO}_3, \text{KHSO}_4$  More sol in  $\text{H}_2\text{O}$  than  
 $\text{KHIO}_3$  (Serullas)

Potassium iodate tungstate

See Tungstiodate, potassium

Rubidium iodate,  $\text{RbIO}_3$

100 pts  $\text{H}_2\text{O}$  dissolve 2 1 pts  $\text{RbIO}_3$  at  
 $23^\circ$  Easily sol in cold  $\text{HCl} + \text{Aq}$  (Wheeler  
 Sill Am J 144 123)

Rubidium hydrogen iodate,  $\text{RbH}(\text{IO}_3)_2$

Sl sol in cold, more readily in hot  $\text{H}_2\text{O}$ ,  
 $\text{RbIO}_3$  separating on cooling Insol in alco-  
 hol (Wheeler)

$\text{RbH}_2(\text{IO}_3)_3$  As above (Wheeler)

Rubidium iodate chloride,  $\text{RbIO}_3, \text{HCl}$ , or  
 $\text{HIO}_3, \text{RbCl}$

Decomp by cold  $\text{H}_2\text{O}$  (Wheeler)

$3\text{RbCl}, 2\text{HIO}_3$  Sol in  $\text{H}_2\text{O}$ , from which  
 $\text{RbIO}_3$  separates (Wheeler)

Rubidium iodate selenate

See Iodoselenate, rubidium

Samarium iodate,  $\text{Sm}(\text{IO}_3)_3 + 6\text{H}_2\text{O}$

Precipitate (Cleve)

**Scandium iodate**,  $\text{Sc}(\text{IO}_3)_3$ +10, 13, 15, and  $18\text{H}_2\text{O}$

Nearly insol in  $\text{H}_2\text{O}$  (Crookes, Phil Trans 1910, 210 A, 361)

**Silver iodate**,  $\text{AgIO}_3$

$1.89 \times 10^{-4}$  moles or  $5.36 \times 10^{-2}$  g  $\text{AgIO}_3$  are sol in 1 liter  $\text{H}_2\text{O}$  at  $25^\circ$  (Noyes and Kohr, Z phys Ch 1903, 42 338)

Sl sol in  $\text{H}_2\text{O}$   $4.35 \times 10^{-2}$  g are dissolved in 1 liter of sat solution at  $20^\circ$  (Bottger, Z phys Ch 1903, 46 603)

1 l  $\text{H}_2\text{O}$  dissolves 40 mg  $\text{AgIO}_3$  at  $18^\circ$  (Kohlrausch, Z phys Ch 1904, 50 356)

1 l  $\text{H}_2\text{O}$  dissolves 0.0275 g  $\text{AgIO}_3$  at  $9.43^\circ$ , 0.039 g at  $18.4^\circ$ , 0.0539 g at  $26.6^\circ$  Solubility increases rapidly with temp (Kohlrausch, Z phys Ch 1908, 64 168)

1 l  $\text{H}_2\text{O}$  dissolves 0.039 g  $\text{AgIO}_3$  at  $20^\circ$  (Whitby, Z anorg 1910, 67 108)

Not completely insol in  $\text{H}_2\text{O}$  (Rose) Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , sol in  $\text{HNO}_3 + \text{Aq}$  (Naquet, J B 1860 201) Sol in conc  $\text{KI} + \text{Aq}$  (Ladenburg, A 135 1)

Sol in 27,700 pts  $\text{H}_2\text{O}$  at  $25^\circ$ , in 42.4 pts 5%  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ , in 2.1 pts 10%  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ , in 1044.3 pts 35%  $\text{HNO}_3 + \text{Aq}$  (sp gr 1.21) at  $25^\circ$  (Longi, Gazz ch it 13 87)

Solubility in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$

Normality $\text{HNO}_3$	G $\text{AgIO}_3$ dissolved per l
0.000	0.0503
0.125	0.0864
0.250	0.1075
0.500	0.1414
1.00	0.2067
2.00	0.3319
4.00	0.6985
8.00	1.5875

(Hill and Simmons, Z phys Ch 1909, 67 602)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 829)

Insol in methyl acetate (Bezold, Dissert 1906, Naumann, B 1909, 42 3790), ethyl acetate (Humeis, Dissert 1906, Naumann, B 1910, 43 314)

**Silver iodate ammonia**,  $2\text{AgIO}_3 \cdot 3\text{NH}_3 + 1\frac{1}{2}\text{H}_2\text{O}$

Very sol in cold  $\text{H}_2\text{O}$  (Ditte, A ch (6) 21 145)

$\text{AgIO}_3 \cdot 2\text{NH}_3$

Sl sol in conc  $\text{NH}_4\text{OH} + \text{Aq}$  (Rosenheim, A 1899, 308 52)

**Sodium iodate**,  $\text{NaIO}_3$

100 pts  $\text{H}_2\text{O}$  dissolve 7.25 pts  $\text{NaIO}_3$  at  $14.5^\circ$  (Gay-Lussac) 100 pts  $\text{H}_2\text{O}$  dissolve 2.52 pts at  $0^\circ$ , 9.07 pts at  $20^\circ$ , 14.39 pts at  $60^\circ$ , 27.7 pts at  $80^\circ$ , 33.9 pts at  $100^\circ$  (Krem-

ers, Pogg 97 5) Sat solution boils at  $102^\circ$  (Kremers),  $105^\circ$  (Ditte)

Sol in warm  $\text{H}_2\text{SO}_4 + \text{Aq}$  diluted with  $\frac{1}{2}$  vol  $\text{H}_2\text{O}$  Crystallizes out on standing over  $\text{H}_2\text{SO}_4$  (Ditte)

Solubility of  $\text{NaIO}_3$  in  $\text{HIO}_3 + \text{Aq}$  at  $30^\circ$

% $\text{HIO}_3$ in the solution	% $\text{NaIO}_3$ in the solution	Solid phase
0	9.36	$\text{NaIO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$
1.98	9.52	"
4.86	10.22	"
5.86	11.04	"
7.40	11.60	"
9.73	14.73	" } labile
6.76	11.18	$\text{NaIO}_3 + 1\frac{1}{2}\text{H}_2\text{O} + \text{Na}_2\text{O}, 2\text{H}_2\text{O}$
6.66	11.28	"
7.80	10.30	$\text{Na}_2\text{O}, 2\text{H}_2\text{O}$
9.15	9.00	"
9.93	8.71	"
11.20	7.54	"
11.89	7.21	$\text{Na}_2\text{O}, 2\text{H}_2\text{O} + \text{NaIO}_3, 2\text{HIO}_3$
11.75	7.18	"
14.62	5.65	$\text{NaIO}_3, 2\text{HIO}_3$
23.23	3.69	"
32.68	2.91	"
40.91	2.64	"
46.62	2.67	"
55.48	2.12	"
65.47	1.83	"
76.19	1.42	$\text{NaIO}_3, 2\text{HIO}_3 + \text{HIO}_3$
76.70	0	$\text{HIO}_3$

(Meerburg, Z anorg 1905, 45 334)

Insol in alcohol Sol in dil  $\text{HCl} \cdot \text{H}_2\text{O} + \text{Aq}$

Insol in methyl acetate (Naumann, B 1909, 42 3790)  $+ 1\frac{1}{2}\text{H}_2\text{O}$  See Meerburg above

**Sodium diiodate**,  $\text{Na}_2\text{O}, 2\text{H}_2\text{O}$

See Meerburg under  $\text{NaIO}_3$

**Sodium triiodate**,  $\text{NaIO}_3, 2\text{HIO}_3 + \frac{1}{2}\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Blomstrand, J pr (2) 42 337)

See also Meerburg under  $\text{NaIO}_3$

**Sodium iodate bromide**,  $\text{NaIO}_3, 2\text{NaBr} + 9\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Sodium iodate chloride**,  $\text{NaIO}_3, \text{NaCl} + 4\text{H}_2\text{O}$ , and  $2\text{NaIO}_3, 3\text{NaCl} + 18\text{H}_2\text{O}$

Cold  $\text{H}_2\text{O}$  dissolves out  $\text{NaCl}$

**Sodium iodate iodide**,  $\text{NaIO}_3, \text{NaI}$

Hot  $\text{H}_2\text{O}$  or alcohol dissolves out  $\text{NaI} + 8\text{H}_2\text{O}$

$+ 10\text{H}_2\text{O}$

$2\text{NaIO}_3, 3\text{NaI} + 20\text{H}_2\text{O}$  (Penny, A 37 202)

Stable in a solution of  $\text{NaI} + \text{NaOH} + \text{Aq}$  (Eakle, C C 1896, II 650)

### Strontium iodate, $\text{Sr}(\text{IO}_3)_2$

*Anhydrous* Insol in  $\text{H}_2\text{SO}_4$  (Ditte), easily sol in cold  $\text{HCl} + \text{Aq}$  (Rammelsberg, Pogg 44 575)

+  $\text{H}_2\text{O}$  Difficultly sol in  $\text{H}_2\text{O}$   
+  $6\text{H}_2\text{O}$  Sol in 416 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and 138 pts at  $100^\circ$  (Gay-Lussac), 342 pts at  $15^\circ$ , and 110 pts at  $100^\circ$  Difficultly sol in warm  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg, Pogg 44 575)

### Thalious iodate, $\text{TlIO}_3$

Difficultly sol in warm  $\text{H}_2\text{O}$  (Oettinger)  
Insol in  $\text{H}_2\text{O}$ , difficultly sol in  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg)

Sl sol in  $\text{H}_2\text{O}$   
0.58  $\times 10^{-1}$  g are dissolved in 1 liter of sat solution at  $20^\circ$  (Böttger, Z phys Ch 1903, 46 603)

2.12  $\times 10^{-3}$  mols = 0.667 g are sol in 1 l  $\text{H}_2\text{O}$  at  $25^\circ$  (Spencer, Z phys Ch 1912, 80 707)

Sol in a little  $\text{NH}_4\text{OH} + \text{Aq}$ , also in boiling  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HCl} + \text{Aq}$  Insol in alcohol (Oettinger)

+  $\frac{1}{2}\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  or dil boiling acids (Ditte, A ch (6) 21 145)

**hallic iodate, basic**,  $\text{Ti}(\text{OH})(\text{IO}_3)_2 + \text{H}_2\text{O} = \text{Ti}_2\text{O}_3, 2\text{I}_2\text{O}_5 + 3\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , sol in cold  $\text{HCl} + \text{Aq}$ , and warm dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Ditte, A ch (6) 21 145)

### Thallic iodate, $\text{Ti}(\text{IO}_3)_3 + 1\frac{1}{2}\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , sl sol in  $\text{HNO}_3 + \text{Aq}$   
Decomp by alkalis (Rammelsberg)

+  $12\text{H}_2\text{O}$  Difficultly sol in  $\text{H}_2\text{O}$   
Easily sol in dil acids (Gewecke, Z anorg 1912, 75, 275)

### Thorium iodate, $\text{Th}(\text{IO}_3)_4$

Precipitate (Cleve)

### Tin (stannous) iodate

Ppt Sol in  $\text{SnCl}_2 + \text{Aq}$ , insol in  $\text{NaIO}_3 + \text{Aq}$

### Tin (stannic) iodate

Ppt

### Uranous iodate

Precipitate Very unstable (Rammelsberg)

### Uranyl iodate, $\text{UO}_2(\text{IO}_3)_2$

Sol or insol in  $\text{HNO}_3$  and  $\text{H}_3\text{PO}_4 + \text{Aq}$ , according to method of preparation (Ditte)

+  $\text{H}_2\text{O}$  Sl sol in  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg)

### Ytterbium iodate, $\text{Yb}(\text{IO}_3)_3 + 6\text{H}_2\text{O}$

Ppt (Cleve, Z anorg 1902, 32 136)

### Yttrium iodate, $\text{Y}(\text{IO}_3)_3 + 3\text{H}_2\text{O}$

Sol in 190 pts  $\text{H}_2\text{O}$  (Berlin)

### Zinc iodate, $\text{Zn}(\text{IO}_3)_2$

*Anhydrous* (Ditte, A ch (6) 21 145)  
+  $2\text{H}_2\text{O}$  Sol in 114 pts cold, and 76 pts hot  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 43 665)  
Sol in  $\text{HNO}_3$ , and  $\text{NH}_4\text{OH} + \text{Aq}$   
Exists also in a very sol modification (Mylhus and Funk, B 1897, 30 1723)

### Zinc iodate ammonia, $3\text{Zn}(\text{IO}_3)_2, 8\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$ , sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , from which it is pptd by alcohol (Rammelsberg, Pogg 44 563)

$\text{Zn}(\text{IO}_3)_2, 2\text{NH}_3$  Insol in  $\text{H}_2\text{O}$  (Ditte, A ch (6) 21 145)

$\text{Zn}(\text{IO}_3)_2, 3\text{NH}_3 + \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Ditte)

$\text{Zn}(\text{IO}_3)_2, 4\text{NH}_3$  (Ditte, A ch 1890, (6) 21 164) (Ephraim, B 1915, 48 53)

### Periodic acid

See Periodic acid

### Iodides

The iodides are in general easily sol in  $\text{H}_2\text{O}$ , exceptions are  $\text{HgI}_2$ ,  $\text{PbI}_2$ ,  $\text{AgI}$ ,  $\text{Cu}_2\text{I}_2$ , and  $\text{BiI}_3$ , also the iodides of the Pt metals, all of which are insol  $\text{SnI}_4$ ,  $\text{SbI}_3$ , and  $\text{TI}_3$  are decomp by  $\text{H}_2\text{O}$  Many iodides are more sol in solutions of salts than in  $\text{H}_2\text{O}$ , and several are sol in alcohol or ether

See under each element

### Iodine, $\text{I}_2$

Sol in 5524 pts  $\text{H}_2\text{O}$  at  $0\ 12^\circ$  (Wittstein J B 1857 123)

Sol in 7000 pts  $\text{H}_2\text{O}$  at  $15^\circ$

Sol in 3800 pts  $\text{H}_2\text{O}$  at  $15^\circ$

Sol in 500 pts  $\text{H}_2\text{O}$  (Jacquelin)

Sol in 7196 pts  $\text{B}_2\text{O}_3$  at  $18\ 75^\circ$  (Abl)

Pure  $\text{H}_2\text{O}$  dissolves 0.01519173 g I per litre, or I is sol in 6582 pts  $\text{H}_2\text{O}$  at  $6\ 3^\circ$  (Dossius and Weith, Zeit Ch 12 378)

Sol in about 4500 pts  $\text{H}_2\text{O}$  (Hager, Comm 1883)

Sol in 7000 pts  $\text{H}_2\text{O}$  (Cap and Garot, J Pharm (3) 26 80)

1 l  $\text{H}_2\text{O}$  at  $25^\circ$  dissolves 0.3387 g  $\text{I}_2$  (Jakowkin, Z phys Ch 1895, 18 590)

1 l  $\text{H}_2\text{O}$  dissolves 1.342 millimols of iodine at  $25^\circ$  (Noyes, Z phys Ch 1898, 27 359)

When iodine is shaken with  $\text{H}_2\text{O}$  at  $15^\circ$ , 1 pt dissolves in 3750 pts  $\text{H}_2\text{O}$ , when iodine and  $\text{H}_2\text{O}$  are heated together and then cooled to  $15^\circ$ , 1 pt iodine dissolves in 3500 pts  $\text{H}_2\text{O}$

At  $30^\circ$ , 1 pt is sol in 2200 pts  $\text{H}_2\text{O}$  (Dietz, Chem Soc 1899, 76, (2) 150)

1 l  $\text{H}_2\text{O}$  dissolves 0.279 grams  $\text{I}_2$  at  $25^\circ$  (McLauchlan, Z phys Ch 1903, 44 617)

Solubility of  $I_2$  in  $H_2O$  at  $t^\circ$ 

$t^\circ$	g I per l $H_2O$
18	0 2765
25	0 3395
35	0 4661
45	0 6474
55	0 9222

(Hartley, Chem Soc 1908, 93 744)

Solubility of  $I_2$  in  $H_2O$  at  $t^\circ$ 

$t^\circ$	g per l	milhat per l
0	0 1649	1 30
20	0 2941	2 30
40	0 5684	4 56

(Fedotieff, Z anorg 1910, 69 30)

1 32 millimol  $I_2$  are sol in 1 l  $H_2O$  (Bray, J Am Chem Soc, 1910, 32 938)

Calculated from electrical conductivity of sat  $I_2$ +Aq 1 l  $H_2O$  dissolves 0 0006383 mols  $I_2$  at  $0^\circ$  (Jones, J Am Chem Soc 1915, 37 256)

Conc  $H_2SO_4$ ,  $HCl$ ,  $HNO_3$ ,  $H_3PO_4$ ,  $HC_2H_3O_2$ , tartaric, or citric acids+Aq dissolve  $I_2$ , but give it up to  $CS_2$  on shaking therewith (Tessier, Z anal 11 313)

Sol in 150 pts  $H_2SO_4$  on warming, but crystallizes out in part on cooling (Kraus)

Much more sol in  $HBr$ +Aq than in pure  $H_2O$ ,  $HBr$ +Aq of sp gr 1 486 dissolves 3-4% (Bineau)

Sl sol in  $HCl$ +Aq Easily sol in even dil  $HI$ +Aq

1 l 0 001 N- $HCl$ +Aq sat with  $I_2$  contains 0 338 g I (Bray and Mackay, J Am Chem Soc 1910, 32 1919)

1 l 0 1 N- $HNO_3$ +Aq sat with  $I_2$  contains 0 340 g I (Sunmet, Z phys Ch 1905, 53 644)

1 l 0 1 N- $H_2SO_4$ +Aq sat with I contains 0 341 g  $I_2$  (Sunmet)

Sol in  $H_2SO_4$ +Aq with decomp

1 l 0 9 N  $H_3BO_3$  dissolves 0 300 g  $I_2$  at  $25^\circ$  (McLauchlan, Z phys Ch 1903, 44 617)

100 cc of a 10% solution of  $BaBr_2$  dissolve 0 231 g  $I_2$  at  $13.5^\circ$  (Meyer, Z anorg 1902, 30 114)

100 cc of a 10% solution of  $BaCl_2$  dissolve 0 067 g  $I_2$  at  $18.5^\circ$  (Meyer)

100 cc of a 10% solution of  $BaI_2$  dissolve 6 541 g  $I_2$  at  $13.5^\circ$  (Meyer)

100 cc of a 10% solution of  $CaBr_2$  dissolve 0 274 g  $I_2$  at  $13.5^\circ$  (Meyer)

100 cc of a 10% solution of  $CaCl_2$  dissolve 0 078 g  $I_2$  at  $18.5^\circ$  (Meyer)

100 cc of a 10% solution of  $CaI_2$  dissolve 8 062 g  $I_2$  at  $13.5^\circ$  (Meyer)

Easily sol in boiling dil  $HgCl_2$ +Aq (Selmi)

Solubility in  $HgCl_2$ +Aq at  $25^\circ$ 

## 10 ccm of the solution contain

millimols $I_2$	millimols $Hg$
0 0134	0
0 1294	0 9444
0 1460	1 2442
0 1806	1 9542
0 2543	3 3460

(Herz and Paul, Z anorg 1914, 85 214)

## Sol in solutions of soluble iodides

100 pts  $KI$ +200 pts  $H_2O$  dissolve 153 pts  $I_2$ , from this solution  $H_2O$  precipitates  $\frac{1}{2}$  the dissolved  $I$  100 pts  $KI$ +400 pts  $H_2O$  dissolve quickly 76 5 pts  $I$  If more water is present, the solution takes place more slowly (Baup)

$CS_2$  extracts the  $I$  from the above solutions

Solubility of  $I$  in  $KI$ +Aq at  $7-7.3^\circ$ 

% $KI$ in $KI$ +Aq	Pts $I$ dissolved	Sp gr of solution
1 802	1 173	1 0234
3 159	2 303	1 0433
4 628	3 643	1 0668
5 935	4 778	1 0881
7 201	6 037	1 1112
8 663	7 368	1 1382
10 036	8 877	1 1637
11 034	9 949	1 1893
11 893	11 182	1 2110
12 643	12 060	1 2293

(Dossius and Weith, Zeit Ch (2) 5 379)

Solubility of  $I_2$  in  $KI$ +Aq at room temperature,  $14.5^\circ$ - $15.1^\circ$ 

% $KI$	% $I$	$I/KI$
1 80	1 17	0 651
3 16	2 30	0 729
4 63	3 64	0 786
5 93	4 78	0 805
7 20	6 04	0 839
8 66	7 37	0 851
10 04	8 88	0 884
11 03	9 95	0 902
11 89	11 18	0 940
12 64	12 06	0 954

(Weith and Dossius, Z phys Ch 1898, 26 150)

Solubility of  $I_2$  in KI+Aq at 15°

% KI	ccm 1/10 n iodine in 50mm of the solution	I/KI
10	35 0	35 0
8	27 1	33 9
6	19 7	32 8
4	12 7	31 8
2	6 25	31 2
1	3 04 *	30 4

\* Obtained with 1/100-normal iodine  
(Bruner, Z phys Ch 1898, 26 151)

Solubility of  $I_2$  in KI+Aq at 25°

Millimols KI per liter	Millimols dissolved iodine per liter
106 3	55 28
53 15	28 03
26 57	14 68
13 29	8 003
6 643	4 667
3 322	3 052
1 661	2 235
0 8304	1 814

(Noyes and Seidenstricker, Z phys Ch 1898, 27 359)

## Solubility in KI+Aq at 25°

KI mol/l	I G atoms/l
1 91	3 29
2 85	5 45
4 51	11 52
5 36	17 12
5 55	17 16

(Abegg, Z anorg 1906, 50 427)

Solubility of  $I_2$  in KI+Aq at 25°

Millimol KI per l	Millimol $I_2$ dissolved
100	51 35
50	25 77
20	11 13
10	6 185
5	3 728
2	2 266
1	1 788

(Bray and MacKay, J Am Chem Soc 1910, 32 919)

## Solubility in KI+Aq at 25°

Sp gr	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% KI	% I

## (a) In equilibrium with excess of KI

1 733	60 39	0 0		0 0
1 888	54 415	11 63	84 92	4 05
2 066	49 045	23 085	85 94	6 32
2 216	44 82	31 01	80 46	10 84
2 539	38 065	44 56	78 56	15 23
2 560	37 655	45 55	77 32	16 73
2 665	35 805	49 61		
3 232	29 71	62 81	39 99	56 10
3 246	27 92	66 45	38 78	56 27

## (b) In equilibrium with excess of I

1 349	16 025	18 49	3 04	85 43
1 516	19 705	26 16	4 48	83 87
1 769	22 88	36 06	3 70	89 33
1 910	23 55	40 515	6 49	83 62
2 403	24 78	53 605	8 62	83 81
2 904	24 995	63 125	4 82	92 41
3 082	25 18	66 04	4 00	94 39

## (c) Invariant point Excess of KI and I

3 316	26 05	68 06		
	25 96	68 01	16 14	83 77
	26 04	68 16		
	25 92	68 13	11 32	86 56

(Parsons and Whittemore, J Am Chem 1911, 33 1934)

## Solubility in KI+Aq at 0°

KI+Aq		KI+Aq sat with I	
Wt norm	Sp gr 0 /4°	G $I_2$ in 1 g of solution	Sp gr 0 /4°
0 09871	(1 0123)	0 01199	(1 0219)
0 09861	1 01231	0 01199	1 02187
0 04969	(1 0061)	0 006094	(1 0109)
0 04966	1 00610	0 006083	1 01089
0 01992	1 00236	0 002535	1 00429
0 01983	(1 0024)	0 0025325	(1 0044)
0 00998	(1 0011)	0 0013532	(1 0020)
0 00992	(1 0011)	0 0013585	(1 0020)
0 004999	(1 0005)	0 0007609	(1 0010)
0 004991	(1 0005)	0 0007577	(1 0011)
0 002000	(1 0001)	0 0004137	(1 0004)
0 002000	(1 0001)	0 0004015	(1 0004)
0 000999	(0 9999)	0 0002839	(1 0002)
0 000992	(1 0000)	0 00028125	(1 0002)

Values in parentheses are found by interpolation

(Jones and Hartman, J Am Chem Soc 1915, 37 247)

1 mol KI in alcohol dissolves 2 atoms I, and the solution does not give up I to  $CS_2$  (Jørgensen, J pr (2) 2 347)

## Solubility in KI+60% alcohol at 25°

Sp gr	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% I	% KI

## (a) In equilibrium with excess KI

1 148	30 93	0 0	0 0	
1 191	29 87	4 51	89 13	0 71
1 285	28 39	12 48	86 60	2 27
1 368	28 00	18 60	87 30	3 21
1 427	27 60	21 80	85 75	4 25
1 533	27 00	28 00	84 39	6 05
1 776	25 90	40 52	81 05	10 30
2 250	24 90	52 42	76 21	16 73
2 507	24 40	58 93	73 20	21 04
2 845	22 49	65 75	71 66	24 15
	21 50	68 95	70 04	26 42

## (b) In equilibrium with excess I

1 134	0 0	23 04	0 0	I
1 530	7 36	43 05	1 40	88 76
1 721	10 60	49 38	2 50	88 21
1 90	12 44	55 33	3 72	87 10
2 11	13 74	59 26	4 41	86 60
2 22	15 20	62 66	5 80	85 20
2 80	17 72	69 10	7 15	85 49
2 99	19 30	71 90	7 45	88 96

## (c) Invariant point Excess KI and I

3 162	20 11	72 51		
	20 03	72 46	21 84	74 64
				KI+I
	20 05	72 54		
	19 98	72 44	7 40	89 81 I
	20 08	72 51	20 61	74 09
				KI+I
	20 06	72 44		
	20 05	72 48	33 46	63 19 KI

(Parsons and Corliss, J Am Chem Soc 1910, 32 1370)

## Solubility in KI+40% alcohol at 25°

Sp gr	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% KI	% I

## (a) In equilibrium with excess KI

1 339	42 10	0 0	0 0	
1 377	40 83	3 76	89 21	0 70
1 455	38 94	10 09	88 80	1 90
1 532	37 41	15 71	88 19	3 02
1 605	36 25	20 52	87 04	4 21
1 655	35 38	24 44	86 08	5 11
1 847	33 26	33 62	83 61	8 41
2 024	31 71	39 99	82 06	10 76
2 169	30 59	44 76	80 80	12 35
2 558	28 56	55 30	75 90	18 63
2 784	26 95	60 27	74 77	20 86
	24 52	65 93	72 98	23 61
	23 04	69 93	72 45	25 04

Solubility in KI+40% alcohol at 25° —  
*Continued*

Sp gr	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% KI	% I

## (b) In equilibrium with excess I

0 962	0 0	2 97	0 0	
1 292	8 45	28 70	1 85	84 51
1 581	12 56	40 63	3 41	84 02
	15 20	49 95	4 98	83 81
2 000	16 02	52 95	5 60	82 96
2 173	17 18	57 38	6 61	83 60
1 749	19 20	66 89	8 45	85 16
2 902	20 12	69 10	7 08	88 81

## (c) Invariant point Excess KI and I

3 246	22 50	70 79	19 48	76 24
	22 43	70 88	69 37	26 14

(Parsons and Corliss, J Am Chem Soc 1910, 32 1372)

See also under KI

Sol in KI+nitrobenzene (Dawson, Chem Soc 1902, 81 529)

Solubility in  $\text{KIO}_3 + \text{Aq}$  is the same as in  $\text{H}_2\text{O}$  (Lamm, C A 1909 1622)Solubility of  $\text{I}_2$  in  $\text{KBr} + \text{Aq}$  at 25°

G KBr per l	G atoms I per l
60 6	0 0176
106 9	0 0278
175 9	0 0415
229 8	0 0532
281 9	0 0628
330 6	0 0717
377 1	0 0797
411 0	0 0864
461 7	0 0948
509 8	0 1006
548 0	0 1062
567 9 sat	0 1094

(Bell and Buckley, J Am Chem Soc 1912, 34 13)

Solubility in  $\text{NaBr} + \text{Aq}$  at 25°

C NaBr per l	C atoms I per l
96 4	0 0266
157 7	0 0425
271 8	0 0538
357 4	0 0598
422 4	0 0638
499 1	0 0648
569 9	0 0644
632 0	0 0622
679 7	0 0595
750 5	0 0551
756 1 sat	0 0550

(Bell and Buckley, J Am Chem Soc 1912, 34 13)



100 cc of a 10% solution of  $\text{SrBr}_2$  dissolve  
0 270 g  $\text{I}_2$  at 13 5° (Meyer, Z anorg 1902,  
30 114)

100 cc of a 10% solution of  $\text{SrCl}_2$  dissolve  
0 066 g  $\text{I}_2$  at 13 5° (Meyer)

100 cc of a 10% solution of  $\text{SrI}_2$  dissolve  
6 616 g  $\text{I}_2$  at 13 5° (Meyer)

### Solubility in salts+Aq at 25°

Salt+Aq	Grams $\text{I}_2$ sol in 1 liter	Salt+Aq	Grams $\text{I}_2$ sol in 1 liter
$\frac{1}{2}$ -N $\text{Na}_2\text{SO}_4$	0 160	N $\text{NaCl}$	0 575
$\frac{1}{2}$ -N $\text{K}_2\text{SO}_4$	0 238	N $\text{KCl}$	0 658
$\frac{1}{2}$ -N $(\text{NH}_4)_2\text{SO}_4$	0 246	N $\text{NH}_4\text{Cl}$	0 735
N $\text{NaNO}_3$	0 257	N $\text{NaBr}$	3 29
N $\text{KNO}_3$	0 266	N $\text{KBr}$	3 801
N $\text{NH}_4\text{NO}_3$	0 375	N $\text{NH}_4\text{Br}$	4 003

(McLauchlan, Z phys Ch 1903, 44 617)

1 14 g are sol in 100 ccm liquid  $\text{H}_2\text{S}$  (Antony, Gazz ch it 1905, 35, (1) 206)

Sol in liquid  $\text{NH}_3$  (Franklin, Am ch J 1898, 20 822)

Sl sol in liquid  $\text{CO}_2$  (Buchner, Z phys Ch 1906, 54 674)

$\text{SO}_2$  (Sestini), and  $\text{SO}_2$

as  $\text{Cl}_3$  dissolve 8 42 pts  $\text{I}$  at 0°,

$\text{I}$  at 15°, 36 89 pts  $\text{I}$  at 96°

(J 46 194)

in liquid  $\text{SO}_2$ ,  $\text{AsCl}_3$ ,  $\text{SO}_2\text{Cl}_2$ , and  
an aldehyde (Walden, Z phys Ch 1903,  
43 407)

Very sol in liquid  $\text{NO}_2$  (Frankland,  
Chem Soc 1901, 79 1361)

Sol in 10-12 pts alcohol (Wittstein)

Sol in wood-spirit (Playfair)

Abundantly sol in amyl (Pelletan), and  
hexyl alcohol (Bouis)

Iodine is sol in 20 pts alcohol, 110 pts oil,  
7000 pts  $\text{H}_2\text{O}$ , 100 pts glycerine (Cap and  
Garot, J Pharm (3) 26 80)

Solubility of  $\text{I}_2$  in  $\text{C}_2\text{H}_5\text{OH}+\text{Aq}$  at room  
temperature (14 5°—15 1°)

Volumes of $\text{C}_2\text{H}_5\text{OH}$ in 100 volumes of $\text{C}_2\text{H}_5\text{OH}+\text{H}_2\text{O}$	Ccm of 1/10 normal iodine in 5 cc of the solution
100	61 7
90	29 4
80	16 6
70	9 2
60	4 45
50	3 4
40	1 0
30	0 4
20	0 25
10	0 2
0	0 0

(Bruner, Z phys Ch 1898, 26 150)

Solubility of  $\text{I}_2$  in  $\text{C}_2\text{H}_5\text{OH}+\text{Aq}$  at room  
temperature (14 5°—15 1°)

Volumes of $\text{C}_2\text{H}_5\text{OH}$ in 100 volumes of $\text{C}_2\text{H}_5\text{OH}+\text{H}_2\text{O}$	Ccm of 1/10 normal iodine in 5 cc of the solution
100	58 8
90	36 0
80	23 6
70	16 1
60	10 7
50	6 4
40	3 7
30	1 56
20	0 42
10	0 19
0	

(Bruner, Z phys Ch 1898, 26 150)

Solubility in ethyl alcohol+Aq at 25°

Molecules of $\text{C}_2\text{H}_5\text{OH}$ in 100 molecules $\text{C}_2\text{H}_5\text{OH}+\text{H}_2\text{O}$	Molecules of $\text{H}_2\text{O}$ in 100 molecules $\text{C}_2\text{H}_5\text{OH}+\text{H}_2\text{O}$	Normality of the iodine solution
0 0	100	0 0022
0 03	99 7(?)	0 0024
0 06	99 4(?)	0 0024
1 12	98 88	0 0023
1 83	98 27(?)	0 0025
9 40	90 60	0 0059
13 48	86 52	0 0111
23 80	76 20	0 0617
50 80	49 20	0 4326
100	0	1 590

(McLauchlan, Z phys Ch 1903, 44 627)

Solubility in acetic acid+Aq at 25°

Molecules of $\text{CH}_3\text{COOH}$ in 100 molecules $\text{CH}_3\text{COOH}+\text{H}_2\text{O}$	Molecules of $\text{H}_2\text{O}$ in 100 molecules $\text{CH}_3\text{COOH}+\text{H}_2\text{O}$	Normality of the iodine solution
0 0	100	0 0022
6 95	93 02	0 0049
16 40	83 60	0 0112
31 90	68 10	0 0331
55 70	44 30	0 0882
100	0	0 205

(McLauchlan, Z phys Ch 1903, 44 627)

Very sol in ether, chloroform, and bromo-  
form

Solubility in ether

100 g of the sat solution contain at

—83° —90° —108°

15 39 14 58 15 09 g  $\text{I}_2$

(Arctowski, Z anorg 1896, 11 276)

About as sol in all fatty oils as in  $\text{CHCl}_3$ ,  
etc (Gruel, Arch Pharm 223 431)

Sol in 56.6 pts chloroform at 10° (Duncan, Pharm J Trans 51 544)

Solubility in  $\text{CHCl}_3$

100 g of the sat solution contain at  
 —49° —55 5° —60° —69 5° —73 5°  
 0 188 0 144 0 129 0 089 0 080 g  $\text{I}_2$   
 (Arctowski, Z anorg 1896, 11 276)

Very sol in methylene iodide (Retgers, Z anorg 3 343)

Solubility of  $\text{I}_2$  in  $\text{C}_6\text{H}_6 + \text{CHCl}_3$  at room temperature (14 5°—15 1°)

Volumes of $\text{C}_6\text{H}_6$ in 100 volumes of $\text{C}_6\text{H}_6 + \text{CHCl}_3$	Ccm of 1/10 normal iodine in 5 cc of the solution
100	41 05
90	38 8
80	34 6
70	30 5
60	27 4
50	24 4
40	21 0
30	19 2
20	17 8
10	16 0
0	14 3

(Bruner, Z phvs Ch 1898, 26 147)

Solubility of  $\text{I}_2$  in  $\text{CS}_2 + \text{CHCl}_3$  at room temperature (14 5°—15 1°)

Volumes of $\text{CS}_2$ in 100 volumes of $\text{CS}_2 + \text{CHCl}_3$	Ccm of 1/10 normal iodine in 5 cc of the solution
100	69 4
90	62 7
80	55 9
70	47 9
60	42 0
50	35 8
40	30 4
30	25 3
20	20 8
10	17 0
0	14 3

(Bruner)

Solubility of  $\text{I}$  in  $\text{C}_6\text{H}_6 + \text{CCl}_4$  at room temperature (14 5°—15 1°)

Volumes of $\text{C}_6\text{H}_6$ in 100 volumes of $\text{C}_6\text{H}_6 + \text{CCl}_4$	Ccm of 1/10 normal iodine in 5 cc of the solution
100	41 05
90	37 2
80	33 6
70	29 6
60	26 1
50	22 4
40	19 25
30	16 1
20	13 4
10	10 75
0	8 1

(Bruner)

Solubility of  $\text{I}_2$  in  $\text{CS}_2 + \text{CCl}_4$  at room temperature (14 5°—15 1°)

Volumes of $\text{CS}_2$ in 100 volumes of $\text{CS}_2 + \text{CCl}_4$	Ccm of 1/10-normal iodine in 5 cc of the solution
100	69 1
90	56 9
80	48 6
70	40 7
60	33 9
50	26 9
40	21 8
30	17 7
20	13 25
10	10 2
0	8 1

(Bruner)

Solubility of  $\text{I}_2$  in  $\text{C}_2\text{H}_5\text{OH} + \text{CHCl}_3$  at room temperature (14 5°—15 1°)

Volumes of $\text{C}_2\text{H}_5\text{OH}$ in 100 volumes of $\text{C}_2\text{H}_5\text{OH} + \text{CHCl}_3$	Ccm of 1/10 normal iodine in 5 cc of the solution
100	61 7
90	37 1
80	34 2
70	30 7
60	27 9
50	26 1
40	24 6
30	22 7
20	19 9
10	17 1
0	14 25

(Bruner)

Solubility of  $\text{I}_2$  in  $\text{C}_2\text{H}_7\text{OH} + \text{CHCl}_3$  at room temperature (14 5°—15 1°)

Volumes of $\text{C}_2\text{H}_7\text{OH}$ in 100 volumes of $\text{C}_2\text{H}_7\text{OH} + \text{CHCl}_3$	Ccm of 1/10 normal iodine in 5 cc of the solution
100	58 8
90	51 9
80	44 2
70	35 4
60	31 8
50	30 8
40	27 9
30	25 3
20	21 8
10	17 8
0	14 25

(Bruner)

Sol in acetone (Naumann, B 1904, 37 4328), (Eidmann, C C 1999, II 1014)  
 Sol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3601)

Sol in allyl mustard oil, phenyl mustard

oil, phenyl isocyanate, pyridine, and alcohol (Mathews, J phys Chem 1905, 9 649)

Solubility of  $I_2$  in glycerine + Aq at 25°  
 G = g glycerine in 100 g glycerine + Aq  
 $I_2$  = g  $I_2$  in 100 cc of the solution

G	$I_2$	Sp gr
0	0 0304	0 9979
7 15	0 0342	1 0198
20 44	0 0482	1 0471
31 55	0 0621	1 0750
40 95	0 0875	1 0995
48 7	0 135	1 1207
69 2	0 278	1 1765
100	1 223	1 2646

(Herz and Knoch, Z anorg 1905, 45 269)

1 l  $N-NH_4C_2H_3O_2$  + Aq dissolves 0 440 g  $I_2$  at 25°

1 l 0 7 N- $(NH_4)_2C_2O_4$  + Aq dissolves 0 980 g  $I_2$  at 25°

(McLauchlan, Z phys Ch 1903, 44 617)

Very sol in benzonitrile (Naumann, B 1914, 47 1369)

#### Solubility in $CS_2$ at t°

t°	Grams iodine in 100 g of sat solution
-100	0 32
-95	0 37
-90	0 41
-85	0 46
-80	0 51
-75	0 55
-25	3 47
-20	4 14
-15	4 82
-10	5 52
-5	6 58
0	7 89
+ 5	9 21
10	10 51
15	12 35
20	14 62
25	16 92
30	19 26
36	22 67
40	25 22
42	26 75

(Arctowski, Z anorg 1894, 6 404)

1 l  $CS_2$  dissolves 230 g  $I_2$  at 25°

1 l  $CHBr_3$  dissolves 189 55 g  $I_2$  at 25°

1 l  $CCl_4$  dissolves 30 33 g  $I_2$  at 25° (Jakowkin, Z phys Ch 1895, 18 590)

#### Solubility in $CS_2$

100 g of the sat solution contain at

-80°	-87°	-92 5°	-94°
0 509	0 440	0 391	0 378 g $I_2$

(Arctowski, Z anorg 1896, 11 274)

When an aqueous solution of I is shaken with  $CS_2$ , 400 pts go into solution in  $CS_2$  for 1 pt remaining in  $H_2O$  (Berthelot and Jungfleisch, C R 69 338)

Abundantly sol in methane (Villard, A ch 1897, (7) 10 387)

Easily sol in hot, less in cold naphtha (Pelletier and Walker)

Sol in about 8 pts hot petroleum from Amiano (de Saussure)

Sl sol in cold, more readily in hot benzene (Mansfield) Easily sol in benzene (Morde, A ch (3) 39 452)

#### Solubility in benzene

100 g of the sat solution contain at

4 7°	6 6°	10 5°	13 7°	16 3°
8 08	8 63	9 60	10 44	11 23 g $I_2$

(Arctowski, Z anorg 1896, 11 276)

1 l benzene sat with iodine at 25° contains 139 g iodine Abegg, Z anorg 1906, 50 409)

1 l nitrobenzene dissolves 50 62 g  $I_2$  at 16-17° (Dawson and Gawler, Chem Soc 1902, 81 524)

#### Solubility of $I_2$ in nitrobenzene + iodides at room temp

Salt	G per l	
	Salt	$I_2$
KI	12 35	112 7
"	45 56	295 7
"	115 8	698 2
"	155 2	943 6
NaI	13 55	125
"	57 7	393
"	109 1	738
"	228	1251
RbI	85 4	421
"	217 5	1060
LiI	84 1	642
CsI	48 2	213
"	223	858
$NH_4I$	69 5	482
"	94 3	669
SrI	106 5	599
$BaI_2$	42 2	237
"	158 5	809
Aniline hydriodide	164	721
Dimethyl aniline hydriodide	160	626
Tetramethylammonium iodide	49 3	266
"	51 4	280

(Dawson and Goodson, Chem Soc 1904, 85 796)

Sol in quinoline (Beckmann and Gabel, Z anorg 1906, 51 236)

Easily sol in oil of turpentine, but an explosion soon occurs (Walker)

Sol in oil of mandarin (Luca)

Sol in oil of arnica root (Zeller)

Very sol in  $\text{CS}_2$ , hgnone, furfurol, glycerine, aldehyde, chloral, warm retinole, toluene, salicylic acid, methyl nitrate, methyl salicylate, mercaptan, amyl carbamate, ethyl sulphhydrate, allyl iodide, ethyl disulphocarbonate, carbon chloride,  $\text{SCl}_2$ ,  $\text{ICl}_3$ ,  $\text{H}_2\text{S}_8$ , chlorochromic acid, amyl valerianate, valerianic acid, warm butyric acid, creosote, aniline, quinoline, methylsalicylic acid. Quickly sol in oil of dill, peppermint, sassafras, and tansy. Slowly sol in oil of cloves, cinnamon, cajeput, and rue. Other essential oils decompose it (Various authorities)

Sol in potassium croconate + Aq (Gmelin)

Sol in potassium antimony tartrate + Aq  
176 pts  $\text{H}_2\text{O}$  + 6 pts potassium antimony tartrate dissolve 2.75 pts I, 378 pts  $\text{H}_2\text{O}$  + 6 pts potassium antimony tartrate dissolve 4.12 pts I

More sol in tannic acid than in  $\text{H}_2\text{O}$  1 pt I is sol in 450 pts  $\text{H}_2\text{O}$  with 3.3 pts tannic acid at  $12^\circ$ , 1 pt I is sol in 240 pts  $\text{H}_2\text{O}$  with 0.015 pt tannic acid at about  $30^\circ$  (Koller, Zeit Ch 1866 380)

200 g  $\text{H}_2\text{O}$  containing 0.3 g tannic acid dissolve 10 g I (Hager, Comm 1883)

Sol in considerable quantity, especially on warming, in resorcin, orcin, or phloroglucin + Aq, without coloration or formation of HI + Aq. These solutions withdraw I from  $\text{CS}_2$  solution, and do not give it up on boiling, but on evaporation in vacuo the I is sublimed in a pure state (Hlasiwetz, Z anal 6 447)

Partition coefficient for iodine between  $\text{CS}_2$  and Aq at  $25^\circ\text{C}$

A = concentration of the water layer

C = concentration of the carbon bisulphide layer

A	C	$h = C/A$
0 2571	167 6	651 8
0 2195	140 2	638 7
0 1947	122 0	626 4
0 1743	108 3	620 0
0 1605	98 27	612 2
0 1229	73 23	595 8
0 1104	65 81	596 0
0 0939	55 29	590 5
0 0518	30 36	586 2

Partition coefficient for iodine between  $\text{CHBr}_3$  and Aq at  $25^\circ\text{C}$

A = concentration of the water layer

C = concentration of the  $\text{CHBr}_3$  layer

A	C	$h = C/A$
0 2736	144 36	527 6
0 1752	85 11	485 7
0 1084	49 93	460 5
0 0757	32 65	431 7
0 0517	22 19	429 3

Partition coefficient for iodine between  $\text{CCl}_4$  and Aq at  $25^\circ\text{C}$

A = concentration of the water layer

C = concentration of the  $\text{CCl}_4$  layer

A	C	$h = C/A$
0 2913	25 61	87 91
0 1934	16 54	85 51
0 1276	10 88	85 30
0 0818	6 966	85 13
0 0516	4 412	85 77

(Jakowkin, Z phys Ch 1895, 18 586-588)

G alcohol in 100 cc of mixture	$\frac{\text{C aq alcohol}}{\text{CCl}_2} \times 10^3$
30 5	1 29
26 7	0 76
22 9	0 49
19 1	0 34
16 3	0 28
11 4	0 23
7 6	0 20

(Osaka, Chem Soc 1905, 88 (2) 811)

Division of iodine between  $\text{CS}_2$  and

$\text{Na}_2\text{SO}_4$  + Aq at  $25^\circ$

A = concentration of I in  $\text{H}_2\text{O}$  layer

C = concentration of I in  $\text{CS}_2$  layer

$\text{Na}_2\text{SO}_4$ + Aq	A	C
1-N	0 1518	142 4
$1/2$ -N	0 1809	141 7
$1/4$ -N	0 2022	143 6
$1/8$ -N	0 2138	142 4

Division of iodine between  $\text{CS}_2$  and  $\text{NaNO}_3$  + Aq

$\text{NaNO}_3$ + Aq	A	C
1-N	0 1923	142 4
$1/2$ -N	0 2090	143 7
$1/4$ -N	0 2164	143 5

(Jakowkin, Z phys Ch 1896, 20 25)

Partition between  $\text{CHCl}_3$  and glycerine

C = millimols iodine in 10 g  $\text{CHCl}_3$  layer

W = millimols iodine in 10 g glycerine layer

C	W	$C/W$
0 564	0 244	2 31
0 919	0 397	2 32
0 151	0 500	2 30

(Herz, Z Elektrochem 1910, 16 870)

artition of  $I_2$  between  $CHCl_3$  and other solvents

C = millimols iodine in 10 ccm of the  $CHCl_3$  layer

W = millimols iodine in 10 ccm of the other layer

Other Solvent	C	W	C/W
Water	0 338	0 0025	134 6
	1 546	0 0120	129 0
	2 318	0 0184	126 3
	3 207	0 0242	132 8
	3 439	0 0259	132 8
5% by vol $H_2O$ + 25% by vol glycerine	1 217	0 0183	66 32
	1 893	0 0290	65 33
	2 434	0 0367	66 31
	3 219	0 0483	66 65
0% by vol $H_2O$ + 50% by vol glycerine	1 217	0 0405	30 0
	1 835	0 0609	30 1
	2 376	0 0782	30 4
	3 294	0 1020	32 2
5% by vol $H_2O$ + 75% by vol glycerine	1 188	0 116	10 25
	1 806	0 173	10 45
	2 656	0 249	10 66
	2 859	0 265	10 80
	3 400	0 312	10 93

(Herz, Z Elektrochem 1910, 16 870)

Distribution of  $I_2$  between benzene and glycerine at  $t^\circ$

$M_1$  = concentration of  $I_2$  in benzene layer expressed in g-mol per l

$M_2$  = concentration of  $I_2$  in glycerine layer expressed in g-mol per l

$t^\circ$	$M_1$	$M_2$
25°	0 00757	0 001604
	0 01610	0 002664
	0 02719	0 004115
	0 04024	0 005794
	0 06255	0 00834
	0 07923	0 01033
	0 10243	0 01324
	0 12201	0 01559
	0 13342	0 01668
	0 16734	0 02081
40°	0 008545	0 00181
	0 01544	0 002593
	0 04432	0 006242
	0 095004	0 012013
	0 13271	0 01632
	0 18508	0 02193
50°	0 00865	0 00184
	0 01523	0 00253
	0 02683	0 00390
	0 04413	0 00576
	0 0620	0 00744
	0 07832	0 00942
	0 10153	0 01214
	0 12166	0 0145
	0 13199	0 01560
	0 18438	0 02122

(Landau, Z phys Ch 1910, 73 202)

Distribution of  $I_2$  between glycerine and  $CCl_4$  at  $t^\circ$

$M_1$  = concentration of  $I_2$  in  $CCl_4$  layer expressed in g-mol per l

$M_2$  = concentration of  $I_2$  in glycerine layer expressed in g-mol per l

$t^\circ$	$M_1$	$M_2$
25°	0 002230	0 0014386
	0 0024113	0 0014595
	0 0048227	0 0027014
	0 010452	0 005581
	0 038973	0 019959
	0 04598	0 023948
	0 05820	0 030097
40°	0 00227	0 00127
	0 00239	0 00138
	0 00461	0 00272
	0 01092	0 00482
	0 02540	0 01116
	0 04091	0 01749
	0 06074	0 02701
50°	0 00257	0 00118
	0 00500	0 00225
	0 01363	0 00596
	0 02549	0 01050
	0 04167	0 01693
	0 06309	0 02502

(Landau, Z phys Ch 1910, 73 203)

Distribution of  $I_2$  between ether and ethylene glycol at  $t^\circ$

$M_1$  = concentration of  $I_2$  in ether layer, expressed in g-mol per l

$M_2$  = concentration of  $I_2$  in  $C_2H_4O_2$  layer, expressed in g-mol per l

$t^\circ$	$M_1$	$M_2$
0°	0 00843	0 00571
	0 03082	0 01713
	0 06551	0 03736
	0 08105	0 04605
	0 12528	0 07148
	0 31511	0 17524
25°	0 00870	0 00571
	0 01677	0 01001
	0 02710	0 01586
	0 03046	0 01713
	0 06385	0 03594
	0 11951	0 06725
	0 30820	0 17524

(Landau, Z phys Ch 1910, 73 205)

Iodine monobromide,  $IBr$

Slowly sol in  $H_2O$  with slight decomp  
Sol in  $CHCl_3$ ,  $CS_2$ , ether, and alcohol  
+5 $H_2O$  (Lowig, Pogg 14 485) Does  
not exist (Bornemann, A 189 183)

**Iodine pentabromide,  $\text{IBr}_5(?)$**

Sol in  $\text{H}_2\text{O}$  with separation of iodine (Lowig, Pogg 14 485)

**Iodine monochloride,  $\text{ICl}$**

Decomp by  $\text{H}_2\text{O}$ , sol without decomp in alcohol, ether, and  $\text{HCl} + \text{Aq}$   
Sol in  $\text{CS}_2$

**Iodine hydrogen chloride,  $\text{ICl}$ ,  $\text{HCl}$**

Unstable Sol in ether (Schutzenberger, C R 84 389)

**Iodine trichloride,  $\text{ICl}_3$**

Deliquescent With  $\text{H}_2\text{O}$ , a part is dissolved without decomp, and the rest is decomp The aqueous solution contains more unchanged  $\text{ICl}_3$ , the more conc it is (Serullas) Precipitated from aqueous solution by  $\text{H}_2\text{SO}_4$  Sol in  $\text{HCl} + \text{Aq}$  Sol in warm conc  $\text{H}_2\text{SO}_4$  without decomp Sol in alcohol, and benzene Decomp by small amount of  $\text{CS}_2$  (Christomanos, B 10 434) Ether does not remove it from aqueous solution (Serullas)

**Iodine lithium chloride,  $\text{ICl}_3$ ,  $\text{LiCl} + 4\text{H}_2\text{O}$**

See Lithium chloroiodide

**Iodine trichloride magnesium chloride,  $2\text{ICl}_3$ ,  $\text{MgCl}_2 + 5\text{H}_2\text{O}$**

Very deliquescent and easily decomposed (Filhol, J Pharm 25 442)  
 $+ 8\text{H}_2\text{O}$  Hydrosopic (Weinland, Z anorg 1902, 30 141)

**Iodine trichloride manganous chloride,  $2\text{ICl}_3$ ,  $\text{MnCl}_2 + 8\text{H}_2\text{O}$**

Hydrosopic (Weinland, Z anorg 1902, 30 139)

**Iodine trichloride nickel chloride,  $2\text{ICl}_3$ ,  $\text{NiCl}_2 + 5\text{H}_2\text{O}$**

If  $\text{CCl}_4$  dissolves out  $\text{ICl}_3$  (Weinland, Z anorg 1902, 30 138)

**Iodine monochloride phosphorus pentachloride,  $\text{ICl}$ ,  $\text{PCl}_5$**

Very deliquescent, decomp by  $\text{H}_2\text{O}$

**Iodine potassium chloride,  $\text{ICl}_3$ ,  $\text{KCl}$**

Sol in  $\text{H}_2\text{O}$  with decomp  
Ether dissolves out  $\text{ICl}_3$  (Filhol, J Pharm 25 433, 506)  
See Potassium chloroiodide

**Iodine sodium chloride,  $\text{ICl}_3$ ,  $\text{NaCl} + 2\text{H}_2\text{O}$**

See Sodium chloroiodide

**Iodine trichloride strontium chloride,  $2\text{ICl}_3$ ,  $\text{SrCl}_2 + 8\text{H}_2\text{O}$**

Hydrosopic (Weinland, Z anorg 1902, 30 142)

**Iodine trichloride sulphur tetrachloride,  $\text{ICl}_3$ ,  $\text{SCl}_4$**

Very deliquescent in air, decomp by  $\text{H}_2\text{O}$  Decomp with formation of clear solution by dil  $\text{HNO}_3 + \text{Aq}$  (Weber, Pogg 128 459)  
 $\text{SCl}_2$ ,  $2\text{ICl}_3$  (Jallard, J B 1860 95)  
Correct formula is as above (Weber, l c)  
 $2\text{ICl}_3$ ,  $\text{SCl}_4$  Sol in  $\text{SO}_2\text{Cl}_2$ ,  $\text{SOCl}_2$ ,  $\text{POCl}_3$ , warm  $\text{SCl}_2$ , petroleum ether, ligroin,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ ,  $\text{CS}_2$  and abs ether (Ruff, B 1904, 37 4519)

**Iodine trichloride zinc chloride,  $2\text{ICl}_3$ ,  $\text{ZnCl}_2 + 8\text{H}_2\text{O}$**

Unstable Hydrosopic (Weinland, Z anorg 1902, 30 140)

**Iodine pentafluoride,  $\text{IF}_5$**

Fumes in air, decomp with  $\text{H}_2\text{O}$  (Gore, C N 24 291)  
Decomp by  $\text{H}_2\text{O}$  into iodic acid and  $\text{HF}$  Decomp by solutions of the alkalis (Moissan, C R 1902, 135 564)

**Iodine trioxide,  $\text{I}_2\text{O}_3$**

Decomp by  $\text{H}_2\text{O}$  (Ogier, C R 85 957, 86 722)  
Probably a mixture

**Iodine tetroxide,  $\text{I}_2\text{O}_4(?)$**

Insol in cold, decomp by hot  $\text{H}_2\text{O}$ , insol in alcohol Decomp by  $\text{HNO}_3 + \text{Aq}$  Sol in  $\text{H}_2\text{SO}_4$  (Millon, J pr 34 319, 337)

**Iodine pentoxide,  $\text{I}_2\text{O}_5$**

Very sol in  $\text{H}_2\text{O}$ , and in dil alcohol Insol in absolute alcohol, ether,  $\text{CS}_2$ , chloroform, and hydrocarbons  
Forms hydrates, iodic acid  $\text{HIO}_3$ , and  $3\text{I}_2\text{O}_5$ ,  $\text{H}_2\text{O}$ , insol in ordinary alcohol  
For sp gr of aqueous solution see iodic acid

**Iodine oxides,  $\text{I}_{10}\text{O}_{19}$ ,  $\text{I}_3\text{O}_{13}$**

The compounds  $\text{I}_{10}\text{O}_{19}$  (Millon, J pr 34 336), and  $\text{I}_3\text{O}_{13}$  (Kimmerer, J pr 83 81), are probably mixtures  
Millon's oxides are impure  $\text{I}_2\text{O}_4$  (Kappeler, B 1911, 44 3496)

**Iodine sulphur oxide,  $5\text{I}_2\text{O}_7$ ,  $\text{SO}_3$**

Decomp by  $\text{H}_2\text{O}$  (Kimmerer)  
 $\text{I}_2\text{O}_5$ ,  $3\text{SO}_3$  Decomp by  $\text{H}_2\text{O}$ , sl sol in hot  $\text{SO}_4$  (Weber, B 20 86)  
 $= (\text{IO})_2(\text{SO}_4)_3$  Iodyl sulphate (?)

**Iodine oxyfluoride,  $\text{IOF}_3 + 5\text{H}_2\text{O}$**

Fumes in the air (Weinland, Z anorg 1908, 60 163)

**Iodine sulphide,  $\text{S I}_2$**

Sol in  $\text{CS}_2$  (Linebarger, Am Ch J 1895, 17 57)

**Iodine sulphoxide,  $I_2SO_3$ (?)**

Decomp by  $H_2O$  (Schultz-Sellack)  
 $I_2(SO_3)_2$ (?) Decomp by  $H_2O$  (Weber, J pr (2) 25 224)  
 $I_2(SO_3)_4$ (?) As above (Weber)  
 See also Iodosulphuric anhydride

**Iodiridic acid****Ammonium iodiridate,  $(NH_4)_2IrI_6$** 

Very easily sol in cold  $H_2O$ , decomp on warming Insol in alcohol (Oppler, J B 1857 263)

**Potassium iodiridate,  $K_2IrI_6$** 

Very easily sol in  $H_2O$  Insol in alcohol

**Sodium iodiridate,  $Na_2IrI_6$** 

Insol in cold, sl sol in hot  $H_2O$  Easily sol in acids (Oppler)

**Iodiridous acid****Ammonium iodiridite,  $(NH_4)_6Ir_2I_{12}+H_2O$** 

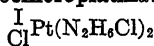
Very sol in  $H_2O$ , but decomp on warming (Oppler)

**Potassium iodiridite,  $K_6Ir_2I_{12}$** 

Insol in  $H_2O$ , or alcohol Slowly sol in acids, easily in warm alkalies + Aq

**Silver iodiridite,  $Ag_6Ir_2I_{12}$** 

Ppt

**Iodochloroplatinodiamine chloride,**

Sl sol in  $H_2O$

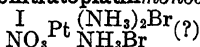
**Iodochromic acid****Potassium iodochromate,  $KCrO_3I$** 

Decomp by boiling  $H_2O$  (Guyot, C R 73 46)

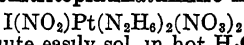
See also Chromiodic acid

**Iodomolybdic acid**

See Molybdoiodic acid

**Iodonitratoplatinmonodiamine bromide,**

Very sl sol in  $H_2O$  (Cleve)

**Iodonitratoplatinodiamine nitrate,**

Quite easily sol in hot  $H_2O$  (Cleve)

**Iodopalladous acid****Potassium iodopalladite**

Deliquescent (Lassaigne)

**Iodophosphoric acid**

See Phosphoiodic acid

**Iodoplatinamine iodide,  $I_2Pt(NH_3)_2I_2$** 

Sol in  $H_2O$ , especially easily if boiled (Cleve)

**Iodoplatinodiamine iodide,  $I_2Pt(N_2H_5)_2I_2$** 

Sol in  $H_2O$ , especially when hot (Cleve)

**— mercuric iodide,  $I_2Pt(N_2H_5)_2, 2HgI_2$** 

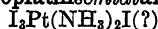
Extremely difficultly sol in cold  $H_2O$ , partly decomp by boiling (Jorgensen, Gr K 3 1214)

**— nitrate,  $I_2Pt(N_2H_5NO_3)_2$** 

More sol in hot than cold  $H_2O$

**— sulphate,  $I_2Pt(N_2H_5)_2SO_4$** 

Very sl sol in  $H_2O$  (Jorgensen, J pr (15 429)

**Iodoplatinsemidiamine iodide,**

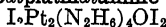
Sl sol in  $H_2O$  (Jorgensen, J pr (2) 1 345)

**— periodide,  $I_3Pt(NH_3)_2I, I_2$** 

Moderately sl sol in  $H_2O$  (Cleve)

**Iododiplatinamine iodide,  $I_2Pt_2(N_2H_5)_2I_4$** 

Insol in  $H_2O$

**Iododiplatinodiamine anhydroiodide,**

Insol in  $NH_4OH$  + Aq

**— anhydronitrate,  $I_2Pt_2(N_2H_5)_4O(NO_3)_2$** 

Easily sol in warm  $H_2SO_3$  + Aq (Cleve)

**— iodide,  $I_2Pt_2(N_2H_5)_4I_4$** 

Ppt

**— nitrate,  $I_2Pt_2(N_2H_5)_4(NO_3)_4+4H_2O$** 

Sl sol in cold, moderately sol in hot  $H_2O$  (Cleve)

**— phosphate,  $I_2Pt_2(N_2H_5)_4[O_3P(OH)]_2$** 

Nearly insol in  $H_2O$

**— sulphate,  $I_2Pt_2(N_2H_5)_4(SO_4)_2$** 

Nearly insol in  $H_2O$

**— platodiamine sulphate,  $I_2Pt_2(N_2H_5)_4SO_4Pt(NH_3)_2SO_4$** 

Very sl sol in  $H_2O$  (Carlgren Sv V A F 47 306)

**Iodoplatinic acid,  $H_2PtI_6+9H_2O$** 

Deliquescent Easily sol in  $H_2O$ , with decomp into  $PtI_4$  and  $HI$  on standing or warming (Topsoe)

**Ammonium iodoplatinate,  $(\text{NH}_4)_2\text{PtI}_6$**

Easily sol in  $\text{H}_2\text{O}$  (Topsoe)  
 $\text{NH}_4\text{I}$ ,  $\text{PtI}_4$  Sl sol in  $\text{H}_2\text{O}$ , insol in alcohol (Lassaigne, A ch (2) 51 128)

**Barium iodoplatinate,  $\text{BaPtI}_6$**

Deliquescent, but less so than  $\text{Na}_2\text{PtI}_6$  which it otherwise resembles (Lassaigne)

**Calcium iodoplatinate,  $\text{CaPtI}_6 \cdot 12\text{H}_2\text{O}$**

Not so deliquescent as Na salt

**Cobalt iodoplatinate,  $\text{CoPtI}_6 \cdot 9\text{H}_2\text{O}$**

Very deliquescent

**Lead tetraiodoplatinate,  $[\text{PtI}_4(\text{OH})_2]\text{Pb}, \text{Pb}(\text{OH})_2$**

Ppt (Bellucci, C C 1902, I 625)

**Magnesium iodoplatinate,  $\text{MgPtI}_6 \cdot 9\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$

**Manganese iodoplatinate,  $\text{MnPtI}_6 \cdot 9\text{H}_2\text{O}$**

Very deliquescent

**Mercuric tetraiodoplatinate,  $[\text{PtI}_4(\text{OH})_2]\text{Hg}$**

Ppt (Bellucci, C C 1902, I 625)

**Nickel iodoplatinate,  $\text{NiPtI}_6 \cdot 9\text{H}_2\text{O}$**

Very deliquescent

**Potassium iodoplatinate,  $\text{K}_2\text{PtI}_6$**

Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol Not attacked by cold conc  $\text{H}_2\text{SO}_4$

**Silver tetraiodoplatinate,  $[\text{PtI}_4(\text{OH})_2]\text{Ag}$**

Ppt (Bellucci, C C 1902, I 625)

**Sodium iodoplatinate,  $\text{Na}_2\text{PtI}_6 \cdot 6\text{H}_2\text{O}$**

Not deliquescent, but easily sol in  $\text{H}_2\text{O}$  and alcohol (Vauquelin) Deliquescent (Lassaigne)

**Thallium tetraiodoplatinate,  $[\text{PtI}_4(\text{OH})_2]\text{Tl}$**

Ppt (Bellucci, C C 1902, I 625)

**Zinc iodoplatinate,  $\text{ZnPtI}_6 \cdot 9\text{H}_2\text{O}$**

Easily sol in  $\text{H}_2\text{O}$

**Iodoplatinocyanhydric acid,  $\text{H}_2\text{Pt}(\text{CN})_4\text{I}_2$**

See Periodoplatinocyanhydric acid

**Silver iodoplatinocyanide,  $\text{Ag}_2(\text{PtI}_4(\text{CN})_4)$**

Ppt (Miolati, Gazz ch it 1900, 30 588)

**Strontium iodoplatinocyanide platinumocyanide,  $\text{SrPt}(\text{CN})_4\text{I}_2, 10\text{SrPt}(\text{CN})_4 + x\text{H}_2\text{O}$**

(Holst)

**Iodopurpleochromium chloride,  $\text{ICr}(\text{NH}_3)_5\text{Cl}_2$**

Quite sol in  $\text{H}_2\text{O}$  (Jorgensen, J pr (2) 25 83)

**— chloroplatinate,  $\text{ICr}(\text{NH}_3)_5\text{PtCl}_6$**

Precipitate (Jorgensen, l c)

**— iodide,  $\text{ICr}(\text{NH}_3)_5\text{I}_2$**

Difficultly sol in  $\text{H}_2\text{O}$  Insol in  $\text{HI}$ , or  $\text{KI} + \text{Aq}$ , insol in alcohol (Jorgensen, l c)

**— nitrate,  $\text{ICr}(\text{NH}_3)_5(\text{NO}_3)_2$**

Much less sol in  $\text{H}_2\text{O}$  than the chloride (Jorgensen, l c)

**Iodopurpleocobaltic iodide,  $\text{CoI}(\text{NH}_3)_5\text{I}_2$**

(Claudet)

Does not exist (Jorgensen, J pr (2) 25 94)

**Iodopurpleorhodium chloride,  $\text{IRh}(\text{NH}_3)_5\text{Cl}_2$**

Relatively easily sol in  $\text{H}_2\text{O}$ , insol in  $\text{HCl} + \text{Aq}$  and alcohol Insol in  $\text{KI} + \text{Aq}$  (Jorgensen, J pr (2) 27 433)

**— fluosilicate,  $\text{IRh}(\text{NH}_3)_5\text{SiF}_6$**

Nearly insol in cold  $\text{H}_2\text{O}$

**— iodoplatinate,  $\text{IRh}(\text{NH}_3)_5\text{PtI}_6$**

Ppt

**— iodide,  $\text{IRh}(\text{NH}_3)_5\text{I}_2$**

Very sl sol in cold  $\text{H}_2\text{O}$ , more sol in hot  $\text{H}_2\text{O}$ , insol in dil  $\text{HI} + \text{Aq}$ , and alcohol (Jorgensen, J pr (2) 27 433)

**— nitrate,  $\text{IRh}(\text{NH}_3)_5(\text{NO}_3)_2$**

Sl sol in  $\text{H}_2\text{O}$ , more easily sol in hot  $\text{H}_2\text{O}$ , insol in dil  $\text{HNO}_3 + \text{Aq}$ , and alcohol

**— sulphate,  $\text{IRh}(\text{NH}_3)_5\text{SO}_4$ , and  $+3\text{H}_2\text{O}$**

Sl sol in even hot  $\text{H}_2\text{O}$  (Jorgensen)

**Iodoselenic acid**

**Ammonium iodoselenate,  $2(\text{NH}_4)_2\text{O}, \text{I O}_5, 2\text{SeO}_3 + \text{H O}$**

Decomp by  $\text{H}_2\text{O}$  (Weinland, B 1903, 36 1400)

$2(\text{NH}_4)_2\text{O}, 3\text{I O}_5, 2\text{SeO}_3 + 5\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with decomp (?) (Weinland)

**Potassium iodoselenate,  $2\text{K}_2\text{O}, \text{I O}_5, 2\text{SeO}_3 + \text{H}_2\text{O}$**

Decomp by  $\text{H}_2\text{O}$  (Weinland)  
 $2\text{K}_2\text{O}, 3\text{I O}_5, 2\text{SeO}_3 + 5\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with decomp (?) (Weinland)



**Rubidium iodoseleate**,  $2\text{Rb}_2\text{O}$ ,  $3\text{I}_2\text{O}_5$ ,  $2\text{SeO}_2$   
 $+5\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Weinland)

### Iodostannous acid

Data concerning solubility of  $\text{SnI}_2$  in  $\text{HI} + \text{Aq}$  indicate formation of this compound (Young, J Am Chem Soc 1897, 19 853)

### Iodosulphobismuthous acid

**Cuprous iodosulphobismuthite**,  $2\text{Cu}_2\text{S}$ ,  $\text{Bi}_2\text{S}_3$ ,  $2\text{BiSI}$

Decomp by  $\text{H}_2\text{O}$  at ord temp Decomp by mineral acids with evolution of  $\text{H}_2\text{S}$  (Ducatte, C R 1902, 134 1213)

**Lead iodosulphobismuthite**,  $\text{PbS}$ ,  $\text{Bi}_2\text{S}_3$ ,  $2\text{BiSI}$

Insol in  $\text{H}_2\text{O}$  Partially decomp by boiling  $\text{H}_2\text{O}$  Decomp by dil mineral acids with evolution of  $\text{H}_2\text{S}$  (Ducatte)

### Iodosulphuric acid

**Ammonium iodosulphate**,  $(\text{NH}_4)_2\text{SO}_3\text{I}_2(?)$

Very sol in  $\text{H}_2\text{O}$  (Zinno, N Rep Pharm 20 449)

**Mercuric iodosulphate**,  $\text{Hg}_2(\text{SO}_4)\text{I}_2$

See Mercuric sulphate iodide

**Potassium iodosulphate**,  $\text{K}_2\text{SO}_3\text{I}_2(?)$

Sol in 7 14 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Zinno, N Rep Pharm 20 449)

**Sodium iodosulphate**,  $\text{Na SO}_3\text{I}_2 + 10\text{H}_2\text{O}$

Sol in 3 64 pts  $\text{H}_2\text{O}$  at  $15^\circ$  and in dil alcohol (Zinno, N Rep Pharm 20 449)

Does not exist (Michaelis and Koethe, B 6 999)

**Iodosulphuric anhydride**,  $\text{ISO}_3$

Decomp very violently by  $\text{H}_2\text{O}$  (Weber, J pr (2) 25 224)

**Duodosulphuric anhydride**,  $\text{I}_2\text{SO}_3$

Decomp with  $\text{H}_2\text{O}$ , but not so violently as  $\text{ISO}_3$  (Weber, J pr (2) 25 224)

**Iodotrisulphuric anhydride**,  $\text{I}(\text{SO}_3)_3$

Decomp by  $\text{H}_2\text{O}$  (Weber, J pr (2) 25 224)

### Iodotelluric acid

**Ammonium iodotellurate**,  $(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{TeO}_3 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Weinland, Z anorg 1901, 28 52)

$(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{TeO}_3 + 8\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Weinland, B 1900, 33 1017)

**Cæsium iodotellurate**,  $\text{Cs}_2\text{TeI}_4$

Insol in  $\text{CsI}$ , or  $\text{HI} + \text{Aq}$  Decomp slowly by cold, rapidly by hot  $\text{H}_2\text{O}$  (Wheeler, Sil Am J 145 267)

**Potassium iodotellurate**,  $\text{K}_2\text{TeI}_6 + 2\text{H}_2\text{O}$

Sl efflorescent Somewhat sol in  $\text{KI} + \text{Ac}$  and dil  $\text{HI} + \text{Aq}$  (Wheeler)

$\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $\text{TeO}_3 + 3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Partially decomp on recryst from  $\text{H}_2\text{C}$  (Weinland, Z anorg 1901, 28 53)

$\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{TeO}_3 + 6\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  without decomp (Weinland)

**Rubidium iodotellurate**,  $\text{Rb}_2\text{TeI}_6$

Sl sol in  $\text{HI}$ , or  $\text{RbI} + \text{Aq}$  Decomp b  $\text{H}_2\text{O}$  Somewhat sol in alcohol (Wheeler  $\text{Rb}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{TeO}_3 + 6\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Weinland))

**Iodotetramine chromium iodide**,

$\text{ICr}(\text{NH}_3)_4\text{I}_2 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Pptd by alcohol (Cleve)

**Iodotetramine cobaltic sulphate**,

$\text{ICo}(\text{NH}_3)_4\text{SO}_4$

(Vortmann and Blasberg, B 22 2652)

**Iodotungstic acid**

See Tungstioiodic acid

**Iodous acid**,  $\text{I}_2\text{O}_3$

See Iodine trioxide

**Iodovanadic acid**,  $\text{I}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$

Very easily sol in  $\text{H}_2\text{O}$   
 $2\text{V}_2\text{O}_5$ ,  $3\text{I}_2\text{O}_5 + 18\text{H}_2\text{O}$  (Ditte, C R 102 757)

**Ammonium iodovanadate**,  $3(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$

$5\text{I}_2\text{O}_5 + 20\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Ditte, C R 102 1019)

**Irididamine compounds**,  $\text{Cl} \cdot \text{Ir}(\text{NH}_3)_4\text{X}_2$

See Chloriridamine compounds

**Iridic acid**

**Potassium iridate** (?)

Sol in  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq}$

**Iridicyanhydric acid**,  $\text{H}_3\text{Ir}(\text{CN})_6$

Easily sol in  $\text{H}_2\text{O}$ , still more easily in alcohol, less in ether (Martius, A 117 369)

**Barium iridicyanide**,  $\text{Ba}_3[\text{Ir}(\text{CN})_6]_2 + 18\text{H}_2\text{O}$

Efflorescent Easily sol in hot or cold  $\text{H}_2\text{O}$  Nearly insol in alcohol Not decomp by acids

**Cupric iridicyanide ammonia**,  $\text{Cu}_3\text{Ir}_2(\text{CN})_{12}$ ,  
 $6\text{NH}_3 + 4\text{H}_2\text{O}$

Ppt Decomp in air (Rumbach, Z anorg  
 1907, **52** 413)

**Potassium iridicyanide**,  $\text{K}_3\text{Ir}(\text{CN})_6$   
 Easily sol in  $\text{H}_2\text{O}$

**Silver iridicyanide ammonia**,  $\text{Ag}_3\text{Ir}(\text{CN})_6$ ,  
 $2\text{NH}_3 + 3\text{H}_2\text{O}$

Ppt Decomp in the light (Rumbach, Z  
 anorg 1907, **52** 414)

### **Iridium, Ir**

Insol in all acids, including aqua regia,  
 except when in finely divided state, as  
 "iridium black," when it is sol in aqua regia  
 (Claus, J pr **42** 251)

### **Iridium ammonia compounds**

See—

**Chlorirididamine comps**,  $\text{ClIr}(\text{NH}_3)_2\text{X}$

**Iridotramine** "  $\text{Ir}(\text{NH}_3)_3\text{X}_3$

**Iridopentamine** "  $\text{Ir}(\text{NH}_3)_5\text{X}_3$

**Iridotetramine** "  $\text{Ir}(\text{NH}_3)_4\text{X}_2$

**Iridoquoopentamine** "  $\text{Ir}(\text{NH}_3)_5(\text{OH}_2)\text{X}_3$

**Iridosoamine** "  $\text{Ir}(\text{NH}_3)_2\text{X}_2$

**Iridosodamine** "  $\text{Ir}(\text{NH}_3)_4\text{X}_2$

### **Iridium tribromide**, $\text{IrBr}_3 + 4\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol or  
 ether (Birnbäum)

### **Iridium tetrabromide**, $\text{IrBr}_4$ , or $\text{H}_2\text{IrBr}_6$

Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol  
 (Birnbäum)

See **Bromiridic acid**

### **Iridium hydrogen sesquibromide**, $3\text{HBr}$ , $\text{IrBr}_3 + \text{H}_2\text{O} = \text{H}_3\text{IrBr}_6 + 3\text{H}_2\text{O}$

See **Bromiridous acid**

### **Iridium sesquibromide with MBr**

See **Bromiridite, M**

### **Iridium tetrabromide with MBr**

See **Bromiridate, M**

### **Iridium phosphorous bromide**, $\text{IrBr}_3$ , $3\text{PBr}_3$

Partly decomp by  $\text{H}_2\text{O}$  into a sol, and  
 insol modification Sol in  $\text{PBr}_3$  (Geisen-  
 heimer)

$\text{IrBr}_3$ ,  $2\text{PBr}_3$  Not easily attacked by  $\text{H}_2\text{O}$   
 $\text{IrBr}_4$ ,  $2\text{PCl}_3$

See **Iridium phosphorus chlorobromide**

### **Iridium carbide**, $\text{IrC}_4(?)$

(Berzelius)

Stable toward  $\text{H}_2\text{O}$ , acids, and alcohol  
 (Strecker, B 1909, **42** 1773)

### **Iridium monochloride**, $\text{IrCl}$

Insol in acids and bases (Wohler, B  
 1913, **46** 1584)

### **Iridium dichloride**, $\text{IrCl}_2$

Insol in acids and bases (Wohler, B  
 1913, **46** 1585)

### **Iridium trichloride**, $\text{IrCl}_3$

Insol in acids or alkalis (Claus, C C  
 1861 690)

Insol in  $\text{H}_2\text{O}$ , acids and alkalis, (Leadé,  
 C R 1899, **129** 1251)

+  $4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Claus)

### **Iridium tetrachloride**, $\text{IrCl}_4$ , or $\text{H}_2\text{IrCl}_6(?)$

Deliquescent, and easily sol in  $\text{H}_2\text{O}$

### **Iridium trichloride with MCl**

See **Chloriridite, M**

### **Iridium tetrachloride with MCl**

See **Chloriridate, M**

### **Iridium chloride with potassium chloride and sulphite**

See **Chloriridosulphite, potassium**

### **Iridium phosphorus chloride**, $\text{IrP}_2\text{Cl}_9$

Insol in cold  $\text{H}_2\text{O}$  Sl decomp by hot  
 $\text{H}_2\text{O}$  (Geisenheimer, A ch (6) **23** 254)

$\text{IrP}_2\text{Cl}_{10}$  Very sol in chloroform (G)

$\text{IrP}_2\text{Cl}_{12}$  Easily sol in  $\text{PCl}_3$ , or  $\text{CHCl}_3$ ,  
 also in  $\text{CS}_2$  with gradual decomp Sl sol in  
 cold  $\text{H}_2\text{O}$  Decomp by boiling into  $\text{IrCl}_3$ ,  
 $3\text{H}_3\text{PO}_4$  Sl sol in benzene, ligrom and  $\text{CCl}_4$   
 (Strecker, B 1909, **42** 1772)

+  $\text{H}_2\text{O}$  Insol in  $\text{PCl}_3$  at  $100^\circ$  Very  
 slowly sol in boiling  $\text{H}_2\text{O}$  (Geisenheimer, A  
 ch (6) **23** 266)

$\text{IrP}_3\text{Cl}_{15}$  Decomp by  $\text{H}_2\text{O}$  into  $2\text{IrCl}_3$ ,  
 $3\text{H}_3\text{PO}_3$ ,  $3\text{H}_3\text{PO}_4$ . Violently decomp by  
 alcohol Sl sol in cold, more in hot  $\text{POCl}_3$ ,  
 without decomp Very sol in  $\text{PCl}_3$  with  
 decomp into  $\text{IrP}_3\text{Cl}_{12}$ , similarly in  $\text{PBr}_3$  Sol  
 in  $\text{AsCl}_3$  with combination Sol in  $\text{CS}_2$  with  
 decomp Sol in  $\text{SCl}_2$  with combination  
 Easily sol in cold  $\text{C}_6\text{H}_6$  with decomp Insol  
 in  $\text{CCl}_4$  Sol in  $\text{CHCl}_3$  with decomp (Gei-  
 senheimer, A ch (6) **23** 254)

### **Iridium phosphorus arsenic chloride**,

$2\text{IrP}_3\text{Cl}_{15}$ ,  $5\text{AsCl}_3$

Sol in  $\text{H}_2\text{O}$  with decomp into correspond-  
 ing acid (Geisenheimer, C R **110** 1336)

$\text{IrCl}_3$ ,  $2\text{PCl}_3$ ,  $2\text{AsCl}_3$  Very sol in  $\text{H}_2\text{O}$   
 with decomp Sol in  $\text{AsCl}_3$ , insol in  $\text{CCl}_4$   
 (Geisenheimer)

### **Iridium phosphorus sulphur chloride**, $\text{IrCl}_3$ , $2\text{PCl}_3$ , $2\text{SCl}_2$

Very sol in sl amt  $\text{H}_2\text{O}$ , with decomp into  
 an acid analogous to chlorophosphoridic acid  
 Sol in  $\text{SCl}_2$  (Geisenheimer)

**Iridium phosphorus chlorobromide**,  $\text{IrBr}_4 \cdot 2\text{PCl}_3$   
(Geisenheimer, C R 111 40)

**Iridium dihydroxide**,  $\text{IrO}_2 \cdot 2\text{H}_2\text{O} = \text{IrO}_4\text{H}_4$   
Insol in dil  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  Slowly but completely sol in  $\text{HCl} + \text{Aq}$  Sol in  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq}$  (Claus, J pr 39 104)

**Iridium sesquihydroxide**,  $\text{Ir}_2\text{O}_3\text{H}_6$   
Not attacked by acids, except slightly by conc  $\text{HCl} + \text{Aq}$  (Claus, C C 1861 690)

**Iridium triiodide**,  $\text{IrI}_3$   
Very sl sol in cold, somewhat more in hot  $\text{H}_2\text{O}$  Insol in alcohol (Oppler, J B 1857 263)

**Iridium tetraiodide**,  $\text{IrI}_4$   
Insol in  $\text{H}_2\text{O}$  or acids (Lassaigne)  
Sol in solutions of iodides (Oppler)

**Iridium triiodide with MI**  
See Iodiridite, M

**Iridium tetraiodide with MI**  
See Iodiridate, M

**Iridium dioxide**,  $\text{IrO}_2$   
Very sl sol in acids  
Freshly pptd Sol in conc  $\text{H}_2\text{SO}_4$ , hot 2-N  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{HCl}$  Insol in 2-N  $\text{KOH}$  and sl sol in hot 1-N  $\text{KOH}$   
Dried in a desiccator Sol in  $\text{HCl}$  Insol in  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$  and  $\text{KOH}$   
Dried at  $100^\circ$  Sol in hot conc  $\text{HCl}$  Insol in  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$  and  $\text{KOH}$  (Wohler, Z anorg 1908, 57 334)  
See also Iridium dihydroxide

**Iridium trioxide**,  $\text{IrO}_3$   
Unstable (Wohler, Z anorg 1908, 57 340)

**Iridium sesquioxide**,  $\text{Ir}_2\text{O}_3$   
Insol in acids  
Sol in conc  $\text{H}_2\text{SO}_4$ , and hot conc  $\text{HCl}$  Forms colloidal solution with dil  $\text{HCl}$  Conc  $\text{HNO}_3$  converts it into the dioxide  
Insol in  $\text{KOH} + \text{Aq}$  (Wohler, Z anorg 1908, 57 339)

**Iridium oxybromide**,  $\text{Ir}_2\text{Br}_3\text{O}_2 = 2\text{IrBr}_4 \cdot \text{IrO}_2$   
Not decomp by  $\text{H}_2\text{O}$  (Geisenheimer, A ch (6) 23 286)

**Iridium phosphide**,  $\text{Ir}_2\text{P}$   
(Clarke and Joslin, Am Ch J 5 231)

**Iridium sesquiselelide**,  $\text{Ir}_2\text{Se}_3$   
Insol in  $\text{HNO}_3$ , slowly sol in hot aqua regia (Chabré and Bouchonnet, C R 1903, 137 1060)

**Iridium monosulphide**,  $\text{IrS}$   
Insol in  $\text{HNO}_3 + \text{Aq}$ , and very sl sol if at all in aqua regia (Berzelius)  
Sol in  $\text{K}_2\text{S}$ , and  $\text{KSH} + \text{Aq}$   
 $+ x\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$ , sol in cold  $\text{HNO}_3 + \text{Aq}$  Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$  or dil acids More sol in  $\text{K}_2\text{S} + \text{Aq}$  than  $\text{PtS}_2$  (Berzelius)

**Iridium disulphide**,  $\text{IrS}_2$   
Not attacked by  $\text{H}_2\text{O}$ , but decomp when exposed moist in air Not attacked by sat  $\text{HCl} + \text{Aq}$  or by conc  $\text{HNO}_3 + \text{Aq}$ , but is oxidised by fuming  $\text{HNO}_3 + \text{Aq}$ , and aqua regia Insol in  $\text{NH}_4$  sulphides, or polysulphides +  $\text{Aq}$  Slowly sol in alkali polysulphides +  $\text{Aq}$  (Antony, Gazz ch it 23, 1 190)

**Iridium sesquisulphide**,  $\text{Ir}_2\text{S}_3$   
Sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$ , or  $\text{K}_2\text{S} + \text{Aq}$

**Iridotriamine chloride**,  $\text{Ir}(\text{NH}_3)_3\text{Cl}_3$   
Sl sol in  $\text{H}_2\text{O}$  Not attacked by boiling  $\text{H}_2\text{SO}_4$  (Palmaer, B 22 15)

**Iridotetraamine chloride**,  $\text{Ir}(\text{NH}_3)_4\text{Cl}_3$   
Very sol in  $\text{H}_2\text{O}$  (Palmaer, B 22 15)

— chlorosulphate,  $[\text{Ir}(\text{NH}_3)_4\text{Cl}_2]\text{SO}_4 + 4\text{H}_2\text{O}$   
(Palmaer)

**Iridopentamine bromide**,  $\text{Ir}(\text{NH}_3)_5\text{Br}_3$   
Sol in 352 pts  $\text{H}_2\text{O}$  at  $12.5^\circ$  (Palmaer, B 23 3817)

— bromochloride,  $\text{Ir}(\text{NH}_3)_5\text{ClBr}_2$   
Sol in  $\text{H}_2\text{O}$  (Palmaer, B 24 2090)

— bromonitrite,  $\text{Ir}(\text{NH}_3)_5\text{Br}(\text{NO}_2)_2$   
Sol in 179 pts  $\text{H}_2\text{O}$  at  $18^\circ$  (Palmaer)

— bromosulphate,  $\text{Ir}(\text{NH}_3)_5\text{BrSO}_4 + \text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Palmaer)

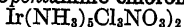
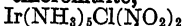
— carbonate,  $[\text{Ir}(\text{NH}_3)_5]_2(\text{CO}_3)_3 + 3\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Claus, J pr 63 99)

— trichloride,  $\text{Ir}(\text{NH}_3)_3\text{Cl}_3$   
Sol in 153.1 pts  $\text{H}_2\text{O}$  at  $15.1^\circ$  (Palmaer, B 23 3810)  
Sol in hot  $\text{H}_2\text{O}$  containing  $\text{HCl}$  (Claus, J pr 69 30)

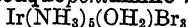
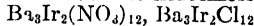
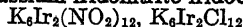
— chlorobromide,  $\text{Ir}(\text{NH}_3)_5\text{ClBr}_2$   
Sol in 213.6 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Palmaer)

— chloroiodide,  $\text{Ir}(\text{NH}_3)_5\text{ClI}_2$   
Sol in 104.5 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Palmaer)

— chlorooxalate,  $\text{Ir}(\text{NH}_3)_5\text{ClC}_2\text{O}_4$   
Sl sol in  $\text{H}_2\text{O}$  (Palmaer)

**Iridopentamine chloronitrate,**Sol in 51.54 pts  $\text{H}_2\text{O}$  at  $15.4^\circ$  (Palmaer)— **chloronitrite,**Easily sol in  $\text{H}_2\text{O}$  (Palmaer)— **chloroplatinate,**  $\text{Ir}(\text{NH}_3)_5\text{Cl}_3, \text{PtCl}_4$ Very sl sol in  $\text{H}_2\text{O}$  (Palmaer)— **chlorosulphate,**  $\text{Ir}(\text{NH}_3)_5\text{ClSO}_4 + 2\text{H}_2\text{O}$ Sol in 134.5 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Palmaer)— **hydroxide,**  $\text{Ir}(\text{NH}_3)_5(\text{OH})_3$ 

Known only in solution, which decomp on evaporation (Claus)

— **nitrate,**  $\text{Ir}(\text{NH}_3)_5(\text{NO}_3)_3$ Moderately sol in  $\text{H}_2\text{O}$  (Claus)Sol in 349 pts  $\text{H}_2\text{O}$  at  $16^\circ$  (Palmaer)— **sulphate,**  $[\text{Ir}(\text{NH}_3)_5]_2(\text{SO}_4)_3$ Sol in  $\text{H}_2\text{O}$  (Claus)**Iridoaquopentamine bromide,**Sol in 4 pts  $\text{H}_2\text{O}$  Pptd from aqueous solution by  $\text{HBr} + \text{Aq}$  (Palmaer, B 24 2090)— **chloride,**  $\text{Ir}(\text{NH}_3)_5(\text{OH}_2)\text{Cl}_3$ Sol in 1.2 to 1.5 pts  $\text{H}_2\text{O}$  at ord temp Pptd by  $\text{HCl} + \text{Aq}$  from aqueous solution (Palmaer, B 24 2090)— **nitrate,**  $\text{Ir}(\text{NH}_3)_5(\text{OH}_2)(\text{NO}_3)_3$ Sol in about 10 pts  $\text{H}_2\text{O}$  at  $17^\circ$  Pptd from aqueous solution by  $\text{HNO}_3 + \text{Aq}$  (Palmaer)**Iridonitrous acid,**  $\text{H}_6\text{Ir}_2(\text{NO}_2)_{12}$ Easily sol in  $\text{H}_2\text{O}$  (Gibbs, B 4 281)**Ammonium iridonitrite,**  $(\text{NH}_4)_6\text{Ir}_2(\text{NO}_2)_{12}$ Almost insol in cold  $\text{H}_2\text{O}$ , decomp by hot  $\text{H}_2\text{O}$  with evolution of  $\text{N}_2$ . Decomp by hot conc  $\text{H}_2\text{SO}_4$  or  $\text{HCl}$ . Insol in sat  $\text{NH}_4\text{Cl} + \text{Aq}$  (Leidich, C R 1902, 134 1583)**Barium iridonitrite iridochloride,**Sol in  $\text{H}_2\text{O}$  (Lang)**Mercuric iridonitrite,**  $\text{Hg}_2\text{Ir}_2(\text{NO}_2)_{12}$ Insol in  $\text{H}_2\text{O}$  (Gibbs, B 4 280)**Potassium iridonitrite,**  $\text{K}_6\text{Ir}_2(\text{NO}_2)_{12}$ Sl sol in cold, more sol in boiling  $\text{H}_2\text{O}$ . Decomp by hot  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . Insol in  $\text{KCl} + \text{Aq}$  (Leidich, Bull Soc 1902, (3) 27 937) $+ 2\text{H}_2\text{O}$  Moderately sol in  $\text{H}_2\text{O}$ **Potassium iridonitrite iridochloride,**Sol in  $\text{H}_2\text{O}$ **Silver iridonitrite,**  $\text{Ag}_6\text{Ir}_2(\text{NO}_2)_{12}$ Difficultly sol in cold, more easily in hot  $\text{H}_2\text{O}$ **Sodium iridonitrite,**  $\text{Na}_6\text{Ir}_2(\text{NO}_2)_{12} + 2\text{H}_2\text{O}$ Sl sol in  $\text{H}_2\text{O}$  Sol in cold  $\text{H}_2\text{O}$  Decomp by hot conc  $\text{H}_2\text{SO}_4$  or  $\text{HCl}$  (Leidich, C R 1902, 134 1583)**Sodium iridonitrite iridochloride,**Sl sol in  $\text{H}_2\text{O}$  (Gibbs) $\text{Na}_6\text{Ir}_2(\text{NO}_2)_{12}, \text{Na}_6\text{Ir}_2\text{Cl}_6$  Insol in cold, sl sol in hot  $\text{H}_2\text{O}$  (Lang)**Iridosamine chloride,**  $\text{Ir}(\text{NH}_3)_2\text{Cl}_2$ Nearly insol in  $\text{H}_2\text{O}$  (Skoblikoff, A 84 275)— **sulphate,**  $\text{Ir}(\text{NH}_3)_2\text{SO}_4$ Easily sol in  $\text{H}_2\text{O}$  (Skoblikoff)**Iridosodium chloride,**  $\text{Ir}(\text{N}_2\text{H}_5)_2\text{Cl}_2$ Insol in cold, decomp by hot  $\text{H}_2\text{O}$  (Skoblikoff)— **nitrate,**  $\text{Ir}(\text{N}_2\text{H}_5\text{NO}_3)_2$ Easily sol in  $\text{H}_2\text{O}$ — **sulphate,**  $\text{Ir}(\text{N}_2\text{H}_5)_2\text{SO}_4$ Sl sol in cold, easily in boiling  $\text{H}_2\text{O}$  Sl sol in alcohol**Iridosulphuric acid****Potassium iridosulphate,**  $\text{K}_6\text{Ir}_2(\text{SO}_4)_6$ Sol in  $\text{H}_2\text{O}$  (de Boisbaudran, C R 96 1406)**Iridosulphurous acid****Ammonium iridosulphite,**  $(\text{NH}_4)_6\text{Ir}_2(\text{SO}_3)_6 + 6\text{H}_2\text{O}$ Slightly sol in  $\text{H}_2\text{O}$  (Birnbbaum, A 136 179)**Potassium iridosulphite,**  $\text{K}_6\text{Ir}_2(\text{SO}_3)_6 + 6\text{H}_2\text{O}$ Slightly sol in  $\text{H}_2\text{O}$ **Sodium iridosulphite,**  $\text{Na}_6\text{Ir}_2(\text{SO}_3)_6 + 8\text{H}_2\text{O}$ Scarcely sol in  $\text{H}_2\text{O}$ **Iron, Fe**Permanent in dry air, oxidises only slowly in moist air, but rapidly when in contact with air and  $\text{H}_2\text{O}$  simultaneously

Fe does not rust in contact with air and

H<sub>2</sub>O containing alkalis even in very small amounts (Payen, A ch 50 305)

Not attacked at ord temp by H<sub>2</sub>O free from air. More easily oxidised by NH<sub>4</sub> salts + Aq than by H<sub>2</sub>O when exposed to air simultaneously (Persoz, A ch (3) 24 506)

Iron is slowly attacked by distilled H<sub>2</sub>O in presence of air. 100 ccm distilled water removed 29 mg from 11.8 sq cm iron in one week, while air free from CO<sub>2</sub> was passed through the solution. In presence of CO<sub>2</sub>, 54 mg were removed (Wagner, Dingl 221 260)

CO<sub>2</sub> acts as a catalyst for the solution of Fe by H<sub>2</sub>O (Whitney, J Am Chem Soc 1903, 25 394)

Iron is most easily oxidised when it is exposed to air, and H<sub>2</sub>O is deposited on it at the same time in liquid form

100 l sea water dissolve 27.37 g from 1 sq metre Fe, 29.16 g from 1 sq metre steel, 1.12 g from 1 sq metre galvanised Fe (Calvert and Johnson, C N 11) 171)

Readily sol in HCl, dil H<sub>2</sub>SO<sub>4</sub> + Aq, and most other acids

Action of H<sub>2</sub>SO<sub>4</sub> + Aq (1 12) is very much accelerated by a few drops of PtCl<sub>4</sub> + Aq, the addition of As<sub>2</sub>O<sub>3</sub> arrests the action completely. Tartar emetic and HgCl<sub>2</sub> diminish the action, but do not arrest it. CuSO<sub>4</sub> + Aq strongly accelerates the action, and Ag<sub>2</sub>SO<sub>4</sub> + Aq also to a less extent

In the case of HCl + Aq, the addition of small amts of metallic salts also influences the action. Weak HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq has but little action, and the addition of PtCl<sub>4</sub> increases it, As<sub>2</sub>O<sub>3</sub> stops it, other solutions have no effect. With racemic and tartaric acids the phenomena are the same

With oxalic acid, PtCl<sub>4</sub> prevents the action. Saline solutions and even distilled H<sub>2</sub>O, when mixed with PtCl<sub>4</sub>, have slight solvent action (Millon, C R 21 45)

Above phenomena are due to galvanic action from metal deposited on the iron (Barreswill, C R 21 292)

H<sub>2</sub>SO<sub>4</sub> has only sl action on cast-iron at ord temp with exclusion of air

Weak acids have a strong action at higher temperatures

Charcoal pig-iron, and case-hardened cast-iron are much less attacked by weak acids at b-pt than other sorts of Fe. Scotch pig-iron is most strongly attacked

99.8% H<sub>2</sub>SO<sub>4</sub> has very sl action on iron at ord temp when air is excluded (Lunge, Dingl 261 131)

Resistance against dil H<sub>2</sub>SO<sub>4</sub> + Aq is greatly increased by increase in amt of C if chemically combined, less so by P or Si (Ledebur, Dingl 223 326)

*Passive Iron* —When Fe is treated with pure conc HNO<sub>3</sub> + Aq of 1.512–1.419 sp gr, it soon becomes coated with a bluish or black coating, apparently FeO, and when thus

covered Fe is not attacked by HNO<sub>3</sub> + Aq of any strength at ord temp or at the temp of a freezing mixture, but action occurs on heating. Nor is Fe attacked at ord temp by acid of 1.401 sp gr or even somewhat weaker acid, though action begins at once on heating. Very dil HNO<sub>3</sub> + Aq attacks Fe at ord temp with formation of NH<sub>4</sub>N<sup>+</sup> and Fe(NO<sub>3</sub>)<sub>2</sub>. The action of HNO<sub>3</sub> + Aq influenced by PtCl<sub>4</sub>. If acid containing 4 equivalents of H<sub>2</sub>O is diluted with 2–3 vol H<sub>2</sub>O, and then poured on Fe turnings, it dissolves at once with evolution of nitro fumes and formation of ferric salt, but if the acid one drop of PtCl<sub>4</sub> be added, on H gas is evolved, and NH<sub>4</sub>NO<sub>3</sub> and Fe(NO<sub>3</sub>)<sub>3</sub> are formed (Millon, C R 21 47)

The more H<sub>2</sub>O the acid contains the lower will be the temp at which the Fe remains passive. Shaking the wire hastens the passivity. Contact with Pt, Au, or C does not prevent it. Fe wire becomes passive by remaining 10 min in HNO<sub>3</sub> vapour (Renard, C R 79 159)

Iron may be made passive by HClO, HBrO<sub>3</sub>, HIO<sub>3</sub>, H<sub>2</sub>CrO<sub>4</sub>, in the same way as by HNO<sub>3</sub>.

Iron may also be made passive by moderate ignition

Passivity occurs with HNO<sub>3</sub> + Aq of 1.3 sp gr after a short time at 31°, but if temp 32°, passivity does not occur

Colourless HNO<sub>3</sub> + Aq of 1.42 sp gr produces passivity at 55° but not at 56°. Refuming HNO<sub>3</sub> + Aq of 1.42 sp gr produces passivity at 82° but not at 83° (Ordway, Sill Am J (2) 40 316)

The passivity of Fe is destroyed when it is placed in a magnetic field at a much lower temperature than when in normal condition (Nichols and Franklin, Sill Am J (3) 34 419)

Passivity depends on a coating of NO which hinders the action of the acid. All operation which removes this layer terminates the passivity, as shaking, rubbing, placing in vacuum, etc (Varenne, C R 89 783)

When Fe is plunged in HNO<sub>3</sub> + Aq of 1.4 sp gr there is a sudden evolution of gas which ceases after 3 to 20 seconds, and the surface becomes bright. The same phenomena take place with a more dilute acid, if of not less than 1.32 sp gr. In the latter case, there is an immediate evolution of gas, which suddenly ceases and the metal becomes bright but soon the acid begins to act again at single point, and the action gradually spreads over the whole surface, this, however, soon ceases again, and we have an "intermittent passivity"

If a part of a piece of iron is immersed in strong acid, the whole of it is made passive. This is explained by the NO spreading over the whole surface by capillarity

The passivity ceases when the Fe is placed in dil acid, after a longer or shorter time

according to the dilution of the acid,—when the acid has sp gr = 1.30, after 11 days  
 “ “ “ 1.28 “ 5 “  
 “ “ “ 1.26 “ 32 hours  
 “ “ “ 1.16 “ 12 “

Iron may also be made passive by long standing in NO gas under pressure (Varenne, C R 90 998)

Fe is made passive by a coating of  $\text{Fe}_3\text{O}_4$ , not by NO (Schonbein, Pogg 39 342) (Beetz, Pogg 67 286) (Ramann, B 14 1430)

Passivity may also be caused by  $\text{NH}_4\text{NO}_3$ +Aq, ammoniacal  $\text{AgNO}_3$ +Aq,  $\text{Fe}(\text{NO}_3)_3$ ,  $\text{Fe}(\text{NO}_3)_2$ ,  $\text{Al}(\text{NO}_3)_3$ ,  $\text{Co}(\text{NO}_3)_2$ ,  $\text{Ni}(\text{NO}_3)_2$ , etc +Aq instead of  $\text{HNO}_3$ +Aq (Ramann, B 14 1933)

Hardly attacked by either dil or conc acids when they are under high pressure (Cailliet C R 68 395)

Iron is dissolved by  $\text{HNO}_3$ +Aq, even when very conc, but no gas is evolved and the process is very slow

$\text{HNO}_3$ +Aq of the following sp gr dissolves the given amts from strips of pure Fe

Sp gr of acid	Diminution of weight in 24 hours
1.28	0.82%
1.34	0.75
1.38	0.29
1.48	0.34
1.53	5.80

(Gautier and Charpy, C R 113 1451)

Insol in liquid chlorine below  $90^\circ$  (Lange, Zeit angew Ch 1900, 13 686)

Insol in liquid  $\text{NH}_3$  (Gore, Am ch J 1898, 20 828)

Not attacked by alkalis

Sol in  $\text{NaOH}$ +Aq (34%) when air is blown through the liquid (Zirnit, Ch Ztg 12 355)

$\text{NaOH}$ +Aq attacks iron and steel (Venator, Dingl 261 133)

$\text{NaOH}$ +Aq dissolves Fe between  $15^\circ$  and  $100^\circ$  (Dingl 261 131)

Presence of rusting material, and fats and oils greatly hinder it (Wagner)

Sol in alkali hydrogen carbonates+Aq (Berzelius)

Sat  $\text{NaCl}$ +Aq has sl but perceptible action on Fe.  $\text{NH}_4\text{Cl}$ +Aq has stronger action than  $\text{NaCl}$ +Aq (Lunge)

100 ccm  $\text{H}_2\text{O}$  containing 0.5 g  $\text{NaCl}$  or  $\text{KCl}$  removed 4.2 mg from 11.8 sq cm iron in one week, while air free from  $\text{CO}_2$  was passed through the solution, and 72 mg in presence of  $\text{CO}_2$

100 ccm  $\text{H}_2\text{O}$  containing 1 g  $\text{NH}_4\text{Cl}$  removed 45 mg, and 76 mg respectively under the above conditions

100 ccm  $\text{H}_2\text{O}$  containing 0.8 g  $\text{MgCl}_2$  re-

moved 49 mg, and 65 mg respectively under the above conditions

Not attacked by 100 ccm  $\text{H}_2\text{O}$  containing 1 g  $\text{Na}_2\text{CO}_3$ , or by  $\text{CaO}_2\text{H}_2$ +Aq (Wagner, Dingl 221 260)

Action of  $\text{KClO}_3$ +Aq  $\text{KClO}_3$ +Aq (6.3%  $\text{KClO}_3$ ) oxidised 11.21 g cast iron and 20.1 g pure iron from a surface of 1 sq metre in 7 hours,  $\text{KClO}_3$ +Aq (25%  $\text{KClO}_3$ ) oxidised 24.59 g cast, and 44.90 g pure Fe under above conditions,  $\text{Ca}(\text{ClO}_3)_2$ ,  $\text{CaCl}_2$ +Aq ( $20^\circ$  Baume) obtained by passing Cl through  $\text{CaO}_2\text{H}_2$ +Aq oxidised 85 g cast, and 95 g pure Fe under the above conditions (Lunge and Deggele, J Soc Chem Ind 4 32)

Easily sol in organic acids

#### Comparative action of oils on Fe

	Amount Fe dissolved
Neatsfoot oil	0.0875 grains
Colza	0.0800 “
Sperm	0.0460 “
Lard	0.0250 “
Olive	0.0062 “
Linseed	0.0050 “
Seal	0.0050 “
Castor	0.0048 “
Paraffine	0.0045 “
Almond	0.0040 “
“Lubricating” oil	0.0018 “

(Watson, C N 42 190)

$\frac{1}{2}$  ccm oleic acid dissolves 0.0097 g Fe in 6 days (Gates, J phys Chem 1911, 15 143)

Fe dissolves in albumen solution to the extent of 1 to 2 per cent (Buchner, Arch Pharm (3) 20 417)

Attacked by sugar+Aq at  $115$ – $120^\circ$ , also by inverted sugar or malt extract, not by glycerine or mannite+Aq (Klein and Berg, C R 102 1170)

#### Iron arsenide, $\text{FeAs}_2$

Min *Lollingite* Sol in  $\text{HNO}_3$ +Aq with separation of  $\text{As}_2\text{O}_3$

$\text{Fe}_3\text{As}_4$  Min *Leucopyrite*

#### Iron arsenide sulphide, $\text{FeAsS}$ , $\text{FeS}$

Min *Arsenopyrite* Sol in  $\text{HNO}_3$ +Aq with separation of S and  $\text{As}_2\text{O}_3$ , wholly sol in aqua regia, not attacked by  $\text{HCl}$ +Aq

#### Iron boride, $\text{Fe}_2\text{B}$

Decomp by  $\text{H}_2\text{O}$  Sol in hot dil  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$  and in hot conc  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$  Sol in hot dil or cold conc  $\text{HNO}_3$  (Jassonneux, C R 1907, 145 122)

$\text{FeB}$  Sol in molten alkali carbonates, not sol in dil or conc  $\text{H}_2\text{SO}_4$  in the cold, sol in boiling  $\text{H}_2\text{SO}_4$  and in  $\text{HNO}_3$  (Moissan, Bull Soc 1895, (3) 13 958)

Stable in dry air Decomp by aqua regia,

not readily sol in conc  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$  (Moissan, C R 1895, 120 176)

$\text{FeBr}_2$  Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  and in hot conc  $\text{HCl}$  (Jassonneix, C R 1907, 145 122)

#### Iron (ferrous) bromide, $\text{FeBr}_2$

Sol in  $\text{H}_2\text{O}$  Decomp by heating on air  
Sat  $\text{FeBr}_2 + \text{Aq}$  contains at

-21°	-7°	+10°	21°
47 0	48 3	52 3	53 7% $\text{FeBr}_2$ ,
37°	50°	65°	95°
56 0	58 0	59 4	63 3% $\text{FeBr}_2$

(Étard, A ch 1894, (7) 2 541)

+4 $\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$ , pptd from cooled aq solution (Volkman, C C 1894, I 611)

+6 $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Löwig)  
+9 $\text{H}_2\text{O}$  (Volkman)

#### Ferrie bromide, $\text{FeBr}_3$

Deliquescent Sol in  $\text{H}_2\text{O}$ , alcohol, and ether (Löwig)

Sl sol in liq  $\text{NH}_3$  (Franklin, Am Ch 1898, 20 828)

+6 $\text{H}_2\text{O}$  Sol in alcohol and ether (Bolchakoff, C C 1898, II 660)

#### Ferrous mercuric bromide

Deliquescent (v Bonsdorff)

#### Ferrie rubidium bromide, $\text{Rb}_2\text{FeBr}_5 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Walden, Z anorg 1894, 7 32)

#### Ferrous stannic bromide

See Bromostannate, ferrous

#### Ferrous bromide nitric oxide, $3\text{FeBr}_2, 2\text{NO}$

Sol in  $\text{H}_2\text{O}$  Not isolated (Thomas, C R 1896, 123 944)

#### Ferrie bromochloride, $\text{FeCl}_2\text{Br}$

Very deliquescent, and sol in  $\text{H}_2\text{O}$ , alcohol, and ether. Notably sol in chloroform, benzene, and toluene Insol in  $\text{CS}_2$  (Lenormand, C R 116 820)

#### Iron carbide, $\text{Fe}_3\text{C}$

(Gurtt, J B 1856, 781)

Mixture of  $\text{Fe}$  and  $\text{FeC}_4$  (Tunner, Polyt Zentralbl 1861 1227)

$\text{Fe}_3\text{C}$  (Karsten, J pr 40 229)

$\text{Fe}_3\text{C}$  Sol in hot conc  $\text{HCl}$ , oxidized slowly by moist air (Campbell, Am Ch J 1896, 18 840-841)

$\text{Fe}_2\text{C}_2$  (Rammelsberg, C C 1847 60)

#### Iron molybdenum carbide, $\text{Fe}_3\text{C}, \text{Mo}_2\text{C}$

Sol in hydracids, insol in  $\text{HNO}_3$  (Williams, C R 1898, 127 484)

#### Iron tungsten carbide, $2\text{Fe}_3\text{C}, 3\text{W}_2\text{C}$

Insol in  $\text{H}_2\text{O}$  and hydracids, sol in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  (Williams, C R 1898, 127 11)

#### Iron carbonyl, $\text{Fe}(\text{CO})_5$

Slowly decomp on air Not attacked by dil  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$  Conc  $\text{HNO}_3 + \text{Aq}$ , or  $\text{Br}_2 + \text{Aq}$  decomp easily Sol alcoholic solution of  $\text{KOH}$  or  $\text{NaOH}$  with subsequent decomp Sol in alcohol, ether, benzene, mineral oils, etc (Mond and Langer, Chem Soc 59 1090)

$\text{Fe}_2(\text{CO})_7$  Decomp on air Not attacked by  $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$  Sol in alcohol potash Very much less sol in organic solvents than  $\text{Fe}(\text{CO})_5$  (Mond and Langer)

#### Ferrous chloride, $\text{FeCl}_2$

Deliquescent Easily sol in  $\text{H}_2\text{O}$  with evolution of heat, or in alcohol Insol in ether (Jahn)

Sol in 2 pts  $\text{H}_2\text{O}$  at 18 75° (Abl)

Sol in 1 pt strong alcohol (Wenzel)

Sp gr of  $\text{FeCl}_2 = \text{Aq}$  at 15 5°

Sp gr	% $\text{FeCl}_2$	% $\text{FeCl}_2, 4\text{H}_2\text{O}$
1 05	5 40	8 45
1 06	6 43	10 09
1 07	7 47	11 69
1 08	8 48	13 29
1 09	9 49	14 86
1 10	10 47	16 41
1 11	11 45	17 86
1 12	12 42	19 46
1 13	13 37	20 96
1 14	14 31	22 41
1 15	15 24	23 87
1 16	16 15	25 31
1 17	17 05	26 73
1 18	17 94	28 13
1 19	18 83	29 51
1 20	19 68	30 85
1 21	20 50	32 14
1 22	21 39	33 53
1 23	22 24	34 84
1 24	23 05	36 11
1 25	23 86	37 38
1 26	24 68	38 67
1 27	25 44	39 87
1 28	26 19	41 04
1 29	26 98	42 29
1 30	27 75	43 49
1 31	28 49	44 65
1 32	29 23	45 81
1 33	29 96	46 94
1 34	30 68	48 08
1 35	31 39	49 18
1 36	32 10	50 30
1 37	32 79	51 39
1 38	33 47	52 46
1 39	34 14	53 50
1 40	34 80	54 55
1 41	35 46	55 57
1 42	36 09	56 56
1 43	36 73	57 55
1 44	37 33	58 51

(Dunn, J Soc Chem Ind 1902, 21 390)

Insol in liquid HF (Franklin, Z anorg 1905, 46 2)

Sol in acetone, insol in methylal (Eidmann, C C 1899, II 1014)

Sol in acetone (Naumann, B 1904, 37 4328)

Sl sol in methyl acetate (Naumann, B 1909, 42 3790)

Sol in ethyl acetate (Naumann, B 1910, 43 314)

Insol in ethyl acetate (Naumann, B 1904, 37 3601)

Yellow modification is sol in benzonitrile (Naumann, B 1914, 47 1369)

Mol weight determined in pyridine (Werner, Z anorg 1897, 15 21)

+2H<sub>2</sub>O (Jonas)

+4H<sub>2</sub>O Deliquescent Easily sol in alcohol Sol in 0.68 pt cold H<sub>2</sub>O (Reimann, Mag Pharm 17 215)

Sat aq solution contains at

16° 18° 25° 28° 43°  
40 5 40 9 41 0 42 5 44 4% FeCl<sub>2</sub>,

50° 53° 72° 89° 96° 118°  
45 0 45 9 49 2 51 3 51 0 51 7% FeCl<sub>2</sub>

(Étard, A ch 1894, (7) 2 537)

100 g FeCl<sub>2</sub>, 4H<sub>2</sub>O + Aq contain 17.54 g Fe at 22.8°, 18.59 g at 43.2° (Boecke, N Jahrb Min 1911, I, 61)

More sol in water containing NO than in pure H<sub>2</sub>O (Gay, Bull Soc (2) 44 175)

Sol in hot HCl + Aq (Sabatier, Bull Soc 1895, (3) 13 599)

[Sabatier could not obtain FeCl<sub>2</sub> + 6H<sub>2</sub>O of Lesceur]

**Ferroferric chloride, Fe<sub>3</sub>Cl<sub>8</sub> + 18H<sub>2</sub>O**

Deliquescent (Lefort, J Pharm (4) 10 85)

**Ferric chloride, Fe<sub>2</sub>Cl<sub>6</sub> or FeCl<sub>3</sub>**

Very deliquescent, and sol in H<sub>2</sub>O with evolution of great heat

100 mols H<sub>2</sub>O dissolve mols anhydrous Fe<sub>2</sub>Cl<sub>6</sub> at t°

t°	Mols Fe <sub>2</sub> Cl <sub>6</sub>	t°	Mols Fe <sub>2</sub> Cl <sub>6</sub>
66	29 20	80	29 20
70	29 42	100	29 75
75	28 92		

(Roozeboom, Z phys Ch 10 477)

See also hydrated salts below

Solution in H<sub>2</sub>O is decomp into colloidal Fe<sub>2</sub>O<sub>3</sub>, xH<sub>2</sub>O and HCl, upon heating if conc, and on simple standing if dil

Krecke (J pr (2) 3 286) gives the following table

% Fe <sub>2</sub> Cl <sub>6</sub> in solution	Temp at which Craham's colloidal hydrate is formed	Temp at which Saint Gilles colloidal hydrate is formed	Temp at which oxychlorides are formed	Temp at which Fe <sub>2</sub> O <sub>3</sub> is formed
32	100-130°	100-130°	100°+	140°
16	100-120		"	120
8	100-110		"	110
4	90-100		90	
2	87		87	
1	83		"	
0.5	75		"	
0.25	64		"	
0.125	54		"	
0.0625	36		"	

Sp gr of Fe<sub>2</sub>Cl<sub>6</sub> + Aq

% FeCl <sub>3</sub>	Sp gr at 4.5°	Sp gr at 9.7°	Sp gr at 14.6°	Sp gr at 19.7°
49.61	1.5609	1.5575	1.5540	1.5497
41.00	1.4413	1.4387	1.4361	1.4335
36.95		1.3847	1.3824	1.3800
33.25	1.3381	1.3359	1.3339	1.3317
24.60	1.2351	1.2334	1.2318	1.2298
22.54	1.2140	1.2129	1.2107	1.2090
16.79	1.1534	1.1521	1.1507	1.1491
10.45	1.0939	1.0930	1.0918	1.0901
4.65			1.0382	
2.70			1.0221	

Sp gr of Fe<sub>2</sub>Cl<sub>6</sub> + Aq increases or diminishes between 8° and 24° for a decrease or increase of temp of 1° by the following amts

% FeCl <sub>3</sub>	Corr	% FeCl <sub>3</sub>	Corr
50-60	0.0008	30-39	0.0005
45-49	0.0007	20-29	0.0004
40-44	0.0006	10-19	0.0003

(Hager, l c)

(Schult, from Gerlach, Z anal 27 278)



Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{HCl} + \text{Aq}$  — *Continued*

$t^\circ$	Sat solution contains per 100 mols $\text{H}_2\text{O}$		Solid phase
	mols $\text{HCl}$	mols $\text{FeCl}_3$	
— 4 5	20 50	24 50	$\text{Fe}_2\text{Cl}_6, 2\text{HCl}, 8\text{H}_2\text{O}$
“	20 66	25 74	
“	23 42	27 40	
— 6	29 10	24 73	
“	26 18	21 75	
“	24 41	21 50	
“	23 25	21 35	
“	21 73	21 84	
“	19 73	25 50	
“	24 42	28 45	
“	28 20	27 04	
— 10	20 48	20 54	
“	24 90	18 94	
“	28 75	20 34	
“	31 42	28 53	
“	28 25	30 25	
“	26 05	30 50	
— 15	24 50	15 83	
— 15	28 40	31 89	
— 20	19 44	12 10	
“	22 83	11 63	
“	25 20	11 60	
“	27 20	11 31	
“	31 08	11 51	
“	34 13	12 90	
“	33 93	31 77	
“	30 08	32 76	
“	28 70	32 88	
— 10	12 01	11 99	$\text{Fe}_2\text{Cl}_6, 2\text{HCl}, 12\text{H}_2\text{O}$
“	19 78	14 02	
“	20 95	16 20	
“	20 25	20 20	
“	17 73	20 70	
“	15 44	19 65	
— 12 5	22 14	16 69	
— 15	21 30	9 65	
“	24 50	15 83	
— 20	9 96	9 94	
“	13 32	8 57	
“	16 90	7 35	
“	18 97	7 16	
“	20 56	7 08	
“	23 40	7 20	
“	24 85	9 88	
“	25 20	11 60	
“	25 40	12 37	
“	25 59	13 39	

(Roozeboom and Schrenemakers, Z phys Ch 1894, 15 633)

Solubility of  $\text{Fe}_2\text{Cl}_6 + \text{NH}_4\text{Cl}$   
See  $\text{NH}_4\text{Cl} + \text{Fe}_2\text{Cl}_6$  under  $\text{NH}_4\text{Cl}$

Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{CsCl}$   
See  $\text{CsCl} + \text{Fe}_2\text{Cl}_6$  under  $\text{CsCl}$

Solubility of  $\text{FeCl}_3 + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $21^\circ$ 

Substance added		Pts by weight sol in 100 pts of solution	
$\text{FeCl}_3$ grams	$\text{KCl}$ grams	$\text{FeCl}_3$	$\text{KCl}$
0	25	0	34 97
13	28	13 44	24 45
18	21	23 18	16 54
3	18 5	28 05	11 69
28	16	35 72	11 68
31	10 5	36 62	11 19
36 2	9	37 35	13 67
41 5	8	42 03	7 88
46 5	6	51 69	7 54
52	0 5		
155	0	83 89	0

(Hinrichsen and Sachsel, Z phys Ch 1904, 50 95)

 $\text{FeCl}_3 + \text{NaCl}$ Solubility of  $\text{FeCl}_3 + \text{NaCl}$  in  $\text{H}_2\text{O}$  at  $21^\circ$ 

Substance added		Pts by weight sol in 100 pts of solution	
$\text{FeCl}_3$ grams	$\text{NaCl}$ grams	$\text{FeCl}_3$	$\text{NaCl}$
0	3 6	0	36 10
1 8	3 0	24 27	9 10
3 6	2 5	25 40	8 45
5 5	2 0	26 40	5 25
7 2	1 5	38 15	3 90
9 0	1 0	43 38	2 45
10 8	0 5	46 75	2 11
10 8	0	83 39	0

(Hinrichsen and Sachsel, Z phys Ch 1904, 50 94)

Solubility of  $\text{FeCl}_3$  in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	Substance added		$\sigma\%$ of Fe in the solution
	$\text{FeCl}_3$	$\text{NaCl}$	
10	40	20	15 2
10	60	20	15 2
10	100	20	15 16
20	60	20	16 2
20	80	20	16 18
20	100	20	16 2
30	70	30	17 7
30	90	30	17 6
30	110	30	17 67
50	30	20	23 5
50	45	20	23 9
40	35	30	25 4
40	50	30	25 5
30	30	20	23 8
30	45	20	24 0
17 6	30	20	24 47
17 6	50	20	24 5

(Hinrichsen and Sachsel, Z phys Ch 1904, 50 95)

Difficultly sol in  $\text{AsBr}_3$  (Walden, Z anorg 1902, 29 374)

Attacked by liquid  $\text{NO}_2$  in the presence of traces of moisture (Frankland, Chem Soc 1901, 79 1361)

Sol in liquid  $\text{SO}_2$  (Walden, B 1899, 32 2864)

Sol in alcohol ether, acetic ether (Cann, C R 102 363), and acetone (Krug and M'Elroy, J anal Ch 6 184)

Sl sol in ethylamine (Shunn, J phys Chem 1907, 11 538)

Sol in benzonitrile (Naumann, B 1914, 47 1369)

Sol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

1 g  $\text{FeCl}_3$  is sol in 1.59 g acetone at  $18^\circ$  Sp gr of sat solution  $18^\circ/4^\circ = 1.160$  (Naumann, B 1904, 37 4333)

Sol in acetone and in methylal (Eidmann, C C 1899, II 1014)

Sol in quinoline (Beckmann and Gabel, Z anorg 1906, 51 236)

Sl sol in  $\text{CS}_2$  (Arctowski, Z anorg 1894, 6 257)

Mol weight determined in pyridine (Werner, Z anorg 1897, 15 22)

*Sublimed*

Sol in  $\text{AsCl}_3$ ,  $\text{POCl}_3$ ,  $\text{SO}_2\text{Cl}_2$  and  $\text{PBr}_3$ , sl sol in  $\text{PCl}_3$  (Walden, Z anorg 1900, 25 214)

The salts with different amts of crystal  $\text{H}_2\text{O}$  have different solubilities (Roozeboom +  $4\text{H}_2\text{O}$  Melts in crystal  $\text{H}_2\text{O}$  at  $73.5^\circ$ )

100 mols  $\text{H}_2\text{O}$  dissolve mols  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$
50	19 96	69	21 53	72 5	26 15
55	20 32	72 5	23 35	70	27 90
60	20 70	73 5	25 00	66	29 20

(Roozeboom, Z phys Ch 10 477)

+  $5\text{H}_2\text{O}$  Correct formula for +  $6\text{H}_2\text{O}$  salt

100 mols  $\text{H}_2\text{O}$  dissolve mols  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 5\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$
12	12 87	30	15 12	55	19 15
20	13 95	35	15 64	56	20 00
27	14 85	50	17 50	55	20 32

(Roozeboom)

Melts in crystal  $\text{H}_2\text{O}$  at  $31^\circ$  (Engel, C R 104 1708), at  $56^\circ$  (Roozeboom)

+  $6\text{H}_2\text{O}$  Very deliquescent Sol in alcohol Ether dissolves out  $\text{Fe}_2\text{Cl}_6$

M-pt is  $31^\circ$  (Ordway) Contains only  $5\text{H}_2\text{O}$  (Roozeboom)

+  $7\text{H}_2\text{O}$  Melts in crystal  $\text{H}_2\text{O}$  at  $32.5^\circ$

100 mols  $\text{H}_2\text{O}$  dissolve mols  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 7\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$
20	11 35	32	13 55	30	15 12
27 4	12 15	32 5	14 99	25	15 54

(Roozeboom)

+  $12\text{H}_2\text{O}$  Less deliquescent than  $\text{Fe}_2\text{Cl}_6$  or  $\text{Fe}_2\text{Cl}_6 + 5\text{H}_2\text{O}$

100 mols  $\text{H}_2\text{O}$  dissolve mols  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 12\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$
-55	2 75	30	5 93	27 4	11 20
-41	2 81	35	6 78	20	12 15
-27	2 98	36 5	7 93	10	12 83
0	4 13	37	8 33	8	13 70
10	4 54	36	9 29		
20	5 10	30	10 45		

(Roozeboom)

Sol in alcohol Ether dissolves out  $\text{Fe}_2\text{Cl}_6$  Melts in crystal  $\text{H}_2\text{O}$  at  $37^\circ$  (Roozeboom), at  $35.5^\circ$  (Ordway)

**Ferric hydrogen chloride**,  $\text{FeCl}_3$ ,  $\text{HCl} + 2\text{H}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$  (Sabatier, Bull Soc (2) 197)

More sol in  $\text{H}_2\text{O}$  than  $\text{FeCl}_3$  (Engel, C R 104 1708)

For solubility, see  $\text{FeCl}_3 + \text{HCl}$ , under ferric chloride

+  $6\text{H}_2\text{O}$  (Roozeboom and Schrenemakers)

For solubility, see  $\text{FeCl}_3 + \text{HCl}$ , under ferric chloride

**Ferrous lithium chloride**,  $\text{FeCl}_2$ ,  $\text{LiCl} + 3\text{H}_2\text{O}$   
(Chassevant, A ch (6) 30 17)

**Ferric magnesium chloride**,  $\text{FeCl}_3$ ,  $\text{MgCl}_2 + \text{H}_2\text{O}$   
Deliquescent (Neumann, B 18 2890)

**Ferrous mercuric chloride**,  $\text{FeCl}_2$ ,  $\text{HgCl}_2 + 4\text{H}_2\text{O}$   
Deliquescent (v Bonsdorff)

**Ferric nitrosyl chloride**,  $\text{FeCl}_3$ ,  $\text{NOCl}$   
Very deliquescent (Weber, Pogg 118 477)

**Ferric phosphoric chloride**,  $\text{FeCl}_3$ ,  $\text{PCl}_5$   
Decomp by  $\text{H}_2\text{O}$  (Baudrimont, A ch (4) 2 15)

Sp gr of $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ at $17.5^\circ$					
% $\text{Fe}_2\text{Cl}_6$	Sp gr	% $\text{Fe}_2\text{Cl}_6$	Sp gr	% $\text{Fe}_2\text{Cl}_6$	Sp gr
1	0073	21	1644	41	13746
2	0146	22	1746	42	13870
3	0219	23	1848	43	13994
4	0292	24	1950	44	14118
5	0365	25	12052	45	14242
6	0439	26	12155	46	14367
7	0513	27	12258	47	14492
8	0587	28	12365	48	14617
9	0661	29	12464	49	14742
10	0734	30	12568	50	14867
11	0814	31	12673	51	15010
12	0894	32	12778	52	15153
13	0974	33	12883	53	15296
14	1054	34	12988	54	15439
15	1134	35	13093	55	15582
16	1215	36	13199	56	15729
17	1297	37	13305	57	15876
18	1378	38	13411	58	16023
18	1378	38	13411	58	16023
19	1458	39	13517	59	16170
20	1542	40	13622	60	16317

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Sp gr of $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ at $17.5^\circ$					
% $\text{Fe}_2\text{Cl}_6$	Sp gr	% $\text{Fe}_2\text{Cl}_6$	Sp gr	% $\text{Fe}_2\text{Cl}_6$	Sp gr
1	008	21	1191	41	1428
2	016	22	1202	42	1441
3	025	23	1212	43	1454
4	033	24	1223	44	1469
5	042	25	1234	45	1481
6	051	26	1245	46	1494
7	060	27	1256	47	1507
8	069	28	1268	48	1520
9	078	29	1280	49	1533
10	087	30	1292	50	1547
11	095	31	1304	51	1560
12	104	32	1316	52	1573
13	113	33	1328	53	1587
14	123	34	1340	54	1600
15	131	35	1352	55	1612
16	140	36	1364	56	1624
17	150	37	1376	57	1636
18	160	38	1390	58	1648
19	170	39	1403	59	1659
20	180	40	1415	60	1670

(Hager, Comm 1883)

Sp gr of conc $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ at $20-21^\circ$					
% $\text{Fe}_2\text{Cl}_6$	Sp gr	% $\text{Fe}_2\text{Cl}_6$	Sp gr	% $\text{Fe}_2\text{Cl}_6$	Sp gr
60	1669	65	1715	70	1758
61	1679	66	1724	71	1766
62	1688	67	1733	72	1774
63	1697	68	1742	73	1782
64	1706	69	1750	74	1790

(Hager, l c)

Solubility of $\text{Fe}_2\text{Cl}_6$ in $\text{HCl} + \text{Aq}$			
$t^\circ$	Sat solution contains per 100 mols $\text{H}_2\text{O}$		Solid phase
	mols $\text{HCl}$	mols $\text{FeCl}_3$	
30	0	12 70	$\text{Fe}_2\text{Cl}_6 + 12\text{H}_2\text{O}$
"	5 92	16 07	
"	0	20 90	
25	0	10 90	
"	2 33	23 72	
"	0	24 50	
20	0	10 20	
"	5 60	23 60	
"	0	25 70	
10	0	9 10	
"	8 75	8 00	$\text{Fe}_2\text{Cl}_6 + 7\text{H}_2\text{O}$
"	16 70	16 65	
"	13 80	23 35	
0	0	8 25	
"	7 52	6 51	
"	13 37	6 33	
"	16 80	8 70	
"	18 45	10 23	
"	20 40	15 40	
"	20 10	16 00	
"	19 95	17 70	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$
"	19 00	22 75	
"	18 05	23 40	
-10	0	7 40	
"	19 46	10 37	
"	20 48	20 54	
-12 5	22 14	16 69	
-15	0	6 98	
"	21 30	9 65	
-20	0	6 56	
"	7 50	4 90	$\text{Fe}_2\text{Cl}_6 + 2\text{H}_2\text{O}$
"	15 30	5 09	
"	20 56	7 08	
30	0	25 20	
"	4 25	27 80	
"	0	30 24	
25	0	23 50	
"	2 33	23 72	
"	7 50	29 75	
"	0	31 50	
20	0	22 50	$\text{Fe}_2\text{Cl}_6 + \text{H}_2\text{O}$
"	5 60	23 60	
"	11 05	29 20	
"	11 05	29 20	
"	0	32 00	
15	10 75	23 50	
"	14 90	28 35	
10	13 80	23 35	
"	17 80	27 75	
"	17 80	27 75	
0	18 05	23 40	$\text{Fe}_2\text{Cl}_6$
"	19 50	25 93	

Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{HCl} + \text{Aq}$  — Continued

$t^\circ$	Sat solution contains per 100 mols $\text{H}_2\text{O}$		Solid phase
	mols $\text{HCl}$	mols $\text{FeCl}_3$	
50	0	35 00	$\text{Fe}_2\text{Cl}_6 + 5\text{H}_2\text{O}$
"	3 25	39 95	
44	0	33 50	
"	3 04	33 80	
"	10 62	34 64	
"	11 50	35 60	
"	10 70	38 00	
40	0	32 40	
"	13 40	37 45	
33	0	31 00	
"	15 70	37 06	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$
30	0	30 24	
"	17 20	34 00	
"	17 15	36 75	
25	0	29 00	
"	7 50	29 75	
"	19 50	35 25	
20	0	27 90	
"	11 05	29 20	
"	15 80	30 68	
"	21 25	34 25	$\text{Fe}_2\text{Cl}_6 + 3\text{H}_2\text{O}$
15	14 90	28 35	
"	16 40	29 32	
10	17 80	27 75	
"	18 80	28 70	
"	24 50	32 75	
0	24 12	30 04	
"	26 00	32 16	
-10	24 95	29 60	
"	26 05	30 50	
"	27 30	32 05	$\text{Fe}_2\text{Cl}_6 + 2\text{H}_2\text{O}$
70	0	44 0	
"	6 75	50 00	
"	0	55 80	
65	0	42 50	
"	10 25	50 00	
"	3 75	57 25	
"	0	59 00	
60	0	41 40	
"	14 25	50 00	
"	10 70	55 25	$\text{Fe}_2\text{Cl}_6 + \text{H}_2\text{O}$
"	0	61 00	
55	0	40 64	
"	19 00	50 72	
"	16 71	53 60	
"	0	62 00	
50	0	39 92	
"	3 25	39 95	
"	21 24	49 33	
"	20 04	52 50	
44	0	39 00	$\text{Fe}_2\text{Cl}_6$
"	10 70	38 00	
"	14 80	38 70	
"	24 14	50 10	
40	13 40	37 45	
"	27 00	50 80	
33	15 70	37 06	
"	29 20	42 70	
"	31 08	46 85	
"	30 81	47 65	

$t^\circ$	Sat solution contains per 100 mols $\text{H}_2\text{O}$		Solid phase
	mols $\text{HCl}$	mols $\text{FeCl}_3$	
33	30 45	48 70	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$
30	17 15	36 75	
"	31 20	43 49	
"	33 80	47 80	
"	32 60	49 93	
25	19 50	35 25	
"	20 60	35 34	
"	31 34	41 58	
"	33 00	43 00	
"	34 65	44 80	
20	21 25	34 25	$\text{Fe}_2\text{Cl}_6$ anhydrous
"	28 81	37 57	
"	34 23	42 02	
"	35 40	43 16	
15	29 40	36 50	
"	33 60	40 03	
10	24 50	32 75	
"	35 04	39 95	
0	26 00	32 16	
"	34 60	38 11	
-10	27 30	32 05	$\text{Fe}_2\text{Cl}_6 + 2\text{H}_2\text{O}$
"	33 56	36 25	
-20	30 08	32 76	
"	32 65	35 44	
45	0	58 00	
"	31 28	50 08	
"	40 65	48 60	
40	0	58 00	
"	27 00	50 80	
"	42 01	48 64	
35	0	58 00	$\text{Fe}_2\text{Cl}_6 + \text{H}_2\text{O}$
"	29 01	50 33	
"	37 04	49 20	
30	0	58 00	
"	32 60	49 93	
"	34 40	49 72	
40	42 50	47 52	
"	42 01	48 64	
35	39 47	46 57	
"	37 04	49 20	
30	40 21	42 54	$\text{Fe}_2\text{Cl}_6 + 2\text{HCl}, 4\text{H}_2\text{O}$
"	38 20	44 70	
"	35 55	47 30	
"	34 40	49 72	
25	40 41	40 25	
"	39 03	41 38	
"	35 74	45 24	
20	39 50	39 25	
"	35 40	43 16	
10	38 62	37 48	
"	37 46	38 33	$\text{Fe}_2\text{Cl}_6$
"	36 30	38 70	
"	35 04	39 93	
0	37 27	36 60	
"	34 60	38 11	
-10	37 92	35 32	
"	34 54	36 00	
"	33 56	36 25	
-20	37 80	34 50	
"	34 10	34 84	
"	32 56	35 44	

Sp gr of $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ at $17.5^\circ$					
$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp gr	$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp gr	$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp gr
1	1 0073	21	1 1644	41	1 3746
2	1 0146	22	1 1746	42	1 3870
3	1 0219	23	1 1848	43	1 3994
4	1 0292	24	1 1950	44	1 4118
5	1 0365	25	1 2052	45	1 4242
6	1 0439	26	1 2155	46	1 4367
7	1 0513	27	1 2258	47	1 4492
8	1 0587	28	1 2365	48	1 4617
9	1 0661	29	1 2464	49	1 4742
10	1 0734	30	1 2568	50	1 4867
11	1 0814	31	1 2673	51	1 5010
12	1 0894	32	1 2778	52	1 5153
13	1 0974	33	1 2883	53	1 5296
14	1 1054	34	1 2988	54	1 5439
15	1 1134	35	1 3093	55	1 5582
16	1 1215	36	1 3199	56	1 5729
17	1 1297	37	1 3305	57	1 5876
18	1 1378	38	1 3411	58	1 6023
18	1 1378	38	1 3411	58	1 6023
19	1 1458	39	1 3517	59	1 6170
20	1 1542	40	1 3622	60	1 6317

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Sp gr of $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ at $17.5^\circ$					
$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp gr	$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp gr	$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp gr
1	1 008	21	1 191	41	1 428
2	1 016	22	1 202	42	1 441
3	1 025	23	1 212	43	1 454
4	1 033	24	1 223	44	1 469
5	1 042	25	1 234	45	1 481
6	1 051	26	1 245	46	1 494
7	1 060	27	1 256	47	1 507
8	1 069	28	1 268	48	1 520
9	1 078	29	1 280	49	1 533
10	1 087	30	1 292	50	1 547
11	1 095	31	1 304	51	1 560
12	1 104	32	1 316	52	1 573
13	1 113	33	1 328	53	1 587
14	1 123	34	1 340	54	1 600
15	1 131	35	1 352	55	1 612
16	1 140	36	1 364	56	1 624
17	1 150	37	1 376	57	1 636
18	1 160	38	1 390	58	1 648
19	1 170	39	1 403	59	1 659
20	1 180	40	1 415	60	1 670

(Hager, Comm 1883)

Sp gr of conc $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ at $20-21^\circ$					
$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp gr	$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp gr	$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp gr
60	1 669	65	1 715	70	1 758
61	1 679	66	1 724	71	1 766
62	1 688	67	1 733	72	1 774
63	1 697	68	1 742	73	1 782
64	1 706	69	1 750	74	1 790

(Hager, l c)

Solubility of $\text{Fe}_2\text{Cl}_6$ in $\text{HCl} + \text{Aq}$			
$t^\circ$	Sat solution contains per 100 mols $\text{H}_2\text{O}$		Solid phase
	mols $\text{HCl}$	mols $\text{FeCl}_3$	
30	0	12 70	$\text{Fe}_2\text{Cl}_6 + 12\text{H}_2\text{O}$
"	5 92	16 07	
"	0	20 90	
25	0	10 90	
"	2 33	23 72	
"	0	24 50	
20	0	10 20	
"	5 60	23 60	
"	0	25 70	
10	0	9 10	
"	8 75	8 00	$\text{Fe}_2\text{Cl}_6 + 7\text{H}_2\text{O}$
"	16 70	16 65	
"	13 80	23 35	
0	0	8 25	
"	7 52	6 51	
"	13 37	6 33	
"	16 80	8 70	
"	18 45	10 23	
"	20 40	15 40	
"	20 10	16 00	
"	19 95	17 70	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$
"	19 00	22 75	
"	18 05	23 40	
-10	0	7 40	
"	19 46	10 37	
"	20 48	20 54	
"	20 25	21 56	
-12 5	22 14	16 69	
-15	0	6 98	
"	21 30	9 65	
-20	0	6 56	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$
"	7 50	4 90	
"	15 30	5 09	
"	20 56	7 08	
30	0	25 20	
"	4 25	27 80	
"	0	30 24	
25	0	23 50	
"	2 33	23 72	
"	7 50	29 75	
"	0	31 50	$\text{Fe}_2\text{Cl}_6 + 2\text{HCl}, 4\text{H}_2\text{O}$
20	0	22 50	
"	5 60	23 60	
"	11 05	29 20	
"	11 05	29 20	
"	0	32 00	
15	10 75	23 50	
"	14 90	28 35	
10	13 80	23 35	
"	17 80	27 75	
"	17 80	27 75	$\text{Fe}_2\text{Cl}_6 + 2\text{HCl}, 4\text{H}_2\text{O}$
0	18 05	23 40	
"	19 50	25 93	

Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{HCl} + \text{Aq}$  — Continued

$t^\circ$	Sat solution contains per 100 mols $\text{H}_2\text{O}$		Solid phase	$t^\circ$	Sat solution contains per 100 mols $\text{H}_2\text{O}$		Solid phase
	mols $\text{HCl}$	mols $\text{FeCl}_3$			mols $\text{HCl}$	mols $\text{FeCl}_3$	
50	0	35 00	$\text{Fe}_2\text{Cl}_6 + 5\text{H}_2\text{O}$	33	30 45	48 70	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$
"	3 25	39 95		30	17 15	36 75	
44	0	33 50		"	31 20	43 49	
"	3 04	33 80		"	33 80	47 80	
"	10 62	34 64		"	32 60	49 93	
"	11 50	35 60		25	19 50	35 25	
"	10 70	38 00		"	20 60	35 34	
40	0	32 40		"	31 34	41 58	
"	13 40	37 45		"	33 00	43 00	
33	0	31 00		"	34 65	44 80	
"	15 70	37 06	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$	20	21 25	34 25	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$
30	0	30 24		"	28 81	37 57	
"	17 20	34 00		"	34 23	42 02	
"	17 15	36 75		"	35 40	43 16	
25	0	29 00		15	29 40	36 50	
"	7 50	29 75		"	33 60	40 03	
"	19 50	35 25		10	24 50	32 75	
20	0	27 90		"	35 04	39 95	
"	11 05	29 20		0	26 00	32 16	
"	15 80	30 68		"	34 60	38 11	
15	14 90	28 35	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$	-10	27 30	32 05	$\text{Fe}_2\text{Cl}_6$ anhydrous
"	21 25	34 25		"	33 56	36 25	
10	14 90	28 35		-20	30 08	32 76	
"	16 40	29 32		"	32 65	35 44	
10	17 80	27 75		45	0	58 00	$\text{Fe}_2\text{Cl}_6$ anhydrous
"	18 80	28 70		"	31 28	50 08	
"	24 50	32 75		"	40 65	48 60	
0	24 12	30 04		40	0	58 00	
"	26 00	32 16		"	27 00	50 80	
-10	24 95	29 60		"	42 01	48 64	
"	26 05	30 50		35	0	58 00	
"	27 30	32 05		"	29 01	50 33	
70	0	44 0	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$	"	37 04	49 20	
"	6 75	50 00		30	0	58 00	
"	0	55 80		"	32 60	49 93	
65	0	42 50		"	34 40	49 72	
"	10 25	50 00		40	42 50	47 52	$\text{Fe}_2\text{Cl}_6, 2\text{HCl}, 4\text{H}_2\text{O}$
"	3 75	57 25		"	42 01	48 64	
"	0	59 00		35	39 47	46 57	
60	0	41 40		"	37 04	49 20	
"	14 25	50 00		30	40 21	42 54	
"	10 70	55 25		"	38 20	44 70	
"	0	61 00		"	35 55	47 30	
55	0	40 64		"	34 40	49 72	
"	19 00	50 72		25	40 41	40 25	
"	16 71	53 60		"	39 03	41 38	
50	0	62 00	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$	"	35 74	45 24	$\text{Fe}_2\text{Cl}_6, 2\text{HCl}, 4\text{H}_2\text{O}$
"	0	39 92		20	39 50	39 25	
"	3 25	39 95		"	35 40	43 16	
"	21 24	49 33		10	38 62	37 48	
"	20 04	52 50		"	37 46	38 33	
44	0	39 00		"	36 30	38 70	
"	10 70	38 00		"	35 04	39 93	
"	14 80	38 70		0	37 27	36 60	
40	13 40	37 45		"	34 60	38 11	
"	27 00	50 50		-10	37 92	35 32	
33	15 70	37 06	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$	"	34 54	36 00	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$
"	29 20	42 70		"	33 56	36 25	
"	31 08	46 85		-20	37 80	34 50	
"	30 81	47 65		"	34 10	34 84	
"				"	32 56	35 44	

Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{HCl} + \text{Aq}$  — *Continued*

$t^\circ$	Sat solution contains per 100 mols $\text{H}_2\text{O}$		Solid phase
	mols $\text{HCl}$	mols $\text{FeCl}_3$	
— 4 5	20 50	24 50	$\text{Fe}_2\text{Cl}_6, 2\text{HCl}, 8\text{H}_2\text{O}$
“	20 66	25 74	
“	23 42	27 40	
— 6	29 10	24 73	
“	26 18	21 75	
“	24 41	21 50	
“	23 25	21 35	
“	21 73	21 84	
“	19 73	25 50	
“	24 42	28 45	
“	28 20	27 04	
— 10	20 48	20 54	
“	24 90	18 94	
“	28 75	20 34	
“	31 42	28 53	
“	28 25	30 25	
“	26 05	30 50	
— 15	24 50	15 83	
— 15	28 40	31 89	
— 20	19 44	12 10	
“	22 83	11 63	
“	25 20	11 60	
“	27 20	11 31	
“	31 08	11 51	
“	34 13	12 90	
“	33 93	31 77	
“	30 08	32 76	
“	28 70	32 88	
— 10	12 01	11 99	$\text{Fe}_2\text{Cl}_6, 2\text{HCl}, 12\text{H}_2\text{O}$
“	19 78	14 02	
“	20 95	16 20	
“	20 25	20 20	
“	17 73	20 70	
“	15 44	19 65	
— 12 5	22 14	16 69	
— 15	21 30	9 65	
“	24 50	15 83	
— 20	9 96	9 94	
“	13 32	8 57	
“	16 90	7 35	
“	18 97	7 16	
“	20 56	7 08	
“	23 40	7 20	
“	24 85	9 88	
“	25 20	11 60	
“	25 40	12 37	
“	25 59	13 39	

(Roozeboom and Schreinemakers, *Z phys Ch* 1894, 15 633)

Solubility of  $\text{Fe}_2\text{Cl}_6 + \text{NH}_4\text{Cl}$   
*See*  $\text{NH}_4\text{Cl} + \text{Fe}_2\text{Cl}_6$  under  $\text{NH}_4\text{Cl}$

Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{CsCl}$   
*See*  $\text{CsCl} + \text{Fe}_2\text{Cl}_6$  under  $\text{CsCl}$

Solubility of  $\text{FeCl}_3 + \text{KCl}$  in  $\text{H}_2\text{O}$  at 2

Substance added		Pts by weight sol in pts of solution	
$\text{FeCl}_3$ grams	$\text{KCl}$ grams	$\text{FeCl}_3$	$\text{KCl}$
0	25	0	34 6
13	28	13 44	24 4
18	21	23 18	16 5
3	18 5	28 05	11 6
28	16	35 72	11 6
31	10 5	36 62	11 1
36 2	9	37 35	13 6
41 5	8	42 03	7 8
46 5	6	51 69	7 5
52	0 5		
155	0	83 89	0

(Hinrichsen and Sachsel, *Z phys Ch* 1904, 50 95)

 $\text{FeCl}_3 + \text{NaCl}$ Solubility of  $\text{FeCl}_3 + \text{NaCl}$  in  $\text{H}_2\text{O}$  at 21

Substance added		Pts by weight sol in pts of solution	
$\text{FeCl}_3$ grams	$\text{NaCl}$ grams	$\text{FeCl}_3$	$\text{NaCl}$
0	3 6	0	36 1
1 8	3 0	24 27	9 1
3 6	2 5	25 40	8 4
5 5	2 0	26 40	5 2
7 2	1 5	38 15	3 9
9 0	1 0	43 38	2 4
10 8	0 5	46 75	2 1
10 8	0	83 39	0

(Hinrichsen and Sachsel, *Z phys Ch* 1904, 50 94)

Solubility of  $\text{FeCl}_3$  in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	Substance added		% of $\text{Fe}$ thc solut
	$\text{FeCl}_3$	$\text{NaCl}$	
10	40	20	15 2
10	60	20	15 2
10	100	20	15 16
20	60	20	16 2
20	80	20	16 18
20	100	20	16 2
30	70	30	17 7
30	90	30	17 6
30	110	30	17 67
50	30	20	23 5
50	45	20	23 9
40	35	30	25 4
40	50	30	25 5
30	30	20	23 8
30	45	20	24 0
17 6	30	20	24 47
17 6	50	20	24 5

(Hinrichsen and Sachsel, *Z phys Ch* 1904, 50 95)

Difficultly sol in  $\text{AsBr}_3$  (Walden, Z anorg 1902, 29 374)

Attacked by liquid  $\text{NO}_2$  in the presence of traces of moisture (Frankland, Chem Soc 1901, 79 1361)

Sol in liquid  $\text{SO}_2$  (Walden, B 1899, 32 2864)

Sol in alcohol ether, acetic ether (Cann, C R 102 363), and acetone (Krug and M'Elroy, J anal Ch 6 184)

Sl sol in ethylamine (Shinn, J phys Chem 1907, 11 538)

Sol in benzonitrile (Naumann, B 1914, 47 1369)

Sol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

1 g  $\text{FeCl}_3$  is sol in 1.59 g acetone at  $18^\circ$   
Sp gr of sat solution  $18^\circ/4^\circ = 1.160$  (Naumann, B 1904, 37 4333)

Sol in acetone and in methylal (Eidmann, C C 1899, II 1014)

Sol in quinoline (Beckmann and Gabel, Z anorg 1906, 51 236)

Sl sol in  $\text{CS}_2$  (Arctowski, Z anorg 1894, 6 257)

Mol weight determined in pyridine (Werner, Z anorg 1897, 15 22)

Sublimed

Sol in  $\text{AsCl}_3$ ,  $\text{POCl}_3$ ,  $\text{SO}_2\text{Cl}_2$  and  $\text{PBr}_3$ , sl sol in  $\text{PCl}_5$  (Walden, Z anorg 1900, 25 214)

The salts with different amts of crystal  $\text{H}_2\text{O}$  have different solubilities (Roozeboom +  $4\text{H}_2\text{O}$  Melts in crystal  $\text{H}_2\text{O}$  at  $73.5^\circ$ )

100 mols  $\text{H}_2\text{O}$  dissolve mols  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$
50	19 96	69	21 53	72 5	26 15
55	20 32	72 5	23 35	70	27 90
60	20 70	73 5	25 00	66	29 20

(Roozeboom, Z phys Ch 10 477)

+  $5\text{H}_2\text{O}$  Correct formula for +  $6\text{H}_2\text{O}$  salt

100 mols  $\text{H}_2\text{O}$  dissolve mols  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 5\text{H}_2\text{O}$  at  $t^\circ$

t	Mols $\text{Fe}_2\text{Cl}_6$	t	Mols $\text{Fe}_2\text{Cl}_6$	t	Mols $\text{Fe}_2\text{Cl}_6$
12	12 87	30	15 12	55	19 15
20	13 95	35	15 64	56	20 00
27	14 85	50	17 50	55	20 32

(Roozeboom)

Melts in crystal  $\text{H}_2\text{O}$  at  $31^\circ$  (Engel, C R 104 1708), at  $56^\circ$  (Roozeboom)

+  $6\text{H}_2\text{O}$  Very deliquescent Sol in alcohol Ether dissolves out  $\text{Fe}_2\text{Cl}_6$

M-pt is  $31^\circ$  (Ordway) Contains only  $5\text{H}_2\text{O}$  (Roozeboom)

+  $7\text{H}_2\text{O}$  Melts in crystal  $\text{H}_2\text{O}$  at  $32.5^\circ$

100 mols  $\text{H}_2\text{O}$  dissolve mols  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 7\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$
20	11 35	32	13 55	30	15 12
27 4	12 15	32 5	14 99	25	15 54

(Roozeboom)

+  $12\text{H}_2\text{O}$  Less deliquescent than  $\text{Fe}_2\text{Cl}_6$  or  $\text{Fe}_2\text{Cl}_6 + 5\text{H}_2\text{O}$

100 mols  $\text{H}_2\text{O}$  dissolve mols  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 12\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$	t	Mols $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols $\text{Fe}_2\text{Cl}_6$
-55	2 75	30	5 93	27 4	11 20
-41	2 81	35	6 78	20	12 15
-27	2 98	36 5	7 93	10	12 83
0	4 13	37	8 33	8	13 70
10	4 54	36	9 29		
20	5 10	30	10 45		

(Roozeboom)

Sol in alcohol Ether dissolves out  $\text{Fe}_2\text{Cl}_6$   
Melts in crystal  $\text{H}_2\text{O}$  at  $37^\circ$  (Roozeboom), at  $35.5^\circ$  (Ordway)

**Ferric hydrogen chloride**,  $\text{FeCl}_3 \cdot \text{HCl} + 2\text{H}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$  (Sabatier, Bull Soc (2) 197)

More sol in  $\text{H}_2\text{O}$  than  $\text{FeCl}_3$  (Engel, C R 104 1708)

For solubility, see  $\text{FeCl}_3 + \text{HCl}$ , under ferric chloride

+  $6\text{H}_2\text{O}$  (Roozeboom and Schreinemakers)

For solubility, see  $\text{FeCl}_3 + \text{HCl}$ , under ferric chloride

**Ferrous lithium chloride**,  $\text{FeCl}_2 \cdot \text{LiCl} + 3\text{H}_2\text{O}$   
(Chassevant, A ch (6) 30 17)

**Ferric magnesium chloride**,  $\text{FeCl}_3 \cdot \text{MgCl}_2 + \text{H}_2\text{O}$

Deliquescent (Neumann, B 18 2890)

**Ferrous mercuric chloride**,  $\text{FeCl}_2 \cdot \text{HgCl}_2 + 4\text{H}_2\text{O}$

Deliquescent (v Bonsdorff)

**Ferric nitrosyl chloride**,  $\text{FeCl}_3 \cdot \text{NOCl}$

Very deliquescent (Weber, Pogg 118 477)

**Ferric phosphoric chloride**,  $\text{FeCl}_3 \cdot \text{PCl}_5$

Decomp by  $\text{H}_2\text{O}$  (Baudrimont, A ch (4) 2 15)

**Iron (ferrous) potassium chloride,  $\text{FeCl}_2$ ,  $2\text{KCl} + 2\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  (Berzelius)

**Ferric potassium chloride,  $\text{FeCl}_3$ ,  $2\text{KCl} + \text{H}_2\text{O}$**

A little  $\text{H}_2\text{O}$  dissolves out  $\text{FeCl}_3$  (Fritzsche J pr 18 483)

Sol in  $\text{H}_2\text{O}$  (Walden, Z anorg 1894, 71 332)

**Ferric rubidium chloride,  $\text{FeCl}_3$ ,  $3\text{RbCl}$**

Easily sol in  $\text{H}_2\text{O}$  Insol in  $\text{HCl} + \text{Aq}$  (Godefroy, Arch Pharm (3) 9 343)

$\text{FeCl}_3$ ,  $2\text{RbCl} + \text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Neumann, A 244 329)

Sol in  $\text{H}_2\text{O}$  (Walden, Z anorg 1894, 7 332)

**Ferric sulphur chloride,  $\text{FeCl}_3$ ,  $\text{SCL}_4$**

Very sensitive toward heat and moisture (Ruff, B 1904, 37 4518)

**Ferric thallium chloride,  $\text{FeCl}_3$ ,  $3\text{TlCl}$**

Decomp by  $\text{H}_2\text{O}$  Can be crystallised from  $\text{HCl} + \text{Aq}$  (Wohler, A 144 250)

**Ferrous chloride ammonia,  $3\text{FeCl}_2$ ,  $2\text{NH}_3$**

Decomp by  $\text{H}_2\text{O}$  (Rogstadus, J pr 86 310)

$\text{FeCl}_2$ ,  $6\text{NH}_3$  Loses  $4\text{NH}_3$  at  $100^\circ$  (Miller, J, 17 577)

Decomp in the air (Miller)

**Ferric chloride ammonia,  $\text{FeCl}_3$ ,  $\text{NH}_3$**

Slowly deliquescent Sol in  $\text{H}_2\text{O}$  with evolution of heat (Rose, Pogg, 24 302)

$\text{FeCl}_3$ ,  $6\text{NH}_3$  Not deliquescent, not sol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl}$  with decomp (Miller, Am Ch J 1895, 17 577)

Loses  $\text{NH}_3$  to give  $\text{FeCl}_3$ ,  $5\text{NH}_3$ , and  $\text{FeCl}_3$ ,  $4\text{NH}_3$

**Ferric chloride cyanhydric acid,  $\text{FeCl}_3$ ,  $2\text{HCN}$**

Deliquescent (Klein, A 74 85)

**Ferrous chloride nitric oxide,  $\text{FeCl}_2$ ,  $\text{NO}$**

Sol in  $\text{H}_2\text{O}$  without evolution of gas (Thomas, C R 1895, 121 204)

$+2\text{H}_2\text{O}$  Sol in cold  $\text{H}_2\text{O}$  without decomp (Thomas, C R 1895, 120 448)

$2\text{FeCl}_2$ ,  $\text{NO}$  Very hygroscopic (Thomas, C R 1895, 121 129)

$10\text{FeCl}_2$ ,  $\text{NO}$  Very hygroscopic (Thomas, C R 1895, 121 128)

**Ferric chloride nitric oxide,  $\text{Fe}_2\text{Cl}_6$ ,  $\text{NO}$**

Very hygroscopic Loses  $\text{NO}$  when exposed to the air

$2\text{Fe}_2\text{Cl}_6$ ,  $\text{NO}$  Very hygroscopic In contact with  $\text{H}_2\text{O}$  gives off  $\text{NO}$  (Thomas, C R 1895, 120 447)

**Iron (ferrous) fluoride,  $\text{FeF}_2$**

Sl sol in  $\text{H}_2\text{O}$ , insol in alcohol and ether Partly sol in hot  $\text{HCl} + \text{Aq}$ , slowly sol in cold, easily in hot  $\text{HNO}_3$ , decomp by  $\text{H}_2\text{SO}_4$  (Poulenc, C R 115 941)

$+8\text{H}_2\text{O}$  Difficultly sol in  $\text{H}_2\text{O}$ , more easily if it contains  $\text{HF}$  (Berzelius)

**Ferroferric fluoride,  $\text{FeF}_3$ ,  $\text{FeF}_2 + 7\text{H}_2\text{O}$**

Sol in dil  $\text{HF} + \text{Aq}$  (Weinland, Z anorg 1899, 22 268)

**Ferric fluoride,  $\text{FeF}_3$**

Sl sol in  $\text{H}_2\text{O}$ , insol in alcohol or ether Sl attacked by  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Poulenc, C R 115 941)

$+4\frac{1}{2}\text{H}_2\text{O}$  More sol in hot than cold  $\text{H}_2\text{O}$  Insol in alcohol (Scheurer-Kestner, A ch (3) 68 472)

**Ferric nickel fluoride,  $\text{FeF}_3$ ,  $\text{NiF}_2 + 7\text{H}_2\text{O}$**

Sl sol in dil  $\text{HF} + \text{Aq}$  (Weinland, Z anorg 1899, 22 268)

**Ferrous potassium fluoride,  $\text{FeF}_2$ ,  $\text{KF} + 2\text{H}_2\text{O}$**

(Wagner, B 19 896)

$\text{FeF}_2$ ,  $2\text{KF}$  Sl sol in  $\text{H}_2\text{O}$  (Berzelius)

**Ferric potassium fluoride,  $\text{FeF}_3$ ,  $2\text{KF}$**

Somewhat sol in  $\text{H}_2\text{O}$ , especially if hot (Berzelius)

$+ \text{H}_2\text{O}$  (Chrstensen, J pr (2) 35 164)

$\text{FeF}_3$ ,  $3\text{KF}$  Properties as above (Berzelius)

**Ferric sodium fluoride,  $\text{FeF}_3$ ,  $2\text{NaF} + \frac{1}{2}\text{H}_2\text{O}$**

Rather easily sol in  $\text{H}_2\text{O}$  Solution decomp on heating Very sol in  $\text{FeCl}_3 + \text{Aq}$  (Nickles, J Pharm (4) 10 14)

$\text{FeF}_3$ ,  $3\text{NaF}$  (Wagner, B 19 896)

**Ferric thalious fluoride,  $2\text{FeF}_3$ ,  $3\text{TlF}$**

Sol in hot  $\text{H}_2\text{O}$ , less sol in cold Sl sol in  $\text{HF}$  (Ephraim, Z anorg 1909, 61 239)

**Ferrous titanium fluoride**

See Fluotitanate, ferrous

**Ferric zinc fluoride,  $\text{FeF}_3$ ,  $\text{ZnF}_2 + 7\text{H}_2\text{O}$**

Sl sol in dil  $\text{HF} + \text{Aq}$  (Weinland, Z anorg 1899, 22 269)

**Ferrous hydroxide,  $\text{FeO}_2\text{H}_2$**

Sol in 150,000 pts  $\text{H}_2\text{O}$  (Bineau, C R 41 509)

Insol in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  Sol in  $\text{NH}_4$  salts  $+ \text{Aq}$  Sl sol in  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Mercer)

Not pptd in presence of  $\text{Na}$  citrate Insol in boiling cane sugar  $+ \text{Aq}$ , but sl sol when  $\text{KOH}$  has been added Not pptd in presence of much  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$  (Rose)

Solubility in glycerine+Aq containing about 60% by vol of glycerine  
100 ccm of the solution contain 10 g FeO  
(Muller, Z anorg 1905, 43 322)

### Iron (ferric) hydroxides, $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$

Many indefinite compounds of  $\text{Fe}_2\text{O}_3$  and  $\text{H}_2\text{O}$  are known, and uncertainty exists as to their composition

According to van Bemmelen (R t c 7 106) there are probably no true definite compounds of  $\text{Fe}_2\text{O}_3$  and  $\text{H}_2\text{O}$

According to Tommasi (B 12 1924, 2334), there are two series of Fe hydroxides,  $\alpha$ , red hydroxides, and  $\beta$ , yellow hydroxides

$\alpha$  Hydroxides  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (unstable),  $\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at 50°), and  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at 92°)

Sol in dil acids and in  $\text{Fe}_2\text{Cl}_6$ +Aq, and pptd from the latter solution by  $\text{Na}_2\text{SO}_4$ , or  $\text{H}_2\text{SO}_4$ +Aq

$\beta$  Hydroxides  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (stable below 70°),  $\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at 105°),  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at 150°)

Sl sol in acids, and insol in  $\text{Fe}_2\text{Cl}_6$ +Aq (Tommasi)

The following more or less uncertain data are given

$2\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  Sol in HCl+Aq Very sl sol in  $\text{HNO}_3$ +Aq (Davies, Chem Soc (2) 4 69)

#### Min Turquoise

$\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  Insol in cold acids, difficultly sol in warm HCl and  $\text{H}_2\text{SO}_4$ +Aq, and especially in warm  $\text{HNO}_3$ +Aq (Schiff, A 114 199)

#### Min Goethite

$2\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$  Sl sol in tartaric, citric, or acetic acids, but easily sol in HCl+Aq (Wittstein)

Scarcely attacked by conc  $\text{HNO}_3$ , or HCl+Aq Sol in acetic acid or dil  $\text{HNO}_3$ , or HCl+Aq, from which solution it is pptd by trace of alkali salts (St Gilles)

#### Min Limonite

$3\text{Fe}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$  (Muck)

$\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  Easily sol in HCl+Aq

#### Min Xanthosiderite

$\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$  Sl sol in acetic acid of 1.03 sp gr, but easily sol if of 1.076 sp gr Sol in mineral acids (Lumberg, J B 1853 70)

Pptd  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O} = \text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  Insol in H<sub>2</sub>O, or in solutions of the alkalis or  $\text{NH}_4$  salts When recently pptd is easily sol in acids (Fresenius)

Sl sol in  $\text{NH}_4\text{OH}$ , and  $\text{NH}_4$  salts+Aq (Odling)

Apparently insol in  $\text{NH}_4\text{Cl}$ , or  $(\text{NH}_4)_2\text{CO}_3$ +Aq (Brett, 1837)

Sl sol in conc, but insol in dil KOH+Aq (Chodniew, J pr 28 221)

Sl sol in very conc KOH+Aq free from  $\text{CO}_2$  (Volcker, A 59 34)

Not at all sol in pure conc KOH+Aq, solubility noticed by previous observers being caused by the presence of silicic acid (Sandrock)

Sl sol in conc alkali carbonates+Aq

When freshly pptd, it is not acted upon by conc  $\text{K}_2\text{CO}_3$ +Aq (Grotthaus)

Readily sol in conc  $(\text{NH}_4)_2\text{CO}_3$ +Aq, but pptd by addition of  $\text{H}_2\text{O}$

Sol in excess of  $(\text{NH}_4)_2\text{CO}_3$ +Aq when pptd by that reagent (Wohler)

Sol in solutions of the alkali bicarbonates (Berzelius)

Sol in aqueous solutions of water-glass (Ordway)

Immediately dissolved by  $\text{H}_2\text{SO}_4$ +Aq

Sol in  $\text{NH}_4\text{F}$ +Aq (Helmholtz, Z anorg 3 124)

Sol in conc  $\text{Al}_2(\text{SO}_4)_3$ +Aq (Schneider, B 23 1352)

Sl sol in a solution of  $\text{MgCO}_3$ (?) (Bischhof)

Insol in ethylamine, or amylamine+Aq (Wurtz, A ch (3) 30 472)

Sol in boiling solution of  $\text{Bi}(\text{NO}_3)_3$ , with pptn of  $\text{Bi}_2\text{O}_3$  (Persoz)

Sol in  $\text{Cr}_2\text{Cl}_6$ +Aq, after 3 months 15 mols  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  were dissolved by 1 mol  $\text{Cr}_2\text{Cl}_6$  (Béchamp, A ch (3) 57 296)

Insol in fumaric acid, even when freshly pptd

When recently pptd, it is easily sol in  $\text{KHC}_4\text{H}_4\text{O}_6$ +Aq, but after drying it is difficultly sol therein

When moist easily sol in  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$ +Aq, but after drying is scarcely sol therein when cold, and only sl sol when hot (Werther)

Easily sol in acetic, citric, and other acids (Wittstein)

Solubility in glycerine+Aq containing about 60% by vol of glycerine

100 ccm of the solution contain 0.8 g  $\text{Fe}_2\text{O}_3$  (Muller, Z anorg 1905, 43 322)

Easily sol in aqueous solution of succates of Ca, Ba, Sr, K, Na (Hunton, 1837)

Unacted upon by cane sugar+Aq (Gladstone)

Sl sol in cane sugar+Aq, from which it is pptd by  $(\text{NH}_4)_2\text{S}$ +Aq, but not by  $\text{NH}_4\text{OH}$ , or  $\text{K}_4\text{FeC}_6\text{N}_6$ +Aq (Pescher)

Solubility of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  in sugar solutions 1 l of sugar solution of given strength dissolves mg of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$

% Sugar	$\text{Mg Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$		
	at 17°	at 40°	at 75°
10	3.4	3.4	6.1
30	2.3	2.7	3.8
50	2.3	1.9	3.4

(Stoll, Z Ver Zuckind 1900 50 340)

Not pptd from solutions by alkalis or alkali carbonates in presence of many organic substances, as tartaric acid, sugar, etc

Not pptd by  $\text{NH}_4\text{OH}$  from solutions containing  $\text{Na}_2\text{P}_2\text{O}_7$  (Rose, Pogg 76 19)

Not pptd by  $\text{NH}_4\text{OH}$  in presence of Na citrate (Spiller)



**Soluble (a) By dialysis** Solutions containing 1% can be concentrated somewhat, whereupon they gelatinise. They also gelatinise by cold, or addition of traces of  $\text{H}_2\text{SO}_4$ , alkalis, alkali carbonates or sulphates, or neutral salts, not, however, by  $\text{HCl}$ ,  $\text{HNO}_3$ , alcohol, or sugar (Graham, A 121 46)

When a dil solution of a solid organic acid, or an alkali, or salt is added to a dialysed solution of  $\text{Fe}_2\text{O}_3\cdot\text{H}_2\text{O}$ , a coagulum sol in  $\text{H}_2\text{O}$  is formed, but if the solutions are conc the separating coagulum is no longer sol in  $\text{H}_2\text{O}$  (Athenstadt, C C 1871 822)

**(b) Pean St Gilles' hydroxide, or meta-iron hydroxide** Sol in  $\text{H}_2\text{O}$  Pptd from solution by traces of  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ +Aq, and alkalis, the ppt is insol in cold acids, but sol in pure  $\text{H}_2\text{O}$  (Pean St Gilles, A ch (3) 46 47)

See also table by Krecke in the article on ferric chloride

### Iron (Ferroferric) hydroxide, $\text{Fe}_3\text{O}_4$ , $\text{H}_2\text{O}$ (?)

Sol in acids

$\text{Fe}_3\text{O}_4$ ,  $4\text{H}_2\text{O}$  (Lefort)

### Ferrous iodide, $\text{FeI}_2$

Very deliquescent Sol in  $\text{H}_2\text{O}$  Solution decomp on evaporating

+ $4\text{H}_2\text{O}$  Very deliquescent, sl sol in  $\text{H}_2\text{O}$ , sol in ether (Jackson, Am Ch J 1900, 24 19)

+ $5\text{H}_2\text{O}$  Deliquescent Sol in alcohol Sol in sugar+Aq, and solution is much more stable than aqueous solution Easily sol in glycerine

Insol in methylene iodide (Retgers, Z anorg 3 343)

+ $4\text{H}_2\text{O}$ , and + $9\text{H}_2\text{O}$  Very sol, pptd from aq solution (Volkman, C C 1894, II 611)

### Ferric iodide, $\text{FeI}_3$

Has not been isolated Solution of I in  $\text{FeI}_2$ +Aq in the molecular ratio of I  $\text{FeI}_2$  probably contains  $\text{FeI}_3$

Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

### Ferrous mercuric iodide, $\text{FeI}_2$ , $2\text{HgI}_2$ + $6\text{H}_2\text{O}$

As the corresponding Mg salt (Dubon, C R 1907, 145 714)

### Ferrous iodide ammonia, $\text{FeI}_2$ , $6\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  (Jackson, Am Ch J 1900, 24 27)

### Ferrous mercuric iodide

Very deliquescent Decomp by  $\text{H}_2\text{O}$ , sol in  $\text{HC}_2\text{H}_3\text{O}_2$  or alcohol

### Iron molybdenide, $\text{FeMo}_2$

Attacked by  $\text{HCl}$ +Aq with difficulty Sol in hot conc  $\text{H}_2\text{SO}_4$  (Steinacker)

### Iron nitride

Easily decomp by  $\text{H}_2\text{O}$  when finely powdered (Rossel, C R 1895, 121 942)

$\text{Fe}_3\text{N}$  Easily sol in  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{S}$  +Aq Very slowly decomp by  $\text{H}_2\text{O}$  (Schmidt, Pogg 125 37)

Sol in  $\text{HCl}$  with decomp, decomp by steam and by  $\text{H}_2\text{S}$  at  $200^\circ$  (Fowler, C 1894, 68 152)

$\text{Fe}_3\text{N}_2$  Probably the same as the above compound (Rogstadius, J pr 86 307)

### Iron nitrososulphantimonate, $\text{Fe}_4\text{S}(\text{NO})_6\text{Sb}$

(Low, C C 1865 948)

Does not exist, but was impure sodium ferrotetranitrososulphide (Pawel, B 15 260)

### Iron nitrososulphides

See Ferrotetranitrososulphidic acid and

Ferroheptanitrososulphide, ammonium

$\text{Fe}_3\text{S}_2\text{H}_2(\text{NO})_4$  (Roussin, C R 46 224)

$\text{Fe}_3\text{S}_2(\text{NO})_4$ + $2\text{H}_2\text{O}$  (Porczynsky, A 1 302)

$\text{Fe}_3\text{S}_2(\text{NO})_{18}$ + $4\text{H}_2\text{O}$  (Rosenberg, B 312)

The compound to which the above formulae were given was impure, according to Pawel (12 1407 and 1949, 15 2600), and contained more or less Na or  $\text{NH}_4$ . Pawel considers the substance as  $\text{NH}_4$  salt of ferroheptanitrosulphidic acid, which see

$\text{Fe}_3\text{S}_2\text{N}_3\text{O}_8$ + $1\frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , alcohol, ether,  $\text{CHCl}_3$ , acetone and ethyl acetate Insol in benzene and light petroleum (Mar, C R 1896, 122, 138)

### Iron sodium nitrososulphide, $3\text{Na}_2\text{S}$ , $\text{Fe}_2$ , $2\text{NO}$

(Roussin)

$\text{Na}_3\text{FeS}_2(\text{NO})_{18}$  (Rosenberg)

Correct formula is  $\text{Na}_2\text{S}_2(\text{NO})_4\text{Fe}_2$ , sodium ferrotetranitrososulphide

### Iron nitrososulphocarbonate, $\text{Fe}_4\text{S}(\text{NO})_6\text{CS}_2$ , $3\text{H}_2\text{O}$

(Low, C C 1865 948)

Correct formula is  $\text{Na}_3\text{S}_2(\text{NO})_7\text{Fe}_4$ + $2\text{H}_2\text{O}$  sodium ferroheptanitrososulphide (Pawel, B 15 2600)

### Ferrous oxide, $\text{FeO}$

Insol in  $\text{H}_2\text{O}$  Sol in acids

Easily sol in  $\text{HCl}$ , and  $\text{HNO}_3$ +Aq, near insol in  $\text{H}_2\text{SO}_4$ , even when heated (Tissandier, C R 74 531)

### Ferric oxide, $\text{Fe}_2\text{O}_3$

Attacked by acids with difficulty, the more the higher it has been heated  $\text{HCl}$ +A is the best solvent, in which it is more quickly sol by long digestion at a gentle heat than by boiling (Fresenius)

Most easily sol in 16 pts of a mixture of 8 pts  $\text{H}_2\text{SO}_4$  and 3 pts  $\text{H}_2\text{O}$  (Mitscherlich, J pr 81 110)

Solubility of  $\text{Fe}_2\text{O}_3$  in  $\text{HF} + \text{Aq}$  at  $25^\circ$ 

	Time	G $\text{Fe}_2\text{O}_3$ in 10 ccm of the solution
N-HF	4½ hrs	0 1581
	21¾ "	0 2235
	45¾ "	0 2279
0 5N-HF	2¾ "	0 0579
	8½ "	0 0884
	23½ "	0 1045
	56½ "	0 1162
0 25N-HF	2¼ "	0 0180
	8½ "	0 0345
	24¾ "	0 0475
	142½ "	0 0534
equal amts N-HF + N-HCl	2¾ "	0 1011
	8½ "	0 1611
	23¾ "	0 1976
	96 "	0 2223
	264 "	0 2297

(Deussen, Z anorg 1905, 44 414)

Solubility of  $\text{Fe}_2\text{O}_3$  in  $\text{HCl} + \text{Aq}$  at  $25^\circ$ 

	Time	G $\text{Fe}_2\text{O}_3$ in 10 ccm of the solution
N-HCl	4¾ hrs	0 0409
	21½ "	0 1230
	45½ "	0 2125
0 5N-HCl	2¾ "	0 0126
	8½ "	0 0188
	23½ "	0 0382
	56½ "	0 0672
0 25N-HCl	2¼ "	0 0040
	8½ "	0 0054
	24¾ "	0 0120
	142½ "	0 0306
equal vol N-HCl + N-NaCl	2¾ "	0 0444
	8½ "	0 0640
	23¾ "	0 0743
	72¼ "	0 0757
	215 "	0 0766

(Deussen, l c)

Solubility of  $\text{Fe}_2\text{O}_3$  in N-oxalic acid at  $25^\circ$ 

Time	G $\text{Fe}_2\text{O}_3$ in 10 ccm of the solution
1¾ hrs	0 0310
6¾ "	0 0790
22 "	0 1960
94 "	0 2326

(Deussen)

Absolutely insol in  $\text{Br}_2 + \text{Aq}$  (Balard)  
 Insol in hot  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rose)  
 Insol in  $\text{KOH} + \text{Aq}$  (Chodnew, J pr 28 222)

Slowly sol in an aq solution of calcium hydrogen carbonate. The velocity of the reaction may be much increased by the addition of small amounts of alkali sulphate or  $\text{CaSO}_4$  (Rohland, Z anal 1909, 48 629)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)

Solubility in (calcium succrate + sugar) + Aq  
 1 l solution containing 418.6 g sugar and 34.3 g  $\text{CaO}$  dissolves 6.26 g  $\text{Fe}_2\text{O}_3$ , 296.5 g sugar and 24.2 g  $\text{CaO}$  dissolves 4.71 g  $\text{Fe}_2\text{O}_3$ , 174.4 g sugar and 14.1 g  $\text{CaO}$  dissolves 3.08 g  $\text{Fe}_2\text{O}_3$  (Bodenbender, J B 1865 600)

Solubility of  $\text{Fe}_2\text{O}_3$  in sugar solutions 1 l of sugar solution of given strength dissolves mg  $\text{Fe}_2\text{O}_3$

% Sugar	mg $\text{Fe}_2\text{O}_3$	
	at $17.5^\circ$	at $45^\circ$
10	1 4	2 0
30	1 4	
50	0 8	1 1

(Stolle, Z Ver Zuckerind, 1900, 50 340)

## Calcined

Solubility of calcined  $\text{Fe}_2\text{O}_3$  in acids at  $25^\circ$ 

Acid	Time	g $\text{Fe}_2\text{O}_3$ in 10 ccm of the solution
N-HF	4½ hrs	0 0889
	43½ "	0 2035
	129½ "	0 2194
N-HCl	4½ "	0 0224
	43½ "	0 1000
	139½ "	0 1910

(Deussen, Z anorg 1905, 44 413)

## See also Ferric hydroxide

Min Hematite Rather easily sol in  $\text{HCl} + \text{Aq}$ , but not readily sol in other acids

## Melacon oxide

## See Ferric hydroxides

Ferroferric oxide,  $6\text{FeO}, \text{Fe}_2\text{O}_3$ 

$\text{FeO}, \text{Fe}_2\text{O}_3 = \text{Fe}_3\text{O}_4$  With insufficient  $\text{HCl} + \text{Aq}$  for complete solution,  $\text{FeO}$  is dissolved and  $\text{Fe}_2\text{O}_3$  left (Berzelius)

Insol in  $\text{HNO}_3 + \text{Aq}$  at the ordinary temperature (Millon)

Insol in acetone (Naumann, B 1904, 37 4329)

Solubility of  $\text{Fe}_2\text{O}_3$  in sugar solutions 1 l of sugar solution of given strength dissolves mg  $\text{Fe}_2\text{O}_3$

% Sugar	mg $\text{Fe}_2\text{O}_3$		
	at 17.5°	at 45°	at 75°
10	10.3	10.3	12.4
30	12.4	10.3	12.4
50	14.5	10.3	14.5

(Stolle, Z Ver Zuckerind 1900, 50 340)

Min Magnetite Insol in  $\text{HNO}_3$ , but sol in hot  $\text{HCl} + \text{Aq}$

Iron sesquioxide zinc oxide,  $\text{Fe}_2\text{O}_3$ ,  $\text{ZnO}$

See Ferrite, zinc

### Ferric oxybromide

Basic ferric bromides containing three equivalents, or less, of base to one of acid may be obtained dissolved in  $\text{H}_2\text{O}$  (Ordway, Am J Sci (2) 26 202)

The most basic soluble compound obtained by three months' digestion of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  with  $\text{Fe}_2\text{Br}_6 + \text{Aq}$ , is  $\text{Fe}_2\text{Br}_6$ , 14 $\text{Fe}_2\text{O}_3$  (Béchamp)

### Ferric oxychlorides

(a) Soluble  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  dissolves in  $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ . By digesting until the acid reaction of the chloride has disappeared a solution of  $\text{Fe}_2\text{Cl}_6$ , 2 $\text{Fe}_2\text{O}_3$  is obtained (Pettenkofer, Report (2) 41 289)

By digesting for several days in the cold,  $\text{Fe}_2\text{Cl}_6$ , 5 $\text{Fe}_2\text{O}_3$  is obtained, and still more basic compounds by further addition of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . When the solution contains  $\text{Fe}_2\text{Cl}_6$ , 12 $\text{Fe}_2\text{O}_3$  it gelatinises, but still dissolves completely in  $\text{H}_2\text{O}$ . The most basic soluble compound is  $\text{Fe}_2\text{Cl}_6$ , 20 $\text{Fe}_2\text{O}_3$  (Béchamp, A ch (3) 57 296)

If the digestion is carried on several weeks, a solution containing  $\text{Fe}_2\text{Cl}_6$ , 23 $\text{Fe}_2\text{O}_3$  is obtained, this can be boiled and diluted without pptn, but  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  is precipitated by the addition of very many salts (Ordway, Sill Am J (2) 26 197)

Solutions containing 10 or less molecules  $\text{Fe}_2\text{O}_3$  to 1 mol  $\text{Fe}_2\text{Cl}_6$  can be dried without the oxychloride becoming insoluble (Ordway)

The above solutions do not become cloudy by boiling or diluting (Phillips)

A very dil solution of  $\text{Fe}_2\text{Cl}_6$ , 10 $\text{Fe}_2\text{O}_3$  remains clear after protracted boiling, and may be boiled without decomp even when  $\text{Fe}_2\text{Cl}_6$ , 20 $\text{Fe}_2\text{O}_3$  is present (Béchamp)

$\text{HNO}_3$ , and  $\text{HCl} + \text{Aq}$  form precipitates in the above solutions, which are sol on addition of more  $\text{H}_2\text{O}$ .  $\text{H}_2\text{SO}_4 + \text{Aq}$  forms a precipitate insol in  $\text{H}_2\text{O}$  (Béchamp)

$\text{Fe}_2\text{Cl}_6$ , 9 $\text{Fe}_2\text{O}_3$  is easily sol in  $\text{H}_2\text{O}$ , weak alcohol, and glycerine, but solutions are pptd by small amts of  $\text{H}_2\text{SO}_4$ ,  $\text{M}_2\text{SO}_4$ , citric or

tartaric acids, or a few drops of  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$  (Jeannel, C R 46 799)

Solutions containing 5 mols  $\text{Fe}_2\text{O}_3$  to 1 n  $\text{Fe}_2\text{Cl}_6$  are completely precipitated by  $\text{K}_2\text{S}$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{MgSO}_4$ ,  $\text{KNO}_3$ ,  $\text{NaNO}_3$ ,  $\text{Zn(NO}_3)_2$ ,  $\text{KCl}$ ,  $\text{NaCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{CaCl}_2$ ,  $\text{MgCl}_2$ ,  $\text{ZnCl}_2$ ,  $\text{KBr}$ , or  $\text{KSCN}$  (Béchamp)

$\text{Ba(NO}_3)_2$  does not precipitate solutions of less than 18–20  $\text{Fe}_2\text{O}_3$  to 1  $\text{Fe}_2\text{Cl}_6$

$\text{Pb(NO}_3)_2$  or  $\text{Pb(C}_2\text{H}_3\text{O}_2)_2$  do not precipitate solutions containing the compound  $\text{Fe}_2\text{Cl}_6$ , 12 $\text{Fe}_2\text{O}_3$ , but a mixture of the two salts causes complete precipitation

Solution has been obtained containing  $\text{Fe}_2\text{O}_3$  to 1  $\text{FeCl}_3$ , probably owing to a formation of soluble colloidal  $\text{Fe}_2\text{O}_3$  (Magnier la Source, C R 90 1352)

Solubility determinations in the system  $\text{Fe}_2\text{O}_3$ ,  $\text{HCl}$  and  $\text{H}_2\text{O}$ , show that at 25° definite basic chloride is formed, but that a stable solid phase is one of a series of solid solutions containing  $\text{Fe}_2\text{O}_3$ ,  $\text{HCl}$  and  $\text{H}_2\text{O}$  (Cameron, J phys Chem 1907, 11 694)

(b) Insoluble  $\text{Fe}_2\text{Cl}_6$ , 6 $\text{Fe}_2\text{O}_3 + 9\text{H}_2\text{O}$

(1) By exposing  $\text{FeCl}_3 + \text{Aq}$  to air Insol in  $\text{H}_2\text{O}$  sl sol in  $\text{HCl} + \text{Aq}$  (Wittstein)  
(2) From  $\text{FeCl}_2 + \text{Aq}$  and  $\text{HNO}_3$  Insol in  $\text{H}_2\text{O}$ , and sl sol in  $\text{HCl} + \text{Aq}$  (Béchamp)  
 $2\text{Fe}_2\text{Cl}_6$ , 25 $\text{Fe}_2\text{O}_3 + 41\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Béchamp)

$\text{Fe}_2\text{Cl}_6$ , 2 $\text{Fe}_2\text{O}_3 + 3\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  with residue of  $\text{Fe}_2\text{O}_3$ , sl sol in dil acids (Rousseau, C R 110 1032)

$\text{Fe}_2\text{Cl}_6$ , 3 $\text{Fe}_2\text{O}_3$  As above (Rousseau, C R 113 542)

Ferric oxyfluoride, 3 $\text{Fe}_2\text{O}_3$ , 2 $\text{FeF}_3 + 4\text{H}_2\text{O}$

Ppt (Scheurer-Kestner)

Ferric oxysulphide,  $\text{Fe}_2\text{O}_3$ , 3 $\text{Fe}_2\text{S}_3$

(Rammelsberg)

Iron phosphide,  $\text{FeP}$

Very slowly (Freese), not (Hvoslef, A 10 99) sol in hot  $\text{HCl} + \text{Aq}$  Still more insol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Freese)

Slowly sol in  $\text{HNO}_3 + \text{Aq}$ , and easily soluble in aqua regia (Struve)

Insol in ammonium citrate +  $\text{Aq}$ , sl sol in  $\text{HCl}$  (Dennis, J Am Chem Soc 18 16 483)

$\text{Fe}_2\text{P}$  Slowly but completely sol in  $\text{H}_2\text{SO}_4$ , or dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Sol in hot conc  $\text{H}_2\text{SO}_4$ , in  $\text{HNO}_3$ , and in aqua regia (Freese, Pogg 132 225)

Insol in all acids except in a mixture of  $\text{HNO}_3$  and  $\text{HF}$  (Maronneau, C R 190 130 657)

$\text{Fe}_3\text{P}_4$  Very slowly sol in hot conc  $\text{HCl} + \text{Aq}$  0.1 g dissolves by 4 days' heating with  $\text{HCl} + \text{Aq}$  0.3 g dissolves in hot conc  $\text{H}_2\text{SO}_4$  in 1½ hours, 0.4 g in 2 hours in  $\text{HNO}_3 + \text{Aq}$  Quite easily sol in aqua regia on warming (Freese)

$\text{Fe}_2\text{P}_3$  Insol in  $\text{HCl}$ ,  $\text{HNO}_3$  and aqua regia Sol in potassium hypobromite so

tion (Granger, Bull Soc 1896, (3) 15 1086)

$\text{Fe}_3\text{P}_3$  Very slowly sol in boiling  $\text{HCl} + \text{Aq}$  Easily sol in  $\text{HNO}_3$  or aqua regia (Struve, J B 1860 77)

Mixture (Freese, Pogg 132 225)

Almost insol in aqua regia Sol in fused alkali (Granger)

$\text{Fe}_3\text{P}$  Nearly insol in dil acids, rapidly sol in  $\text{HNO}_3$  or aqua regia, decomp by conc  $\text{HCl}$ , or  $\text{KOH} + \text{Aq}$  (Schneider, J B 1886 2026)

Of the nine iron phosphides described the constitution has been established for only two,  $\text{Fe}_3\text{P}$  and  $\text{Fe}_2\text{P}$

$\text{Fe}_3\text{P}$  Sol in conc  $\text{HCl}$

$\text{Fe}_2\text{P}$  Sol in hot aqua regia Insol in other acids (Le Chatelier, C R 1909, 149 709)

### Iron selenide, $\text{Fe}_2\text{Se}$

Not attacked by  $\text{HNO}_3$  or acetic acid SI attacked by conc  $\text{HCl}$  Readily attacked by aqua regia Sol in  $\text{HF}$  (Vigouroux, C R 1905, 141 829)

$\text{FeSe} + x\text{H}_2\text{O}$  Sol in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{HCl}_2\text{H}_2\text{O}_2 + \text{Aq}$  Insol in alkalis, or  $(\text{NH}_4)_2\text{S} + \text{Aq}$  (Reeb, J Pharm (4) 9 173)

$\text{Fe}_2\text{Se}_3$  Sol in dil  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$  with evolution of  $\text{H}_2\text{Se}$  Sol in conc  $\text{HNO}_3 + \text{Aq}$  (Little, A 112 211)

$\text{Fe}_2\text{Se}_4$  Decomp by fuming  $\text{HNO}_3$  (Fonzes-Diacon, C R 1900, 130 1711)

$\text{Fe}_7\text{Se}_8$  Decomp by fuming  $\text{HNO}_3$  (Fonzes-Diacon, C R 1900, 130 1711)

$\text{FeSe}_2$  Insol in conc  $\text{HCl}$ , decomp by fuming  $\text{HNO}_3$  (Fonzes-Diacon, C R 1900, 130 1711)

### Iron silicide, $\text{Fe}_3\text{Si}$

Difficultly sol in  $\text{HCl} + \text{Aq}$ , easily sol even in dil  $\text{HF} + \text{Aq}$  (Hahn, A 129 57)

$\text{Fe}_3\text{Si}$  Not easily sol in conc  $\text{HCl}$  and  $\text{HNO}_3$  but readily sol in  $\text{HF}$  (Moissan, C R 1895, 121 623)

$\text{Fe}_{10}\text{Si}_9$  Sol in hot  $\text{HCl} + \text{Aq}$  only when melted (Hahn)

by conc  $\text{HF}$  or  $\text{H}_2\text{SO}_4$  (Hahn)

Sol in cold  $\text{HF}$  (de Chalmot, Am Ch J 1897, 19 123)

Existence questioned by Jouve, (Bull Soc 1901, 25 290-293)

$\text{Fe}_3\text{Si}$  Sol in  $\text{HF}$  and in fused  $\text{KNO}_3$  and  $\text{KNaCO}_3$  (de Chalmot, J Am Chem Soc 1895, 17 924)

### Iron semisulphide, $\text{Fe}_2\text{S}$

Sol in dil acids with decomposition (Arfvedson, Pogg 1 72)

### Ferrous sulphide, $\text{FeS}$

Decomp by dil acids, with evolution of  $\text{H}_2\text{S}$  and without separation of S, except with  $\text{HNO}_3 + \text{Aq}$

$+x\text{H}_2\text{O}$  SI sol in  $\text{H}_2\text{O}$ , especially if hot (Berzelius)

1 l  $\text{H}_2\text{O}$  dissolves  $70.1 \times 10^{-6}$  moles  $\text{FeS}$  at  $18^\circ$  (Weigel, Z phys Ch 1907, 58 294)

Very violently decomp, even by dil acids Sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  Insol in  $\text{H}_2\text{S}$  or  $(\text{NH}_4)_2\text{S} + \text{Aq}$  SI sol in  $\text{Na}_2\text{S}$ , or  $\text{K}_2\text{S} + \text{Aq}$  SI in  $\text{Na}_2\text{S}$  or  $\text{K}_2\text{S} + \text{Aq}$  (de Koninck, Z angew Ch 1891 204)

Insol in  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4\text{Cl} + \text{Aq}$  (Brett)

Not completely pptd in presence of Na citrate (Spiller)

Contrary to assertion of Persoz, it can be nearly completely pptd in presence of  $\text{Na}_4\text{P}_2\text{O}_7$  by  $(\text{NH}_4)_2\text{S} + \text{Aq}$  (Rose, Pogg 76 18)

Sol in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, and -stannates (Storch, B 16 2015)

Sol in  $\text{KCN} + \text{Aq}$

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Solubility of  $\text{FeS}$  in sugar solutions 1 l sugar of given strength dissolves mg  $\text{FeS}$

% Sugar	mg $\text{FeS}$		
	at $17.5^\circ$	at $45$	at $75^\circ$
10	3 8	3 8	5 3
30	7 1	9 1	7 2
50	9 9	19 8	9 1

(Stolle, Z Ver Zuckerind 1900, 50 300)

*Colloidal*—A very dilute solution has been obtained which coagulated very readily (Winssinger, Bull Soc (2) 49 452)

### Ferric sulphide, $\text{Fe}_2\text{S}_3$

Decomp by dil  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  with evolution of  $\text{H}_2\text{S}$ , leaving a residue of  $\text{FeS}_2$

$+1\frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , also in alcoholic ammonia SI sol in  $(\text{NH}_4)_2\text{S} + \text{very dil Na}_2\text{S}_2\text{O}_4 + \text{Aq}$  (Phipson, C N 30 139)

### Iron disulphide, $\text{FeS}_2$

Insol in dil  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  Decomp by  $\text{HNO}_3$  or aqua regia with separation of S Insol in a 10% solution of alkali sulphide

Min *Pyrite Marcasite* Sol in a mixture of  $\text{Na}_2\text{S}$  and  $\text{NaOH} + \text{Aq}$   $\text{Na}_2\text{S} + \text{Aq}$ , or mixture of  $\text{Na}_2\text{S}$  and  $\text{NaSH} + \text{Aq}$ , insol in cold  $\text{NaSH} + \text{Aq}$  *Marcasite* is more easily sol in above than *pyrite* (Becker, Bull Am J (3) 33 199)

### Ferroferric sulphide, $\text{Fe}_3\text{S}_4$ or $\text{Fe}_7\text{S}_8$

Min *Pyrrhotite* Sol in dil acids with a residue of S Extremely slowly sol in a 10% solution of alkali sulphides (Terrell, C R 69 1360)

**Iron (ferrous) nickel sulphide,  $2\text{FeS}$ ,  $\text{NiS}$** Min *Penitlandite***Ferrous phosphorus sulphide,  $\text{FeS}$ ,  $\text{P}_2\text{S}_3$** 

(Berzelius)

$2\text{FeS}$ ,  $\text{P}_2\text{S}_3$  Slowly decomp by  $\text{H}_2\text{O}$  Insol in boiling  $\text{HCl} + \text{Aq}$ , decomp by aqua regia (Berzelius, A 46 256)

**Iron potassium sulphide (potassium sulphoferrite),  $\text{K}_2\text{Fe}_2\text{S}_4 = \text{K}_2\text{S}$ ,  $\text{Fe}_2\text{S}_3$** 

Insol in cold or hot  $\text{H}_2\text{O}$  Violently attacked by dil acids Not decomp by boiling with alkalis, alkali carbonates, or sulphides + Aq Decomp by  $\text{KCN}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Preis, J pr 107 16)

$\text{K}_2\text{S}$ ,  $2\text{FeS}$  (Schneider, Pogg 136 460)

**Iron silver sulphide (silver sulphoferrite),  $\text{Ag}_2\text{S}$ ,  $\text{Fe}_2\text{S}_3$** 

Not attacked by dil  $\text{HCl} + \text{Aq}$ , decomp by conc  $\text{HCl} + \text{Aq}$  (Schneider)

$2\text{Ag}_2\text{S}$ ,  $\text{FeS}_2$  (Schneider, Pogg 138 305)  
 $\text{Ag}_2\text{S}$ ,  $3\text{FeS}$ ,  $\text{FeS}_2$  Min *Sternbergite* Decomp by aqua regia

**Iron sodium sulphide (sodium sulphoferrite),  $\text{Na}_2\text{Fe}_2\text{S}_4 + 4\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  Decomp by very dil acids (Schneider, Pogg 138 302)

phosphide,  $\text{Fe}_2\text{PS}_3$

decomp by acids at  $100^\circ$  boiling  $\text{NaOH} + \text{Aq}$  (Ferrand, A ch 1899, (7) 17 410)

**Ferrous telluride,  $\text{FeTe}$** 

Insol in  $\text{H}_2\text{O}$ , sol in acids (Fabre, C R 105 277)

**Kermes**

See Antimony trisulphide

**"Knallplatin" compounds**

See Fulminoplatinum compounds

**Krypton, Kr**

Absorption by  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Coefficient of absorption det by two series of experiment	
0	0 1249	0 1166
10	0 0965	0 0877
20	0 0788	0 0670
30	0 0762	0 0597
40	0 0740	0 0561
50	0 0823	0 0610

(Antropoff, Roy Soc Proc 1910, 83 A 480)

**Lanthanic acid**

**Barium metalanthanate**,  $\text{Ba}(\text{H}_3\text{La}_5\text{O}_{15})_2$   
 (Baskerville, J Am Chem Soc 1904, 2 79)

**Lithium metalanthanate**,  $\text{LiH}_3\text{La}_5\text{O}_{15} + 2\text{H}_2\text{O}$   
 (Baskerville)

**Potassium metalanthanate**,  $\text{KH}_3\text{La}_5\text{O}_{15}$   
 $15\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Baskerville)

**Sodium metalanthanate**,  $\text{NaH}_3\text{La}_5\text{O}_{15} + 4\text{H}_2\text{O}$

Almost insol in  $\text{H}_2\text{O}$ , but decomp by 1 (Baskerville)

**Disodium tetralanthanate**,  $\text{Na}_2\text{La}_4\text{O}_7$

Insol in  $\text{H}_2\text{O}$  (Baskerville)

**Lanthanicotungstic acid**

**Ammonium lanthanicotungstate**,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{La}_2\text{O}_3$ ,  $16\text{WO}_3 + 16\text{H}_2\text{O}$

Ppt Insol in  $\text{H}_2\text{O}$  (E F Smith, J Am Chem Soc 1904, 26 1481)

**Barium lanthanicotungstate**,  $5\text{BaO}$ ,  $\text{La}_2\text{O}_3$ ,  $16\text{WO}_3 + 16\text{H}_2\text{O}$

Ppt (E F Smith)

**Silver lanthanicotungstate**,  $5\text{Ag}_2\text{O}$ ,  $\text{La}_2\text{O}_3$ ,  $16\text{WO}_3 + 4\text{H}_2\text{O}$

Very insol in  $\text{H}_2\text{O}$  (E F Smith)

**Lanthanum, La**

Slowly decomp cold, rapidly hot  $\text{H}_2\text{O}$  Not attacked by cold conc  $\text{H}_2\text{SO}_4$ , but energetically by cold conc  $\text{HNO}_3 + \text{Aq}$  Sol in dil acids (Hillebrand and Norton, PoGL 155 633)

**Lanthanum bromide**,  $\text{LaBr}_3 + 7\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  Not very sol in absolute alcohol Insol in ether (Clcve, Sv V A H Bih 2 No 7)

**Lanthanum nickel bromide**,  $2\text{LaBr}_3$ ,  $3\text{NiBr}_3 + 18\text{H}_2\text{O}$

Deliquescent (Frenchs and Smith, A 191 355)

**Lanthanum zinc bromide**,  $2\text{LaBr}_3$ ,  $3\text{ZnBr}_3 + 36\text{H}_2\text{O}$

Very deliquescent (F and S)

**Lanthanum carbide**,  $\text{LaC}_2$

Decomp by  $\text{H}_2\text{O}$  and dil acids (Pettersson, B 1895, 28 2422)

Sol in conc  $\text{H}_2\text{SO}_4$  and dil acids, insol in conc  $\text{HNO}_3$

Sol in fused oxidizing agents, decomp by  $H_2O$  at ordinary temps (Moissan, C R 1896, 123 149)

### Lanthanum chloride, $LaCl_3$

Anhydrous Deliquescent (Hermann)  
Insol in acetone (Naumann, B 1904, 37 329)  
+  $7\frac{1}{2}H_2O$  Not deliquescent (Zschiesche)  
Easily sol in alcohol (Hermann)

### Lanthanum mercuric chloride, $2LaCl_3, HgCl_2 + \frac{8}{3}H_2O$

Not deliquescent Very sol in  $H_2O$  (Marignac, Ann Min (5) 15 272)

### Lanthanum stannic chloride

See Chlorostannate, lanthanum

### Lanthanum fluoride, $LaF_3 + H_2O$

Precipitate Sl sol in  $HCl + Aq$  (Cleve)

### Lanthanum hydrogen fluoride, $2LaF_3, 3HF$

Precipitate (Frerichs and Smith, A 191 355)  
Does not exist (Cleve, B 11 910)

### Lanthanum hydride, $La_2H_3$

Decomp by dil acids (Winkler, B 24 1966)

$LaH_3$  Decomp by  $H_2O$  Sol in acids with evolution of  $H_2$  Decomp by alkalis (Muthmann, A 1902, 325 266)

### Lanthanum hydroxide, $La_2O_3H_6$

Insol in  $H_2O$ , easily sol in acids, insol in  $KOH$ , or  $NaOH + Aq$   
Sol in citric acid (Baskerville, J Am Chem Soc 1904, 26 49)

### Lanthanum zinc iodide, $2LaI_3, 3ZnI_2 + 27H_2O$

Very sol in  $H_2O$  (Frerichs and Smith, A 191 358)

### Lanthanum nitride, $LaN$

Decomp by  $H_2O$  with evolution of  $NH_3$   
Sol in mineral acids Decomp by alkali (Muthmann, A 1902, 325 275)

### Lanthanum oxide, $La_2O_3$

Easily sol, even when ignited, in mineral and acetic acids (Hermann)  
Sol in boiling conc  $NH_4Cl + Aq$  (Mosander)  
Sol in cold conc  $NH_4NO_3 + Aq$  (Damour and Deville)  
Insol in  $(NH_4)CO_3 + Aq$  (Mosander)  
Insol in acetone (Naumann, B 1904, 37 4329)

### Lanthanum peroxide, $La_2O_6$

Sol in  $HCl, H_2SO_4, HNO_3$ , and  $HC_2H_3O_2 + Aq$  with decomp (Cleve, Bull Soc (2) 43 359)  
 $La_2O_6 + xH_2O$  Unstable Sol in dil  $H_2SO_4 + Aq$  with decomp (Mehkoff, Z anorg 1899, 21 71)

### Lanthanum oxybromide, $LaOBr$

Ppt (Frerichs and Smith)

### Lanthanum oxychloride, $3La_2O_3, 2LaCl_3$

Insol in  $H_2O$  Difficultly and slowly sol in  $HCl$ , or  $HNO_3 + Aq$  (Hermann)  
 $LaOCl$  Boiling  $H_2O$  dissolves only traces (Frerichs and Smith)

### Lanthanum sulphide, $La_2S_3$

Decomp by  $H_2O$  and acids (Didier)

### Lanthanum disulphide, $LaS_2$

Decomp by heat (Biltz, Z anorg 1911, 71 435)

### Lead, Pb

Lead in contact with  $H_2O$  and air free from  $CO_2$  gives a solution of  $PbO$  which turns litmus blue and turns red and is turned brown with  $H_2S$

$H_2O$  which has been boiled does not dissolve Pb if there is no access of air When shaken up with air it dissolves 0.01 to 0.008%  $PbO$  in 2 hours Pure spring water containing 1% grains salts in 2 pounds  $H_2O$  and no  $CO_2$  when conducted through a lead pipe 150 feet long dissolves so much lead that it turns brown with  $H_2S$  (Yorke Phil Mag J 5 82)

$CO_2$  or small amts of salts prevent the solution of Pb 1 vol  $H_2O$  with  $\frac{1}{2}$  vol  $CO_2$  dissolves only a trace of Pb Spring  $H_2O$  containing in 10 pounds 1.21 grains  $NaCl$  and  $CaCl_2$  and 6.4 grains  $CaCO_3$  dissolved in  $CO_2$  does not dissolve lead (Yorke)

If the amt of salts in solution equals  $\frac{1}{1000}$  the amt of  $H_2O$  and especially if they are carbonates very slight amts of Pb are dissolved (Christison Phil Mag J 21 158)

$CaCO_3$  dissolved in  $CO_2$  water decreases the solubility of Pb more than any other salt

Distilled  $H_2O$  quietly standing in a closed flask with lead and air free from  $CO_2$  deposits white flocks of  $PbO_2H_2$  and dissolves  $\frac{1}{1000}$  pt  $PbO$  The solution has an alkaline reaction (v. Bonsdorff Pogg 41 305)

Water of 3 hardness does not take up enough Pb to become injurious (Clarke J B 1856 608)

Soluble carbonates increase the solubility of Pb in  $H_2O$  (Nevins C C 1851 608) especially  $(NH_4)CO_3$  (Bottger)

Presence of  $H_2SO_4$  decreases the solubility of Pb (Horsford Chem Gaz 1849 247)

$H_2O$  containing  $K_2SO_4$  takes up only a trace of Pb (Wetzlar Schw J 54 324)

Presence of sulphates diminishes (Christison) does not diminish (Graham Miller and Hoffmann) the action of  $H_2O$  on Pb

$CaSO_4$  protects Pb but it is attacked by much  $MgSO_4$  (Nevins)

$NaCl + Aq$  dissolves only a trace of Pb  
 $\frac{1}{1000}$  pt in  $H_2O$  is not sufficient to prevent the action of  $Cl_2$  on Pb

Presence of chlorides increases the solubility (Graham Miller and Hoffmann Nevins)

$H_2O$  containing  $KNO_3$  does not corrode Pb

Nitrates hinder the action of  $H_2O$  (v. Bonsdorff)

Nitrates increase the action of  $H_2O$  (Graham Miller and Hoffman) Nitrates have no influence (Kersting)

10 lbs of  $H_2O$  dissolved the following amts from Pb pipes in 24 hours if distilled  $H_2O + 1\% Na_2CO_3$ , 0.38 grain Pb, if Duna water, 0.19 grain Pb, if canal water, 0.15 grain Pb, if distilled  $H_2O + 1\% NH_4NO_3$ , 0.15 grain Pb, if hard well water, 0.04 grain Pb, if distilled  $H_2O + 1\% KNO_3$ , 0.01 grain Pb (Kersting, Dingl 169 183)

200 l Manchester drinking water dissolved 2.094 g from 1 sq metre Pb in 8 weeks, 9 l well water dissolved 1.477 g from 1 sq metre Pb in 8 weeks, 11 l distilled  $H_2O$  containing

are dissolved 110 003 g from 1 sq metre Pb in 8 weeks, distilled  $H_2O$  free from air dissolved 1 829 g from 1 sq metre Pb in 8 weeks, sea water dissolved 0 038 g from 1 sq metre Pb in 8 weeks (Calvert and Johnson, C N 16 171)

A lead pipe taken up in Paris, which had been exposed to action of ordinary  $H_2O$  for 200 years, was found perfectly smooth and uncorroded (Belgrand, C R 77 1055)

Pb is attacked by all waters, hard or soft, even highly calcareous water dissolves some lead (Mayençon and Bergeret, C R 78 484)

Pure distilled  $H_2O$  does not act on Pb, but extremely small quantities of  $NH_3$ ,  $HNO_3$ , etc cause an action, but for this action on Pb the presence of air and  $CO_2$  is also required (Stallman, Dingl 180 366)

100 ccm distilled  $H_2O$  dissolved 3 mg from 11 8 sq cm lead in one week when air without  $CO_2$  was passed through the solution 8 mg were dissolved when the air contained  $CO_2$  (Wagner, Dingl 221 260)

Action of dil salt solutions on lead In 500 ccm of the solutions containing salt, bright sheets of lead of 5600 sq metres surface were so suspended that the liquid reached all parts of the metal without hindrance, and the amts dissolved determined after 24, 48, and 72 hours of action

Salt	Grammes salt per litre	Dissolved Pb in mg per litre		
		after 24	48	72 hrs
$NH_4NO_3$	0 020	13 0		25
"	0 040	15 0		32
"	0 080	15 0		
{ $KNO_3$ + $NaNO_3$	{ 0 020 0 050	2 0	2 0	
{ $KNO_3$ + $Na_2SO_4$	{ 0 040 0 212	0 8	1 0	
{ $KNO_3$ + $K_2CO_3$	{ 0 045 0 308			0 3
{ $KNO_3$ + $K_2SO_4$	{ 0 070 0 504			0 5
$CaSO_4$	0 252	0 4		0 8
"	0 408	0 4	1 0	
$K_2CO_3$	0 310			0 2
"	0 516			0 2
$CaCl_2$	0 250	0 5	0 5	0 5
"	0 510	0 3		0 4
$Na_2SO_4$	0 200			0 8
"	0 400			0 5
{ $NH_4NO_3$ + $CaCl_2$	{ 0 020 0 060		1 8	
{ $NH_4NO_3$ + $K_2CO_3$	{ 0 020 0 100			0 4
$Na_2SO_4$	0 200			
$Na_2SO_4$ + $K_2CO_3$	0 200 0 040			0 1
$CaCl_2$	0 100			
Water from L Katrine		1 0	1 0	1 5
Distilled water		2 0	2 0	3 0

(Muir, C N 25 294)

Action of salt solutions on 11 8 sq cm Pb in one week while air either with or without  $CO_2$  was passed through the solution

Solubility of Pb in salt solutions

100 ccm solutions containing the given amts salts dissolve Pb in mg —

Salt	g salt in 100 ccm	mg Pb dissolved	
		without $CO_2$	with $CO$
KCl	0 5	21	12
NaCl	0 5	21	12
$NH_4Cl$	1 0	12	5
$MgCl_2$	0 83	20	35
$K_2SO_4$	1 0	0	0
$KNO_3$	1 0	14	20
$Na_2CO_3$	1 0	0	
NaOH	0 923	430	
$CaO, H_2$	Saturated	137	

(Wagner, Dingl 221 260)

Solubility of Pb in salt solutions

25 sq cm were acted upon by a solution containing 0 2 g salt in a litre for 21 days

Three series of experiments were carried on I In corked flasks II In beakers covered with porous paper, diameter of mouth of beaker = 11 5 cm III In basins covered with porous paper, diameter of mouth of basin = 14 5 cm IV In corked flasks with constant current of air V In beakers half filled and covered with porous paper, the lead being suspended so that equal amts of surface were above and beneath the liquid

The amts in mgs of Pb dissolved were as follows —

Salt used	I	II	III	IV	V
$NH_4NO_3$	1 8	4 0	16 0		
$KNO_3$	1 6	0 5	6 0	1 5	
$CaCl_2$	3 0	2 8	5 5	3 5	3 5
$(NH_4)_2SO_4$	0 7	1 3	16 0	5 0	2 5
$K_2CO_3$	0 3	0 3	0 7	0 6	0 3
Dist $H_2O$	1 5	0 8	4 2	2 0	

(Muir, Chem Soc 36 660)

$H_2O$  sat with  $CO$  dissolves 0 012 g Pb to a litre in 3 days (Muir, C R 77 1529)

Action of  $H_2O$  charged with  $CO$  under 760 mm pressure on Pb 3 mg of Pb were dissolved per litre in 24 hours, and the amt was not increased by further action The addition of 100 mg  $K_2CO_3$  + 20 mg  $NH_4NO_3$  to a litre prevented all action

Action of  $H_2O$  charged with  $CO$  under 6 atmos pressure on Pb

14 8 mg were dissolved per l in 24 hours, and 24 mg per l in 48 hours

Action of various salt solutions added to above solution of  $CO$  were as follows —

	mg salt per l	mg Pb dissolved	
		after 24 hrs	after 48 hrs
$K_2CO_3$	80	13 2	32 0
$K_2CO_3$	160		6 0
$CaCl_2$	160	32 0	44 0
$NH_4NO_3$	16	5 0	
$NH_4NO_3$	40	10 0	35 0
Distilled $H_2O$		14 8	24 0

(Murr, C N 33 125)

The corrosion of Pb by ordinary distilled  $H_2O$  depends upon the presence of  $CO_2$  and O. If the dissolved  $CO_2$  is double the amt of the dissolved O, the action is most energetic. When  $CO_2$  is wholly absent and O present, the action is very slight, and when the  $H_2O$  contains  $1\frac{1}{2}$  or more vol %  $CO_2$  with normal amt of oxygen, there is no visible corrosion. Pure distilled H O containing neither O nor  $CO_2$  has no action on Pb. In the above cases the greater part of the Pb remains in the form of a white ppt or crust on the Pb, but in the case where O and  $CO_2$  are both present in the ratio of 1 2, very small amts of Pb go into solution in a few days, the amt, however, diminishes on standing. As the amt of  $CO_2$  increases, the amt of Pb dissolved in the  $H_2O$  also increases.

$NH_4OH$  alone does not protect Pb from corrosion, but when in combination with  $CO_2$  the action is much diminished.

$CaO_2H_2$ , and  $NaOH + Aq$  attack Pb much more actively in absence of CO and presence of air. In absence of dissolved O neither  $CaO_2H_2$  nor  $NaOH$  attacks Pb.

$Na_2CO_3 + Aq$  in absence of  $CO_2$  attacks Pb slightly, but  $NaHCO_3 + Aq$  has not the slightest action.

$CaH_2(CO_3)_2 + Aq$  also has not the slightest action on Pb, and the presence of  $CaCO_3$  and CO wholly prevents  $H_2O$  attacking Pb.

$CaSO_4 + Aq$  in presence of air forms a crust on Pb, but no Pb is found in solution, but if air is excluded there is no visible action. Presence of  $CO_2$  causes a strong corrosive action.

H O containing  $CaSO_4$  and  $CaH_2(CO_3)_2$  does not attack Pb.

The above reactions are not in the least altered by the presence of moderate amts of nitrates, chlorides, or ammonium, or organic compounds, but ammonium salts in excess have a strong solvent action on Pb. (Muller, J pr (2) 36 317.)

See also an extended report of the action of  $H_2O$  on Pb made to the Water Committee of Huddersfield, England, in 1886, by Messrs Crookes, Odling, and Lidy.

Very extended researches are published by Cornolley and Frew (Jour Soc Chem Ind 7 15), of which only the general conclusions can be given here.

The action of slaked lime, limestone, sand calcium silicate, mortar, etc., was tested. The results were as follows—

1 In nearly all cases the corrosion is greater with free exposure to the air than when air is excluded. The difference is especially great in those cases where the greatest action on the lead takes place. Aluminum hydroxide and blue clay form exceptions, and exert a greater corrosive action when air is excluded. In the case of  $CaCO_3$ , old mortar,  $CaSiO_3$ , or a mixture of  $CaCO_3$  and  $CaO_2H_2$ , the exclusion or presence of air makes no appreciable difference.

$KNO_3 + Aq$  shows a peculiar behaviour. In the presence of air it acts nearly as much on the Pb as pure  $H_2O$ , but when air is excluded it exerts nearly as much retarding action as  $CaSiO_3$ .

2 In the presence of air the action of  $H_2O$  on Pb is considerably increased by the presence of  $NH_4NO_3$  or  $CaO_2H_2$ , with exclusion of air, by  $CaSO_4$ , also by a mixture of  $CaO_2H_2$  and sand. All the other investigated substances, even  $KNO_3$ , hinder the action of  $H_2O$  on Pb either with or without exclusion of air.

3  $CaO_2H_2 + Aq$  exerts in all cases a much greater corrosive action than pure H O, and although this action is diminished by sand yet fresh mortar very quickly destroys lead pipes when in contact therewith. Old mortar, on the other hand, and also  $CaSiO_3$  and  $CaCO_3$ , have a protective action.

4 The fact is very important that sand,  $CaCO_3$ , old mortar,  $CaSiO_3$ , and a mixture of sand and  $CaCO_3$  afford considerable protection to lead against  $H_2O$ . A mixture of limestone and sandstone has more effect than the two substances separately.

5  $CaSiO_3$  totally prevents the corrosive action of  $KNO_3$  and  $NH_4NO_3$ , so that the lead is not attacked by solutions of those salts any more than by  $H_2O$  containing  $CaSiO_3$  alone. Sand, and a mixture of sand and  $CaCO_3$  have a similar effect, but not to such a degree.

6 The protective influence of  $CaCO_3$  does not appear to depend on the presence of  $CO_2$  and the formation of  $CaH_2(CO_3)_2$ .

7  $MgCO_3$  prevents the corrosion of Pb as much as  $CaSiO_3$ . (Cornolley and Frew, Jour Soc Chem Ind 7 15.)

Pb in contact with Zn or Fe is protected thereby from the solvent action of H O, and in fact the action is nearly null. Sn, on the other hand, increases the action. This is of importance in regard to the use of tin-coated lead pipes.

The presence of Cl salts does not influence the action of the  $H_2O$  on Pb, hard or soft H O provided it contains  $CO_2$  having a strong corrosive action. Removal of air from  $H_2O$  diminishes the solvent action. Simple filtration will remove all Pb from  $H_2O$  if suitable filters are used. (Flogel, J B 1888 2645.)



Pure distilled  $H_2O$  has strong corrosive action on Pb, which is very much weakened by addition of a solution of  $CaCO_3$  in carbonic acid water, but the presence of sulphates increase the action. Pb is not appreciably attacked by  $H_2O$  in presence of chlorides alone,

but very strongly when  $CaSO_4$  is also present.  $H_2O$  containing  $CO_2$  also corrodes Pb. The conclusion was drawn that the absence of action of  $H_2O$  on Pb in lead pipes is due to the presence of traces of  $CaH_2(CO_3)_2$  (Barbaglia and Gucci, C C 1888 934)

### Solubility in $H_2O$ containing various solids in solution

Water used	Pts of lead per 100 000			
	1	2	3	4
Water alone, unfiltered	8 19	12 98	8 19	4 09
Water alone, filtered	3 00	4 09	2 07	2 32
Water containing 0 049 g NaCl per l, unfiltered	1 36	2 73	0 68	4 04
" " " " " " filtered	0 68	1 50	0 67	1 36
Water containing 0 49 g $Na_2SO_4$ per l, unfiltered	3 41	6 83	2 05	1 84
" " " " " " filtered	2 05	3 41	1 64	1 77
$CaHCO_3$ +Aq containing 0 04 g CaO as carbonate per l	2 45	3 14	2 63	5 70
$CaHCO_3$ +Aq with NaCl	2 05	3 41	2 35	3 40
$CaHCO_3$ +Aq with $Na_2SO_4$	2 18	3 32	2 05	3 16
$CaSO_4$ +Aq containing 0 095 g CaO as sulphate per l	6 83	6 83	3 41	1 35
$CaSO_4$ +Aq with NaCl	5 46	6 57	3 51	1 50
$CaSO_4$ +Aq with $Na_2SO_4$	4 78	5 87	3 69	1 77

Column 1 gives the numbers for distilled water free from air, column 2 for distilled water aerated by agitation with air, column 3 for water continuously aerated by passing 1 litre of air through it per hour, column 4 for distilled water through which 1 litre of air and 400 cc of  $CO_2$  were passed per hour throughout the experiment (Antony and Benelli, Gazz ch it 1896, 26, (2) 97 and 352)

Almost insol in cold  $HCl$ +Aq, and only sl attacked when boiling. Completely sol in  $HNO_3$ +Aq if not too conc, but presence of  $H_2SO_4$  or  $HCl$  diminishes the solvent power to a great extent (Rose)

Granulated Pb is sl sol in conc  $HCl$ +Aq, addition of  $PtCl_4$  makes the action very energetic. Dil  $HCl$ +Aq may also be used with  $PtCl_4$  (Millon, C R 21 49)

$HCl$ +Aq of 12 sp gr, with Pb, gives off H at ord temp, more abundantly when heated. Evolution of H is hastened by placing Cu in contact with the Pb (Stolba, J pr 94 113)

Quickly decomp by hot  $HCl$ +Aq, slowly by cold (Sharpley, C N 50 126)

Scarcely acted upon by boiling conc  $HCl$ +Aq

Sol in aqua regia

$HNO_3$ +Aq is the best solvent, but Pb is as good as insol in a mixture of  $HNO_3$  and  $H_2SO_4$  (Berzelius)

Not acted upon by very conc  $HNO_3$ +Aq

Pb is only sl attacked by  $HNO_3$ +Aq of any strength below  $15^\circ$ . Above  $15^\circ$  it is most rapidly attacked by a rather weak acid (Montemartini, Gazz ch it 22 397)

Action of  $H_2SO_4$  on Pb

$H_2SO_4$  of 1 842 sp gr dissolves 201 g from 1 sq metre pure lead at ordinary temp (time?), and  $H_2SO_4$  of 1 705 sp gr dissolves only 59 g

Slight impurities in the lead lessen this

solubility (Calvert and Johnson, Chem Soc (2) 1 66)

Strongly attacked by 99 8%  $H_2SO_4$  at ord temp with exclusion of air (Lunge, Dingl 261 131)

When 0 2 g pure Pb was heated with 50 ccm  $H_2SO_4$  of  $66^\circ B$  there was no appreciable action below  $175^\circ$ . At  $230$ – $250^\circ$  all the Pb was suddenly converted into  $PbSO_4$ , which dissolved (Bauer, B 8 210)

Lead is slowly attacked by pure cold conc  $H_2SO_4$ +Aq (99 78%  $H_2SO_4$ ). Lead vessels which held the  $H_2SO_4$  were gradually destroyed by long standing (Napier and Lunge, C N 42 314)

$H_2SO_4$ +Aq (20%) does not evolve H under the same circumstances (Stolba)

Sol in  $HC_2H_3O_2$ +Aq when in contact with the air

Strong  $NH_4OH$ +Aq does not dissolve litharge, but lead immersed in  $NH_4OH$ +Aq 3 days gives an ammoniac solution (0 0139% lead (Endemann, Am Ch J 1897, 19 892)

Somewhat sol in  $NaCl$ +Aq (Reichelt, Dingl 172 155)

$NaCl$ +Aq attacks Pb at high temp (Lunge, l c)

Action of  $KClO_3$ .  $KClO_3$ +Aq (6 3%  $KClO_3$ ) oxidised 64 31 g Pb from 1 sq metre surface by boiling 7 hours,  $KClO_3$ +Aq (25%  $KClO_3$ ) oxidised 151 12 g under same conditions, and  $Ca(ClO_3)_2$ ,  $CaCl_2$ +Aq ( $20^\circ$  Baume)

tions, and  $\text{Ca}(\text{ClO}_3)_2$ ,  $\text{CaCl}_2 + \text{Aq}$  (20° Baume), obtained by passing  $\text{Cl}_2$  through  $\text{CaO}_2\text{H}_2 + \text{Aq}$ , oxidised 437.70 g (Lunge and Deggeler, Jour Soc Chem Ind 4 31)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 828)

Sol in a solution of K in liquid  $\text{NH}_3$  (Kraus, J Am Chem Soc 1907, 29 1562)

$\frac{1}{2}$  ccm oleic acid dissolves 0.0592 g Pb in 6 days (Gates, J phys Chem 1911, 15 143)

Solubility of Pb in petroleum

If b-pt is under 230°, only slightest trace is dissolved in 4 months; if 230–300°, 0.0026% in 4 months, if over 300°, 0.0244% in 4 months; if over 300°, 0.0244% in 4 months

Solubility of Pb in commercial oil of turpentine and resin oil

	Temp	% Pb dissolved	
		in 8 days	in 14 days
Fresh oil of turpentine	15–20°	sl trace	0.0722
Old oil of turpentine	15–20	0.0522	0.1435
Fresh oil of turpentine	100	0.265	0.715
Old oil of turpentine	100	0.982	1.851
Fresh oil of turpentine	130–150	0.938	2.045
Old oil of turpentine	130–150	1.738	4.083
Fresh resin oil	15–20	trace	0.024
Old "	15–20	0.073	0.185
Fresh "	100	0.380	0.880
Old "	100	1.190	2.711
Fresh "	130–150	1.050	2.065
Old "	130–150	2.208	4.740

(Fngler and Kneis, Dingl 263 193)

Pb is slowly attacked by oil of turpentine (Am Chem 4 289)

The fatty oils dissolve Pb in considerable amt (Muller, J B 1878 1169)

Not attacked by sugar + Aq (Klein and Berg, C R 102 1176)

#### Lead potassium amide

*Su* Potassium ammonoplumbite

#### Lead azoimide, basic, $\text{PbO}$ , $\text{PbN}_6$

Insol in  $\text{H}_2\text{O}$  (Wohler, B 1913, 46 2054)

#### Lead azoimide, $\text{PbN}_6$

Insol in cold  $\text{H}_2\text{O}$ , much less sol in boiling  $\text{H}_2\text{O}$  than  $\text{PbCl}_2$ . 1 l  $\text{H}_2\text{O}$  dissolves about  $\frac{1}{2}$  g  $\text{PbN}_6$ . Easily sol in warm  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  insol in conc  $\text{NH}_4\text{OH} + \text{Aq}$  (Curtius, B 24 3344)

#### Lead bromide, $\text{PbBr}_2$

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$ , or in  $\text{H}_2\text{O}$  containing  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{HC}_2\text{H}_3\text{O}_2$  (Lowig)

1 l  $\text{H}_2\text{O}$  dissolves 6 g  $\text{PbBr}_2$  at 10°, addition of  $\text{HBr}$  causes a ppt which redissolves on further addition of  $\text{HBr}$ . 1000 pts of a liquid containing 720 pts  $\text{HBr}$  dissolve 550 g  $\text{PbBr}_2$ . This solubility increases by heating (Ditte, C R 92 718)

1 l  $\text{H}_2\text{O}$  dissolves 26.28 millimols  $\text{PbBr}_2$  at 25.2° (von Ende, Z anorg 1901, 26 159)

Solubility in 100 g  $\text{H}_2\text{O}$  at t°

t°	G $\text{PbBr}_2$
0	0.4554
15	0.7305
25	0.9744
35	1.3220
45	1.7457
55	2.1376
65	2.5736
80	3.3430
95	4.3613
* 100	4.7510

\* By extrapolation

(Lichty, J Am Chem Soc 1903, 25 474)

Sl sol in  $\text{H}_2\text{O}$

$8.34 \times 10^{-1}$  gram are dissolved in 1 liter of sat solution at 20° (Bottger, Z phys ch 1903, 46 603)

Solubility of  $\text{PbBr}_2$  in  $\text{HNO}_3 + \text{Aq}$  at 25.2°

S=solubility in millimols per litre

$\text{HNO}_3$ normal	S
0.001	39.11
0.01	39.87
0.051	42.56
0.04 $\text{KNO}_3 +$	
0.01 $\text{HNO}_3$	42.77

(von Ende, Z anorg 1901, 26 162)

Slowly sol in cold, easily in warm  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Wittstein)

Not pptd in presence of Na citrate (Spiller)

Insol in  $\text{H}_2\text{O}$  containing  $\text{Pb}(\text{NO}_3)_2$  (von Ende, Z anorg 1901, 26 159)

Insol in benzene (Franchimont, B 16 387)

Moderately sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Difficultly sol in acetone (Naumann, B 1904, 37 4328)

+3 $\text{H}_2\text{O}$  (Ditte, l c)

**Lead hydrogen bromide**,  $5\text{PbBr}_2, 2\text{HBr} + 10\text{H}_2\text{O}$

Sol in  $\text{HBr} + \text{Aq}$  (Ditte, C R 92 718)

**Lead magnesium bromide**,  $\text{PbBr}_2, 2\text{MgBr}_2 + 16\text{H}_2\text{O}$

Very deliquescent. Decomp immediately by  $\text{H}_2\text{O}$  or alcohol (Otto and Drewes, Arch Pharm 229 585)

**Lead potassium bromide (potassium bromoplumbite)**,  $\text{PbBr}_2, \text{KBr} + \text{H}_2\text{O}$

(Remsen and Herty, Am Ch J 14 124)

$+-\text{H}_2\text{O}$  (Wells, Sill Am J 145 129)

$\text{PbBr}_2, 2\text{KBr}$  Sol in a little  $\text{H}_2\text{O}$  without decomp, but decomp by an excess with separation of  $\text{PbBr}_2$  (Lowig)

$+\text{H}_2\text{O}$  (Wells, Sill Am J 145 129)

$2\text{PbBr}_2, \text{KBr}$  (Wells)

**Lead potassium perbromide**,  $\text{K}_3\text{Pb}_2\text{Br}_8 + 4\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  and alcohol (Wells, Z anorg 4 340)

**Lead rubidium bromide**,  $\text{PbBr}_2, 2\text{RbBr} + \frac{1}{2}\text{H}_2\text{O}$

(Wells, Sill Am J 146 34)

$2\text{PbBr}_2, \text{RbBr}$  (Wells)

uide

y  $\text{H}_2\text{O}$  (Lowig)

**Lead bromochloride**,  $\text{PbBrCl} = \text{PbBr}_2, \text{PbCl}_2$

Can be recrystallised from  $\text{H}_2\text{O}$  without decomp (Hes, C N 43 216)

$3\text{PbCl}_2, \text{PbBr}_2$  Sol in  $\text{H}_2\text{O}$  with decomp Sol in  $\text{HCl}$  and in  $\text{HBr}$  Insol in cold alcohol, sl sol in boiling alcohol (Thomas, C R 1899, 128 1235)

**Lead bromiodide**,  $\text{PbBrI} = \text{PbBr}_2, \text{PbI}_2$

Decomp by  $\text{H}_2\text{O}$  Cryst from a solution of  $\text{PbI}_2$  in  $\text{HBr}$  (Grissom and Thorp, Am Ch J 10 229)

$3\text{PbBr}_2, \text{PbI}_2$  Decomp by  $\text{H}_2\text{O}$  (Thomas, C R 1899, 128 1236)

$6\text{PbBr}_2, \text{PbI}_2$  (G and T)

**Lead bromosulphide**,  $\text{PbBr}_2, \text{PbS}$

Properties as chlorosulphide (Parmentier)

**Lead chloride**,  $\text{PbCl}_2$

Slowly sol in 135 pts  $\text{H}_2\text{O}$  at 12°, and in a much smaller quantity of hot  $\text{H}_2\text{O}$  (Bischof)

Sol in 30 pts cold and 22 pts hot  $\text{H}_2\text{O}$  (Wittstein)

Sol in 30 pts  $\text{H}_2\text{O}$  at 18.75° (Abl)

100 pts  $\text{H}_2\text{O}$  dissolve 4.59 pts  $\text{PbCl}_2$  at 1.5° (Ure's Dict)

100 pts  $\text{H}_2\text{O}$  dissolve 0.9712 pt  $\text{PbCl}_2$  at 20° (Formánek, C C 1887 270)

100 pts  $\text{H}_2\text{O}$  dissolve 0.946 pt  $\text{PbCl}_2$  at 17.7° (Bell, Chem Soc (2) 6 355)

Sol in 105.2 pts  $\text{H}_2\text{O}$  at 16.5° (Bell, C N 16 69)

100 pts  $\text{H}_2\text{O}$  dissolve 0.8 pt  $\text{PbCl}_2$  at 0°, 1.18 pts at 20°, 1.7 pts at 40°, 2.1 pts at 55°, 3.1 pts at 80° (Ditte, C R 92 718)

1.1  $\text{H}_2\text{O}$  dissolves 38.80 millimols  $\text{PbCl}_2$  at 25.2° (von Ende, Z anorg 1901, 26 148)

9.61 x 10<sup>-1</sup> gram are dissolved in 1 liter of sat solution at 20° (Eottger, Z phys ch 1903, 46 603)

Solubility in  $\text{H}_2\text{O}$

100 g  $\text{H}_2\text{O}$  dissolve g  $\text{PbCl}_2$  at t°

t°	G $\text{PbCl}_2$
0	0.6728
15	0.9090
25	1.0842
35	1.3244
45	1.5673
55	1.8263
65	2.1265
80	2.6224
95	3.1654
* 100	3.8420

\* By extrapolation

(Lichty, J Am Chem Soc 1903, 25 474)

33.6 millimols  $\text{Pb}$  are dissolved in 1 liter  $\text{H}_2\text{O}$  at 18° (Pleissner, C C 1907, II 1056)

1.1  $\text{H}_2\text{O}$  dissolves 77.76 milliequivalents  $\text{PbCl}_2$  at 25° Sp gr of the solution 25°/4° = 1.0069 (Harkins and Wunninghoff, J Am Chem Soc 1911, 33 1816)

0.0388 mol  $\text{mg}$   $\text{PbCl}_2$  are sol in 1 l  $\text{H}_2\text{O}$  (Kernot and Pomilio, Soc R Napoli, 1912, (3), XVII, 353)

A colloidal modification is sol in hot water to give cryst modification (Van de Veide, Ch Z 1893, 17 1908)

Solubility in  $\text{H}_2\text{O}$  is not much increased by the addition of acids (Fresenius)

Sol in conc  $\text{HCl} + \text{Aq}$ , from which it is pptd by  $\text{H}_2\text{O}$ , but less sol in dil  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Berzelius)

Sol in 1636 pts  $\text{H}_2\text{O}$  containing  $\text{HCl}$  (Bischof)

Sat solution of  $\text{PbCl}_2$  in  $\text{HCl} + \text{Aq}$  of 1.116 sp gr contains 2.566%  $\text{PbCl}_2$  at 16.5°

Solubility in  $\text{HCl} + \text{Aq}$  100 pts liquid containing pts  $\text{HCl}$  of 1.1162 sp gr in 100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{PbCl}_2$  at 17.7°

Pts $\text{HCl}$	Pts $\text{PbCl}$	Pts $\text{HCl}$	Pts $\text{PbCl}_2$	Pts $\text{HCl}$	Pts $\text{PbCl}$
1	0.347	8	0.099	50	0.356
2	0.201	9	0.096	60	0.559
3	0.165	10	0.093	70	0.933
4	0.145	15	0.090	80	1.498
5	0.131	20	0.111	90	2.117
6	0.107	30	0.151	100	2.900
7	0.100	40	0.216		

(Bell, Chem Soc 21 350)

Solubility of  $\text{PbCl}_2$  in  $\text{HCl}$ 

Amt HCl in 100 pts $\text{H}_2\text{O}$	Amount $\text{PbCl}_2$ dissolved in 1000 pts of liquid				
	At 0°	At 20	At 40	At 50°	At 80°
0 0	8 0	11 8	17 0	21 0	31 0
5 6	2 8	3 0	4 6	6 5	12 4
10 0	1 2	1 4	3 2	5 5	12 0
18 0	2 4	4 8	7 2	9 8	19 8
21 9	4 7	6 2	10 4	12 9	23 8
31 5	11 9	14 1	19 0	24 0	38 0
46 0	29 8	30 0			

(Ditte, C R 92 718)

Solubility in  $\text{HCl} + \text{Aq}$  at 0°  $\frac{\text{PbCl}_2}{2} = \frac{1}{2} \text{ mols}$  $\text{PbCl}_2$  in mgs in 10 ccm solution,  $\text{HCl} =$   
mols  $\text{HCl}$  in ditto

$\frac{\text{PbCl}_2}{2}$	$\text{HCl}$	$\frac{\text{PbCl}_2}{2}$	$\text{HCl}$
0 42	0	0 072	5 8
0 22	0 35	0 088	11 7
0 135	0 675	0 100	29 5
0 11	1 125	0 209	46 7
0 105	1 6	0 95	73 5
0 099	2 3	1 5	89 0
0 090	3 4	1 9	96 0
0 08	4 5	3 01	111 5

It is seen that very little  $\text{HCl} + \text{Aq}$  is sufficient to diminish solubility very considerably, and, that on further addition of  $\text{HCl} + \text{Aq}$ , the solubility is nearly constant, and increases finally very much when large amts of  $\text{HCl} + \text{Aq}$  are present (Engel, A ch (6) 17 359)

Solubility of  $\text{PbCl}_2$  in  $\text{HCl} + \text{Aq}$  at 25°

G $\text{HCl}$ per l	G $\text{PbCl}_2$ per l	G $\text{HCl}$ per l	C $\text{PbCl}_2$ per l
0	10 79	3	5 0
0 5	9 0	6	3 1
1	7 6	10	1 8
2	6 0		

(Noyes, Z phys Ch 1892, 9 623)

Solubility of  $\text{PbCl}_2$  in  $\text{HCl} + \text{Aq}$  at 25 20°

S = solubility in millimols per litre

$\text{HCl}$ normal	S	$\text{HCl}$ normal	S
0 0000	38 80	0 3714	6 35
0 0009	38 66	0 5142	5 37
0 0022	38 20	0 7386	4 73
0 0030	37 94	1 026	4 41
0 0045	37 35	1 538	4 61
0 0091	35 80	2 051	5 13
0 0114	34 99	2 564	6 25
0 0151	33 75	3 085	7 78
0 0226	31 46	3 718	8 16
0 0302	29 32	5 0	19 38
0 0452	25 46	7 5	65 86
0 0910	17 12	10 0	141 35
0 1850	10 12	12 05	164 3

(von Ende, Z anorg 1901, 26 148)

Solubility of  $\text{PbCl}_2$  in  $\text{HCl}$  at 18°

$\text{HCl}$ Normality	G $\text{PbCl}_2$ per l
0	9 34
0 0001	9 305
0 0002	9 300
0 0005	9 243
0 00102	9 200
0 0102	8 504

(Pleissner, Arb Kais Gesundamt 1907, 26 384)

Sol in hot, insol in cold conc  $\text{H}_2\text{SO}_4$  (Hayes)Sol in dil  $\text{HNO}_3 + \text{Aq}$ , from which it is pptd by  $\text{HCl} + \text{Aq}$  (Gladstone)Easily and completely decomp by hot  $\text{HNO}_3 + \text{Aq}$  (Wurtz)Solubility of  $\text{PbCl}_2$  in  $\text{HNO}_3 + \text{Aq}$  at 25 2°

S = solubility in millimols per litre

$\text{HNO}_3$ normal	S
0 001	38 87
0 01	39 71
0 051	42 92
0 04 $\text{KNO}_3 +$	
0 01 $\text{HNO}_3$	43 36

(von Ende, Z anorg 1901, 26 162)

Solubility of  $\text{PbCl}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at 25 20°

S = solubility in millimols per litre

$\text{NH}_4\text{Cl}$ normal	S
0 25	9 47
0 50	7 11
1 0	4 35

(von Ende, Z anorg 1901, 26 152)

Solubility of  $\text{PbCl}_2 + \text{NH}_4\text{Cl}$  at 22°

G equiv per l $\text{H}_2\text{O}$ $\text{NH}_4\text{Cl}$	G equiv per 100 cc $\text{H}_2\text{O}$ 1 bcl	G equiv per l $\text{H}_2\text{O}$ $\text{NH}_4\text{Cl}$	G equiv per 100 cc $\text{H}_2\text{O}$ $\text{PbCl}_2$
0 0	7 49 x 10 <sup>-3</sup>	1 0	0 758 x 10 <sup>-3</sup>
0 1	3 10	1 2	0 707
0 2	1 916	1 5	0 671
0 3	1 508	2 0	0 695
0 4	1 348	2 5	0 812
0 5	1 263	3 0	0 968
0 55	1 189	4 0	1 502
0 6	1 092	5 0	2 338
0 65	1 012	6 0	3 580
0 7	0 956	7 0	5 628
0 8	0 837	7 29*	6 46
0 9	0 793		

\* Saturated

(Bronsted, Cong Appl Chem 1909, Sec X, 110)

Solubility in $\text{NH}_4\text{Cl} + \text{Aq}$ at $t^\circ$				Much more sol in $\text{HgCl}_2 + \text{Aq}$ than in $\text{H}_2\text{O}$				
$t^\circ$	G $\text{PbCl}_2$ in 100 g of the solution	G $\text{NH}_4\text{Cl}$ in 100 g of the solution	Solid phase	Grammes $\text{HgCl}_2$ in 100 cem	Grammes $\text{PbCl}_2$ dissolved	After subtracting amt dissolved by $\text{H}_2\text{O}$ alone	Calculated no of milliequivalents	
17°	0 89	0 0	$\text{PbCl}_2$	0	0 9712			
	0 21	0 96		4	1 8972	0 9350	23 37	
	0 16	1 43		2	1 4874	0 5208	26 04	
	0 14	2 40		1	1 2272	0 2600	26 00	
	0 076	3 48		0 5	1 0808	0 1134	22 68	
	0 078	4 23	eutectic-pt	0 25	1 0192	0 0500	20 00	
	0 078	4 93		$2\text{PbCl}_2, \text{NH}_4\text{Cl}$	0 125	0 9926	0 0226	18 08
	0 098	12 36						
	0 34	22 33						
	0 64	26 49	eutectic-pt					
	0 52	26 68						
	0 33	26 91	$\text{NH}_4\text{Cl}$					
	0 30	27 03						
	0 0	27 14						
50°	1 69	0 0	$\text{PbCl}_2$					
	1 08	0 51						
	0 67	1 45						
	0 58	2 45						
	0 48	4 86						
	0 49	12 45	eutectic pt					
	0 71	19 42						
	1 76	27 16	$2\text{PbCl}_2, \text{NH}_4\text{Cl}$					
	3 31	31 90						
	3 96	33 56						
	2 65	33 62	eutectic pt					
	1 62	33 88						
	0 32	34 14	$\text{NH}_4\text{Cl}$					
	0 0	34 25						
100°	3 10	0 0	$\text{PbCl}_2$					
	2 02	1 32						
	1 85	5 33						
	1 80	6 01						
	1 76	8 59						
	1 98	13 19	eutectic pt					
	4 54	26 08						
	8 32	32 64	$2\text{PbCl}_2, \text{NH}_4\text{Cl}$					
	11 40	36 29						
	12 67	37 62						
	12 50	38 14	eutectic pt					
	11 60	38 32						
	10 70	38 66	$\text{PbCl}_2, 2\text{NH}_4\text{Cl}$					
	9 88	40 22						
	9 26	41 90						
	4 21	42 91	eutectic pt					
	3 06	43 20						
	1 61	43 42	$\text{NH}_4\text{Cl}$					
	0 0	43 51						
These results show that the double salt $\text{PbCl}_2, 2\text{NH}_4\text{Cl}$ can only exist in aqueous solution at temperature above $70^\circ$ (Demassieux, C R 1913, 156 894)				(Formánek, C C 1887 270) Solubility of $\text{PbCl}_2$ in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at $20^\circ$ G equiv per l				
				$\text{Pb}(\text{NO}_3)_2$	$\text{PbCl}_2$			
				0 0	0 0777			
				0 2	0 0832			
				(Noyes, Z phys Ch 1892, 9 623) Solubility in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at $25^\circ$ C = concentration of $\text{Pb}(\text{NO}_3)_2$ in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ expressed in milliequivalents per l $d_1 = \text{Sp gr of } \text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at $25^\circ$ S = Solubility of $\text{PbCl}_2$ in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ expressed in milliequivalents per l $d_2 = \text{Sp gr } 25^\circ/4^\circ \text{ of } \text{PbCl}_2 + \text{Pb}(\text{NO}_3)_2 + \text{Aq}$				
				C	$d_1$	S	$d_2$	
				20 020	1 0008	76 75	1 0095	
				50 063	1 0045	76 64	1 0139	
				99 660	1 0119	77 98	1 0210	
				(Harkins and Winnifhof, J Am Chem Soc 1911, 33 1816) Solubility of $\text{PbCl}_2$ in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at $25^\circ$ G $\text{Pb}(\text{NO}_3)_2$ per l				
						% $\text{PbCl}_2$		
				0		1 09		
				3 31		1 10		
				6 62		1 05		
				33 12		1 11		
				82 80		1 29		
				(Armstrong and Fyfe, Proc Roy Soc 1913, (A) 88 234) Solubility of $\text{PbCl}_2$ in $\text{KCl} + \text{Aq}$ at $25^\circ$ S = Solubility in millimols per litre				
				KCl normal	S	KCl normal	S	
				0 0000	38 80	0 0999	16 90	
				0 001	38 32	0 5006	7 40	
				0 0025	37 85	0 7018	7 38	
				0 0049	37 02	0 9991	4 90	
				0 0049	37 02	0 9991	4 90	
				0 0099	35 28	1 5018	4 83	
				0 0200	32 16	2 0024	5 56	
				0 0599	22 62	3 0036	9 74	
				(von Ende, Z anorg 1901, 26 151)				

Solubility of  $\text{PbCl}_2 + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $20^\circ$ 

Values = g equivalents

In 1000 g solution		In 1000 g $\text{H}_2\text{O}$		Solid phase
$\text{PbCl}_2$	KCl	$\text{PbCl}_2$	KCl	
		28 0	4 57	$\text{PbCl}_2, \text{KCl}$ $\frac{1}{3}\text{H}_2\text{O} + \text{KCl}$
17 80	3 18	23 42	4 18	$\text{PbCl}_2, \text{KCl}$ $\frac{1}{3}\text{H}_2\text{O}$
16 56	3 05	21 50	3 96	
15 50	2 91	19 85	3 78	
14 76	2 77	18 66	3 50	
13 96	2 66	17 48	3 33	
13 16	2 47	16 17	3 03	
13 08	2 45	16 06	3 01	
12 94	2 40	15 80	2 93	
12 96	2 36	14 92	2 87	
12 86	2 35	15 63	2 86	
12 44	2 30	15 03	2 78	$2\text{PbCl}_2, \text{KCl}$
11 84	2 29	14 30	2 77	
11 38	2 24	13 70	2 70	
10 60	2 20	12 72	2 64	
11 98	2 29	14 35	2 62	
10 46	2 14	12 47	2 55	
10 22	2 10	12 13	2 49	
9 82	2 04	11 60	2 41	
9 34	1 96	10 96	2 31	
8 94	1 88	10 42	2 20	
7 86	1 57	8 92	1 79	$\text{PbCl}_2$
7 72	1 52	8 72	1 74	
7 66	1 40	8 56	1 57	
7 46	1 32	8 29	1 47	
7 36	1 24	8 11	1 34	
7 38	1 23	8 13	1 34	
7 30	1 12	7 98	1 23	
7 34	1 12	8 01	1 22	
7 36	1 05	8 00	1 15	
7 48	1 02	8 10	1 10	
7 52	0 98	8 13	1 06	$\text{PbCl}_2$
7 70	0 93	8 28	1 00	
7 82	0 88	8 38	0 94	
8 24	0 82	8 79	0 85	
8 42	0 78	8 96	0 83	
8 84	0 71	9 36	0 76	
9 54	0 63	10 03	0 67	
10 68	0 57	11 18	0 60	
12 32	0 52	12 85	0 54	
12 38	0 50	12 88	0 52	$\text{PbCl}_2$
12 36	0 48	12 85	0 50	
12 56	0 47	13 04	0 49	
12 48	0 45	12 95	0 47	
12 24	0 37	13 65	0 38	
14 52	0 29	14 88	0 30	
19 00	0 19	19 33	0 19	

(Bronsted, Z phys Ch 1912, 80 208)

$\text{PbCl}_2$  is sol in 120 pts pure  $\text{H}_2\text{O}$ , but on adding 5%  $\text{NaCl}$  437 pts are required to effect solution. When  $\text{PbCl}_2$  is digested with conc  $\text{NaCl} + \text{Aq}$ , 1 pt dissolves in 129 pts of the liquid

A study of the equilibrium between lead chloride and sodium chloride in aqueous solution at  $13^\circ$ ,  $50^\circ$  and  $100^\circ$  shows that at none of these temp do these chlorides form a double salt (Demasseux, C R 1914, 158 702)

Solubility in salts + Aq at  $25^\circ$ 

Salt used	Concentration of the salt Equivalents per liter	Solubility of $\text{PbCl}_2$ Equivalents per liter
None	0	0 07770
HCl	0 05	0 04786
"	0 1	0 03243
"	0 2	0 01927
KCl	0 05	0 0482
"	0 1	0 0341
"	0 2	0 0219
$\text{MgCl}_2$	0 05	0 0503
"	0 1	0 0350
$\text{CaCl}_2$	0 05	0 0503
"	0 1	0 0355
"	0 2	0 0219
$\text{MnCl}_2$	0 05	0 0501
"	0 1	0 0349
"	0 2	0 0217
$\text{ZnCl}_2$	0 2	0 0220
$\text{CdCl}_2$	0 05	0 0601
"	0 1	0 0481
"	0 2	0 0355

(Noyes, Z phys Ch 1892, 9 623)

Sol in  $\text{KOH} + \text{Aq}$  (Rose)

Less sol in dil salt solutions than in  $\text{H}_2\text{O}$ , especially  $\text{CaCl}_2 + \text{Aq}$ , sol in 534 pts  $\text{H}_2\text{O}$  containing  $\text{CaCl}_2$  (Bischof)

More sol in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  than in  $\text{H}_2\text{O}$ , but not as sol as  $\text{AgCl}$  (Herschell, 1819)

More sol in  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Anthon)

Easily sol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ 

Sl sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Insol in conc alcohol (Wittstein) Insol in 94% alcohol, very sl sol in cold or hot 76% alcohol

Solubility in alcohol at  $25^\circ$ 

Alcohol = g mol alcohol in 1 l of solvent

 $\text{PbCl}_2$  = g mol  $\text{PbCl}_2$  in 1 l of solution

Alcohol	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$
$\text{PbCl}_2$	0 0172	0 0257	0 0298	0 0330	0 0338

Alcohol	$\frac{1}{8}$	0
$\text{PbCl}_2$	0 0367	0 0388

(Kernot and Pomilio, Soc R Napoli, (3) 17 353)

Insol in benzene (Franchimont, B 16 387)

Insol in  $\text{CS}_2$  (Arcetowski, Z anorg 1894, 6 257)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Insol in methyl acetate (Naumann, B

1909, **42** 3790), ethyl acetate (Naumann, B 1910, **43** 314)

Insol in methylal (Eidmann, C C **1899**, II, 1014)

Insol in acetone (Naumann, B 1904, **37** 4329)

Glycerine dissolves 1 995%  $\text{PbCl}_2$   
1 pt glycerine+1 pt  $\text{H}_2\text{O}$  dissolves 1 32%

$\text{PbCl}_2$   
1 pt glycerine+3 pts  $\text{H}_2\text{O}$  dissolves 1 0365%

$\text{PbCl}_2$   
Glycerine containing 87 5%  $\text{H}_2\text{O}$  dissolves 0 91%  $\text{PbCl}_2$  (Piesse, B **7** 599)

Solubility of  $\text{PbCl}_2$  in mannite+Aq at 25°  
Mannite=g mol mannite in 1 l of solvent

$\text{PbCl}_2$ =g mol  $\text{PbCl}_2$  in 1 l of solution  
Mannite  $\frac{1}{2}$   $\frac{1}{4}$   $\frac{1}{8}$   $\frac{1}{16}$   $\frac{1}{32}$

$\text{PbCl}_2$  0 0408 0 0403 0 0394 0 0384 0 0385

Mannite  $\frac{1}{64}$  0

$\text{PbCl}_2$  0 0377 0 0388

(Kernot and Pomilio, Soc R Napoli, (3) **17** 353)

Min *Cotunnite*

**Lead tetrachloride**,  $\text{PbCl}_4$

Sol in  $\text{H}_2\text{O}$  with subsequent decomp (Rivot, Beudant, and Dagun, Ann Min (**5**) **4** 239)

Obtained in a pure state by Friedrich Sol in a little cold  $\text{H}_2\text{O}$ , but is decomp by warming or diluting Miscible with conc  $\text{HCl}$ +Aq, not attacked by conc  $\text{H}_2\text{SO}_4$  even on warming (Friedrich, W A B **102**, 2b 534)

**Lead tetrachloride with MCl**

See Chloroplumbate, M

**Lead magnesium chloride**,  $\text{PbCl}_2$ ,  $2\text{MgCl}_2$ +  
 $13\text{H}_2\text{O}$

Deliquescent Decomp by  $\text{H}_2\text{O}$  (Otto and Drewes, Arch Pharm **228** 495)

**Lead potassium chloride** (potassium chloroplumbite),  $\text{PbCl}_2$ , KCl

(Remsen and Herty, Am Ch J **14** 125)

Contains  $\frac{1}{3}$   $\text{H}_2\text{O}$  (Wells, Sill Am J **145** 130)

See also Demassieux,  $\text{PbCl}_2$ +KCl under  $\text{PbCl}_2$

$2\text{PbCl}_2$ , KCl (Wells)

See also Demassieux as above

**Lead rhodium chloride**

See Chlororhodite, lead

**Lead rubidium chloride**,  $\text{PbCl}_2$ ,  $2\text{RbCl}$ +  
 $\frac{1}{2}\text{H}_2\text{O}$

(Wells, Sill Am J **146** 34)

$2\text{PbCl}_2$ , RbCl (Wells)

**Lead sodium chloride**

Decomp by  $\text{H}_2\text{O}$

**Lead sodium tetrachloride**,  $2\text{PbCl}_4$ ,  $9\text{NaCl}$

Very sol in  $\text{H}_2\text{O}$  (Sobrero and Selmi, A ch (**3**) **29** 165)

See also Chloroplumbate, lead

**Lead thalious chloride**,  $\text{PbCl}_2$ ,  $3\text{TlCl}$

Sl sol in cold, more in hot  $\text{H}_2\text{O}$  (Noyes, Z phys Ch **9** 622)

$\text{PbCl}_2$ ,  $\text{TlCl}$  Ppt (Ephraim, Z anorg **1909**, **61** 245)

**Lead chloride ammonia**,  $2\text{PbCl}_2$ ,  $3\text{NH}_3$

(Rose, Pogg **20** 157)

**Lead tetrachloride ammonia**,  $\text{PbCl}_4$ ,  $4\text{NH}_3$

Pptd from chloroform solution (Matthews, J Am Chem Soc **1898**, **20** 825)

$\text{PbCl}_4$ ,  $2\text{NH}_3$  Fumes in the air Decomp by  $\text{H}_2\text{O}$  (Matthews)

**Lead chloride arsenate**,  $3\text{Pb}_3(\text{AsO}_4)_2$ ,  $\text{PbCl}_2$

See Arsenate chloride, lead

**Lead chloride borate**,  $\text{Pb}(\text{BO}_2)_2$ ,  $\text{PbCl}_2$ +  
 $\text{H}_2\text{O}$

See Borate chloride, lead

**Lead chloride carbonate**

See Carbonate chloride, lead

**Lead chloride chlorite**

See Chlorite chloride, lead

**Lead chloride with fluoride and iodide**

See Lead chlorofluoride and Lead chloroiodide

**Lead chloride phosphate**

See Phosphate chloride, lead

**Lead chloride phosphite**,  $\text{PbCl}_2$ ,  $\text{Pb P}_2\text{O}_5(?)$

Ppt (Berzelius)

Does not exist (Rose)

**Lead chloride sulphate**

See Sulphate chloride, lead

**Lead chloride sulphide**,  $\text{PbCl}$ ,  $3\text{PbS}$

See Lead chlorosulphide

**Lead chlorofluoride**,  $\text{PbClF}$

Sl sol in  $\text{H}_2\text{O}$  without decomp Easily sol in  $\text{HNO}_3$ +Aq (Berzelius)

Solubility in  $\text{H}_2\text{O}$

100 g  $\text{H}_2\text{O}$  dissolve 0 0211 g  $\text{PbClF}$  at 0°, 0 0370 g at 25°, 0 1081 g at 100° (Starck, Z anorg Ch **1911**, **70** 174)

Solubility in  $\text{HCl}$ +Aq at 25°

Solution of  $\text{PbClF}$  in  $\text{HCl}$ +Aq containing 0 0535 g equiv per l contains 0 0758 g  $\text{PbClF}$  in 100 cc of solvent

Solution of  $\text{PbClF}$  in  $\text{HCl}$ +Aq containing

0.1069 g equiv per l contains 0.1006 g PbClF in 100 cc of solvent (Starck)

Solubility in acetic acid at 25°

Solution of PbClF in  $\text{HC}_2\text{H}_3\text{O}_2$  containing 0.0518 g equiv per l contains 0.05129 g PbClF in 100 cc of solvent

Solution of PbClF in  $\text{HC}_2\text{H}_3\text{O}_2$  containing 0.1055 g equiv per l contains 0.0561 g PbClF in 100 cc of solvent (Starck)

#### Solubility in $\text{PbCl}_2 + \text{Aq}$

t°	G equiv per l $\text{PbCl}_2$	G PbClF in 100 cc of solvent
18°	0.0100	0.0020
"	0.0195	0.0016
"	0.0495	0.0002
25°	0.00996	0.0030
"	0.0196	0.0008
"	0.0392	0.0005

(Starck)

#### Lead chloriodide, $2\text{PbCl}_2, \text{PbI}_2$

Sol in hot  $\text{NH}_4\text{Cl} + \text{Aq}$  (Poggiale, J pr 35 329)

$\text{PbCl}_2, \text{PbI}_2$  Sol in hot  $\text{HCl} + \text{Aq}$  (Engelhardt)

Sol in  $\text{H}_2\text{O}$  (Thomas, C R 1898, 126 1351)

#### Lead chloroselenide

Decomp by boiling  $\text{H}_2\text{O}$  and by conc  $\text{KOH} + \text{Aq}$  (Fonze-Diacon, C R 1900, 130 1133)

#### Lead chlorosulphide, $\text{PbCl}_2, 3\text{PbS}$

Partially decomp by hot  $\text{H}_2\text{O}$  Not attacked by dil, but decomp by conc  $\text{HCl} + \text{Aq}$  (Hunsfeld, J pr 7 27)

$\text{PbS}, \text{PbCl}$  Decomp by  $\text{H}_2\text{O}$ , acids, or alkalies (Purmentier, C R 114 298)

$\text{ClPbS}_2, \text{PbS}_2, \text{PbS}, \text{PbCl}$  Ppt (Hofmann, B 1904, 37 250)

#### Lead fluoride, $\text{PbF}_2$

Very sl sol in  $\text{H}_2\text{O}$ , and not more in  $\text{HIF} + \text{Aq}$  (Berzelius, Pogg 1 31)

5.5 millimols are sol in 1000 ccm  $\text{H}_2\text{O}$  (Jacquet, Z anorg 1901, 27 35)

1 l  $\text{H}_2\text{O}$  dissolves 640 mg at 18° (Kohlrausch, Z phys Ch 1901, 50 356)

641 mg in 1 l of sat solution at 18° (Kohlrausch, Z phys Ch 1908, 64 168)

More sol in  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$  Sl sol in  $\text{Kl} + \text{Aq}$  (Herty, Am Ch J 14 107)

Sl sol in dil  $\text{Hl} + \text{Aq}$ , insol in strong  $\text{HF} + \text{Aq}$

0.0150 g atoms Pb are sol in 1000 cc  $\text{Hl}$  (Jacquet, Z anorg 1901, 27 37)

Insol in liquid  $\text{Hl}$  (Franklin, Z anorg 1905, 46 2)

Insol in liquid  $\text{NH}_3$  (Gore, Am J Ch 1893, 20 828)

Insol in ethylacetate (Naumann, B 1910, 43 314)

Insol in acetone (Naumann, B 1904, 37 4329)

#### Lead potassium fluoride, $3\text{KF}, \text{HF}, \text{PbF}_4$

Decomp  $\text{H}_2\text{O}$ , stable in dry air (Brauner, Z anorg 1894, 7 7)

#### Lead silicon fluoride

See Fluosilicate, lead

#### Lead tantalum fluoride

See Fluotantalate, lead

#### Lead titanium fluoride

See Fluotitanate, lead

#### Lead fluoride sulphate

See Sulphate fluoride, lead

#### Lead hydroxide, $\text{PbO}_2\text{H}_2$

Not appreciably sol in  $\text{H}_2\text{O}$  (Jaeger, Z anorg 1901, 27 38)

1 l  $\text{H}_2\text{O}$  dissolves 0.155 g  $\text{PbO}_2\text{H}_2$  at 20° and 100° (Sehnal, C R 1909, 148 1396)

#### Solubility in $\text{NaOH} + \text{Aq}$

G Na in 20 ccm	G Pb in 20 ccm
0.2024	0.1012
0.3196	0.1736
0.5866	0.3532
0.9476	0.4071
1.7802	0.5170

(Rubenbauer, Z anorg 1902, 30 336)

#### Solubility of $\text{PbO}_2\text{H}_2$ in $\text{NaOH} + \text{Aq}$ at 25°

G mol per l		Solid Phase
Na	Pb	
0.274	0.0181	$\text{PbO}_2\text{H}_2$
0.431	0.287	"
0.476	0.319	"
0.745	0.489	"
1.132	0.711	"
1.519	0.101	"

(Wood, Chem Soc 1910, 97 884)

Insol in acetone (Naumann, B 1904, 37 4329)

$2\text{PbO}, \text{PbO}_2\text{H}_2 = 3\text{PbO}, \text{H}_2\text{O}$  Sol in 10,000 to 12,000 pts  $\text{H}_2\text{O}$  (Yorke) Sol in 7000 pts  $\text{H}_2\text{O}$  (v Bonsdorff, Pogg 41 307)

0.45 millimol Pb are sol in 1 liter  $\text{H}_2\text{O}$  at 18° (Pleissner, C C 1907, II 1056)

Sol in acids Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in  $\text{NaOH}$ , or  $\text{KOH} + \text{Aq}$  Sol in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ , and reprecip by  $\text{NH}_4\text{OH} + \text{Aq}$

Solubility in  $\text{KOH} + \text{Aq}$ , according to Ditte (C R 94 130) When  $\text{KOH} + \text{Aq}$  is gradu-



ally added to lead hydroxide suspended in  $H_2O$ , the lead hydroxide is at first dissolved proportional to the amount of KOH, until the strength reaches 200 g KOH to 1 litre  $H_2O$ . The solubility then diminishes and increases again until 400 g KOH are dissolved in 1 litre  $H_2O$ . The amorphous lead hydroxide is then converted into crystalline  $2PbO(PbO_2H_2)$ . By further addition of KOH the solubility is suddenly decreased, and then increases again (Ditte)

Sol in triethyl toluenyl ammonium hydroxide + Aq

Sol in sorbine + Aq (Pelouze)

Sol in acetates + Aq (Mercer)

Sol in Ca, Ba, Sr, K, or Na succinate + Aq

Not pptd in presence of Na citrate + Aq (Spiller)

See also under Lead, and Lead oxide

### Lead perhydroxide, $PbO_2, H_2O$

See Lead peroxide

### Lead imide, $PbNH$

Decomp by  $H_2O$  and dilute acids (Franklin, Z anorg 1905, 46 27)

### Lead iodide, $PbI_2$

Sol in 187 pts boiling  $H_2O$  (Berthelot)

Sol in 1235 pts  $H_2O$  at ord temp, and 194 pts at  $100^\circ$  (Denot, J pr 1 425)

Sol in 2400 pts  $H_2O$  at  $18.75^\circ$  (Abl)

Sat  $PbI_2$  + Aq at  $20^\circ$  contains 0.0017 pt, at  $27^\circ$ , 0.002 pt, at  $100^\circ$ , 0.0039 pt  $PbI_2$  (Lassaigne, J chim med 7 364)

11  $H_2O$  dissolves 0.6 g  $PbI_2$  at  $10^\circ$  (Ditte, C R 92 718)

1.1  $H_2O$  dissolves 1.58 millimols  $PbI_2$  at  $25.2^\circ$  (Von Ende, Z anorg 1901, 26 159)

$0.47 \times 10^{-1}$  gram are dissolved in 1 litre of sat solution at  $20^\circ$  (Bottger, Z phys Ch 1903, 46 603)

Solubility in 100 g  $H_2O$  at  $t^\circ$

$t^\circ$	G $PbI$
0	0.0442
15	0.0613
25	0.0764
35	0.1042
45	0.1453
55	0.1755
65	0.2183
80	0.3023
95	0.3960
* 100	0.4360

\* By extrapolation

(Lichty, J Am Chem Soc 1903, 25 474)

0.0013 g mol  $PbI_2$  are dissolved in 1.1  $H_2O$  at  $20^\circ$  (Fedotieff, Z anorg 1911, 73 178)

Not more sol in  $HC_2H_3O_2$  + Aq than in  $H_2O$ , contrary to Henry (Denot, l c)

Pptd from aqueous solution by little HI + Aq, but redissolved by the addition of more (Ditte, C R 92 718)

Insol in cold, sol in hot HCl + Aq with decomp

Solubility of  $PbI_2$  in  $HNO_3$  + Aq at  $25.2^\circ$

S = Solubility in millimols per litre

$HNO_3$ normal	S
0.001	38.87
0.01	39.06
0.051	39.45
0.04 $KNO_3$ +	
0.01 $HNO_3$	39.45

(von Ende, Z anorg 1901, 26 162)

Sol in KOH + Aq

Sol in conc KI, NaI,  $BaI_2$ ,  $SrI_2$ ,  $CaI_2$ , and  $MgI_2$  + Aq, from which it is pptd by  $H_2O$  (Berthelot)

Very sol in KI + Aq, 2 mols  $PbI_2$  being dissolved for 1 mol KI (Boullay)

Sol in  $NH_4I$  + Aq. Easily sol in  $Na_2S_2O_3$  + Aq (Werner, C N 53 51)

Not pptd in presence of Na citrate (Spiller)

Solubility in sat  $I_2$  + Aq at  $20^\circ = 0.00216$  g mol per l. Solid phase  $PbI_2 + I_2$  (Fedotieff Z anorg 1911, 73 178)

Very easily sol in liquid  $NH_3$  (Franklin Am Ch J 1898, 20 828)

Sl sol in alcohol (Henry) Decomp by boiling ether (Vogel)

100 g formic acid dissolve 0.25 g at  $19.5^\circ$  (Aschan, Ch Ztg 1913, 37 1117)

Insol in  $CS_2$  (Arcetowski, Z anorg 1894 6 257)

Sl sol in benzonitrile (Naumann, B 1914, 47 1369)

Difficultly sol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Insol in acetone (Naumann, B 1904 37 4329)

0.02 pts are sol in 100 pts acetone at  $59^\circ$

0.02 pts are sol in 100 pts amyl alcohol at  $133.5^\circ$

0.50 pts are sol in 100 pts aniline at  $13^\circ$

1.10 pts are sol in 100 pts aniline at  $154^\circ$  (Laszczyński, B 1894, 27 2287)

Solubility of  $\text{PbI}_2$  in pyridine at  $t^\circ$ 

$t^\circ$	G $\text{PbI}_2$ per 100 g pyridine	Solid phase
-37	0 166	$\text{PbI}_2, \text{C}_5\text{H}_5\text{N}$
-20	0 175	"
-9	0 186	"
0	0 200	"
+3	0 215	"
6	0 225	"
15	0 208	$\text{PbI}_2, \text{C}_5\text{H}_5\text{N} + \text{PbI}_2, 2\text{C}_5\text{H}_5\text{N}$
35	0 188	$\text{PbI}_2, 2\text{C}_5\text{H}_5\text{N}$
57	0 190	"
77	0 228	"
92	0 290	"
98	0 340	"
105	0 370	"
108	0 410	"
112	0 445	"

(Heise, J phys Ch 1912, 16, 273)

**Lead hydrogen iodide,  $\text{PbH}_2\text{I}_2 = \text{PbI}_2, 2\text{HI}$** Cold  $\text{H}_2\text{O}$  dissolves out  $\text{HI}$  Sol in hot  $\text{H}_2\text{O}$ , from which crystallizes  $\text{PbI}_2$  (Guyot, J chim med 12 247) $+10\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Berthelot, C R 91 1024)**Lead lithium iodide,  $\text{PbI}, \text{LiI} + 5\text{H}_2\text{O}$** Loses 1 mol  $\text{H}_2\text{O}$  at  $95^\circ$  and loses another mol  $\text{H}_2\text{O}$  at  $100^\circ$  (Bogorodski, C C 1894, II 515) $\text{PbI}_2, 2\text{LiI} + 6\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Mosnier, C R 1895, 120 446)**Lead magnesium iodide,  $\text{PbI}_2, 2\text{MgI}_2$** Decomp by  $\text{H}_2\text{O}$  and by alcohol (Mosnier, A ch 1897, (7) 12 402) $+16\text{H}_2\text{O}$  Very hygroscopic Decomp immediately by  $\text{H}_2\text{O}$  (Otto and Drewes, Arch Pharm 229 180)**Lead nickel iodide,  $\text{PbNi}_2\text{I}_6 + 3\text{H}_2\text{O}$** Decomp by  $\text{H}_2\text{O}$  (Mosnier, A ch 1897, (7) 12 411)**Lead potassium iodide (Potassium iodoplumbite),  $\text{PbI}_2, \text{KI}$** Permanent Completely decomp by  $\text{H}_2\text{O}$  Unacted upon by cold, but completely decomp by hot alcohol (Boullay, A ch (2) 34 366) $+2\text{H}_2\text{O}$  The only salt that could be obtained by Remsen and Herty (Am Ch J 14 110) $\text{PbI}_2, 2\text{KI}$  Sl sol in boiling chloroform, easily sol in strong  $\text{KI} + \text{Aq}$ , insol in alcohol (Brooks, C N 1898, 77 191) $+2\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Berthelot, A ch (5) 29 289)

Does not exist (R and H)

 $+4\text{H}_2\text{O}$  (Ditte, C R 92 134) Does not exist (R and H) $\text{PbI}_2, 4\text{KI}$  Decomp by  $\text{H}_2\text{O}$ , insol in alcohol (Boullay) Does not exist (R and H) $3\text{PbI}_2, 4\text{KI} + 6\text{H}_2\text{O}$  (Berthelot, l c) Does not exist (R and H)**Lead potassium periodide,  $\text{K}_3\text{Pb}_2\text{I}_8 + 4\text{H}_2\text{O}$** Decomp by  $\text{H}_2\text{O}$  or alcohol (Wells, Z anorg 4 346)**Lead rubidium iodide,  $\text{PbI}_2, \text{RbI} + 2\text{H}_2\text{O}$** 

(Wells, Sil Am J 146 34)

**Lead silver iodide,  $\text{PbI}_2, 2\text{AgI}$** 

(Ruff and Geisel, B 1905, 38 2663)

**Lead silver iodide ammonia,  $\text{PbI}_2, 2\text{AgI}, 5\text{NH}_3$** 

(Ruff and Geisel, B 1905, 38 2663)

**Lead sodium iodide,  $\text{PbI}_2, \text{NaI}$** Decomp by  $\text{H}_2\text{O}$  (Poggiale, C R 20 1180) $+x\text{H}_2\text{O}$  (Remsen and Herty, Am Ch J 14 124) $\text{PbI}_2, 2\text{NaI} + 6\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Moissner, C R 1895, 120 445)**Lead iodide ammonia,  $\text{PbI}_2, 2\text{NH}_3$** Decomp by  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 48 166)**Lead iodide carbonate**

See Carbonate iodide, lead

**Lead iodosulphide,  $\text{PbS}, 4\text{PbI}_2$** Decomp by light, heat, acids and alkalies (Lenher, J Am Chem Soc 1895, 17 512) Sol in conc  $\text{HI}$ , insol in dil  $\text{HI} + \text{Aq}$  (Lenher, J Am Chem Soc 1901, 23 681)  $\text{IPbS}_2\text{PbS}_2\text{PbI}$  Ppt (Hofmann, B 1904, 37 251)**Lead suboxide,  $\text{Pb}_2\text{O}$** Decomp by  $\text{H}_2\text{O}$  into  $\text{PbO}_2\text{H}_2$ Decomp by dil  $\text{H}_2\text{SO}_4, \text{HCl}, \text{HNO}_3, \text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , or alkalies, into  $\text{PbO}$ , which dissolves, and  $\text{Pb}$ , which dissolves or not, according to the reagent Sol in dil  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ **Lead monoxide (Litharge),  $\text{PbO}$** Sol in 7000 pts  $\text{H}_2\text{O}$  (Horsford)Pure  $\text{PbO}$  is insol in  $\text{H}_2\text{O}$  (Brandecke, Report 53 155, Siebold, Repert, 53 174, Herbergen, Repert 55 55) Sl sol in  $\text{H}_2\text{O}$  (York, Phil Mag (3) 5 82)0.31 millmoles  $\text{Pb}$  are dissolved in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$  (Pleissner, C C 1907, II 1056)1.71  $\times 10^{-2}$  g are dissolved in 1 litre of sat solution at  $20^\circ$  (Bottger, Z phys Ch 1903, 46 603)

Easily sol in acids

Sol in KOH, or NaOH + Aq, also in  $\text{CaO} \cdot \text{H} + \text{Aq}$

Sol in boiling  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  with pptn of Aq

Sol in  $\text{CaCl}_2$ , and  $\text{SrCl}_2 + \text{Aq}$  (André, C R 104 359)

Sol in  $\text{MgCl}_2 + \text{Aq}$  (Voigt, Ch Ztg 13 695)

Sol in boiling  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  with pptn of  $\text{CaO}$

Partially sol in  $\text{Cd}(\text{NO}_3)_2$ , and  $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$  with pptn of  $\text{CdO}$  and  $\text{MnO}$  respectively

Not acted upon by Mg, Ag, Co, Ni, or Ce nitrates + Aq (Persoz)

Very sol in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  (Rochleder)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Insol in acetone (Eidmann, C C 1899, II, 1014)

When finely pulverised, sol in cane sugar + Aq, but less than  $\text{Pb}_3\text{O}_4$  (Peschier)

Sol in glycerine. Readily sol in glucose + Aq (Persoz)

Sol in volatile oils (Schweitzer)

*Yellow modification*

Solubility in  $\text{H}_2\text{O}$  at 22°

	Solubility in g equiv per litre
1 Yellow $\text{PbO}$ , obtained by boiling lead hydroxide with 10% NaOH	$1.03 \times 10^{-4}$
2 Yellow $\text{PbO}$ , obtained by heating 1 at 630°	$1.05 \times 10^{-4}$
3 Yellow $\text{PbO}$ , obtained by heating at 740° red $\text{PbO}$ , formed by boiling lead hydroxide with conc NaOH	$1.00 \times 10^{-4}$
4 Yellow $\text{PbO}$ obtained by heating pure, commercial, yellow-brown $\text{PbO}$ at 620°	$1.09 \times 10^{-4}$

(Ruef, Z anorg 1906, 50 273)

*Red modification* Obtained by boiling lead hydroxide with conc NaOH + Aq

Solubility in  $\text{H}_2\text{O}$  at 22 =  $0.06 \times 10^{-4}$  g equiv per l (Ruef, Z anorg 1906 50 273)

*Yellow brown modification* Solubility in  $\text{H}_2\text{O}$  at 22 =  $1.10 \times 10^{-4}$  g equiv per litre (Ruef, Z anorg 1906, 50 273)

See also Lead

Min Mat coal

**Lead oxide (Red lead),  $\text{Pb}_3\text{O}_4$**

Insol in  $\text{H}_2\text{O}$

Converted by acids into  $\text{PbO}$  and salts of monoxide

Sol in a large amt of glacial acetic acid (Berzelius). Insol in acetic acid (Schonbein, J pr 74 325)

Solution in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  may decompose or not according to concentration of acid. When treated with an excess of  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  of 8° B,  $\text{Pb}_3\text{O}_4$  is quickly dissolved, but the solution soon deposits  $\text{PbO}_2$ , this decomposition is facilitated by dilution. But if  $\text{Pb}_3\text{O}_4$  is treated with a large excess of glacial  $\text{HC}_2\text{H}_3\text{O}_2$ , it dissolves, and the solution is permanent if atmospheric air is excluded, and temp does not rise above 40° (Jacquelin, J pr 53 152)

Insol in acetone (Eidmann, C C 1899, II, 1014, Naumann, B 1904, 37 4329)

Easily sol in cane sugar + Aq (Peschier) Min *Minimum*

**Lead sesquioxide,  $\text{Pb}_2\text{O}_3$**

Insol in  $\text{H}_2\text{O}$  or in KOH + Aq

Decomp by strong acids into  $\text{PbO}_2$  and corresponding salt of monoxide

**Lead peroxide,  $\text{PbO}_2$**

Insol in  $\text{H}_2\text{O}$ . Sol in acids, also in conc alkali hydroxides + Aq. The solutions in acids are very unstable, except when concentrated and kept at a low temperature.

Decomp by cold HCl, HCN, HBr, and HI + Aq. Not attacked by other acids when cold, but decomp thereby when hot. Insol in moderately conc  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ .

There are two forms of  $\text{PbO}$ , the amorphous and the crystalline.

1 l of very conc  $\text{H}_2\text{SO}_4$  dissolves 10 millimols crystalline  $\text{PbO}$ .

Solubility of amorphous  $\text{PbO}$  in  $\text{H}_2\text{SO}_4 + \text{Ac}$  at 22°

99.5 millimols  $\text{PbO}$  are dissolved in 1 l of acid containing 1720 g  $\text{H}_2\text{SO}_4$ .

4 millimols  $\text{PbO}$  are dissolved in 1 l of acid containing 1097 g  $\text{H}_2\text{SO}_4$ .

$x$  = mols  $\text{H}_2\text{SO}_4$  per mole of  $\text{H}_2\text{O}$

$c$  = millimols  $\text{PbO}$  dissolved in 1 litre

$x$	$c$	$x$	$c$
0.32	0.82	0.20	$8 \times 10^{-4}$
0.30	0.4	0.15	$5 \times 10^{-4}$
0.25	7.10	0.10	$1 \times 10^{-4}$

(Dolezale and Fenech, Z anorg 1906 51 25, 5)

Decomp by  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol in conc KOH, or NaOH + Aq.

Sol with decomp in  $\text{H}_2(\text{NO}_3)_2 + \text{Aq}$  (Evoll)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904 37 2913)

Min *Plattnerite*

**Lead manganese peroxide,  $\text{PbO}$ ,  $4\text{MnO}$**

Ppt (Gibbs and Parkmann, Sill Am J (2) 39 58)

**Lead oxybromide,  $\text{PbBr}_2$ ,  $\text{PbO}$** 

Insol in  $\text{H}_2\text{O}$   
 +1,  $1\frac{1}{2}$ , and  $3\text{H}_2\text{O}$  (André, C R 96 1502)  
 $6\text{PbO}$ ,  $\text{PbBr}_2 + 2\text{H}_2\text{O}$  Ppt (Stromholm, Z anorg 1904, 38 436)

**Lead oxychloride,  $2\text{PbCl}_2$ ,  $\text{PbO} + 2\text{H}_2\text{O}$** 

(André, C R 96 435)  
 $\text{PbCl}_2$ ,  $\text{PbO}$  Absolutely insol in hot or cold  $\text{H}_2\text{O}$  (André, A ch (6) 3 108)  
 Min *Matlockite*  
 +  $\text{H}_2\text{O}$  Sol in hot  $\text{NaOH} + \text{Aq}$  (André) 0.38 millimols Pb are dissolved in 1 litre  $\text{H}_2\text{O}$  at  $18^\circ$  (Pleissner, C C 1907, II 1055)  
 $\text{PbCl}_2$ ,  $2\text{PbO}$  Insol in  $\text{H}_2\text{O}$  Sol in dil  $\text{KOH} + \text{Aq}$  (about 110 g in 1 l) (Ditte, C R 94. 1180)  
 Min *Mendipite* Easily sol in  $\text{HNO}_3 + \text{Aq}$  +  $2\text{H}_2\text{O}$  (André, A ch (6) 3 111)  
 $\text{PbCl}_2$ ,  $3\text{PbO}$  Insol in  $\text{H}_2\text{O}$  (Dober-einer)  
 +  $\frac{1}{2}\text{H}_2\text{O}$  Ppt (Stromholm, Z anorg 1904, 38 435)  
 +  $2\text{H}_2\text{O}$  0.10 millimols Pb are dissolved in 1 litre  $\text{H}_2\text{O}$  at  $18^\circ$  (Pleissner, C C 1907, II 1056)  
 +  $3\text{H}_2\text{O}$  Ppt (André, C R 104 359)  
 +  $4\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$  Sl sol in  $\text{NaOH} + \text{Aq}$  (Vauquehn)  
 $\text{PbCl}_2$ ,  $5\text{PbO}$  (Dober-einer)  
 $6\text{PbO}$ ,  $\text{PbCl}_2 + 2\text{H}_2\text{O}$  Ppt (Stromholm, Z anorg 1904, 38 434)  
 $\text{PbCl}_2$ ,  $7\text{PbO}$  Cassel-yellow

**Lead strontium oxychloride,  $2\text{PbO}$ ,  $\text{SrCl}_2 + 5\text{H}_2\text{O}$** 

(André, C R 104 359)

**Lead oxychloride, iodide,  $\text{PbCl}_2$ ,  $\text{PbI}_2$ ,  $4\text{PbO}$** 

Min *Schwarzenbergite* Sol in dil  $\text{HNO}_3 + \text{Aq}$

**Lead oxyiodide,  $\text{PbI}_2$ ,  $\text{PbO}$** 

Insol in boiling  $\text{H}_2\text{O}$  or  $\text{KI} + \text{Aq}$  (Brandes, A 10 269)  
 +  $\frac{1}{2}\text{H}_2\text{O}$  (Ditte, C R 92 145)  
 +  $\text{H}_2\text{O}$   
 $\text{PbI}_2$ ,  $2\text{PbO}$  Insol in  $\text{H}_2\text{O}$  (Denot, J Pharm 20 1)  
 +  $\text{H}_2\text{O}$   
 $\text{PbI}_2$ ,  $3\text{PbO} + 2\text{H}_2\text{O}$  Ppt (Kuhn, C C 1847 593)  
 $\text{PbI}_2$ ,  $5\text{PbO}$  Insol in  $\text{H}_2\text{O}$  (Denot)  
 +  $7\text{H}_2\text{O}$  (Ditte, C R 92 145)  
 $6\text{PbO}$ ,  $\text{PbI}_2 + 2\text{H}_2\text{O}$  Ppt (Stromholm, Z anorg 1904, 38 437)  
 $9\text{PbO}$ ,  $\text{PbI}_2 + 2\text{H}_2\text{O}$  (Stromholm, Z anorg 1904, 38 437)

**Lead oxyperiodide,  $\text{PbO}$ ,  $\text{PbI}_2\text{I}_3$** 

Decomp by boiling  $\text{H}_2\text{O}$  Sol in dil  $\text{HCl}_2\text{H}_2\text{O}_2 + \text{Aq}$  (Groger, W A B 100, 2b 415)

**Lead phosphide,  $\text{PbP}_2$** 

Decomp by  $\text{H}_2\text{O}$  and dil acid. (Bassett, C R 1913, 157 721)

**Lead phosphoselenide,  $\text{Pb}_2\text{P}_2\text{Se}_2$** 

Insol in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$  Sol in  $\text{HNO}_3 + \text{Aq}$   
 Insol in cold, slowly decomp by hot alkalis +  $\text{Aq}$  (Hahn, J pr 2 93 430)  
 $2\text{PbSe}$ ,  $\text{P}_2\text{Se}_2$  Insol in  $\text{H}_2\text{O}$   $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  Slowly sol in red fuming  $\text{HNO}_3$  (Hahn)  
 $2\text{PbSe}$ ,  $\text{P}_2\text{Se}_2$  Decomp by fuming  $\text{HNO}_3$  (Hahn)

**Lead selenide,  $\text{PbSe}$** 

Cold  $\text{HNO}_3 + \text{Aq}$  dissolves Pb with separation of Se, which dissolves on warming (Lattle, A 112 212)  
 Min *Clausthalite* Sol in  $\text{HNO}_3 + \text{Aq}$  with separation of Se, when warmed

**Lead mercury selenide,  $(\text{Pb Hg})_2\text{Se}$** 

Min *Lehrbachite*

**Lead sulphide,  $\text{PbS}$** 

Very sl sol in  $\text{H}_2\text{O}$   
 1 l  $\text{H}_2\text{O}$  dissolves  $3.6 \times 10^{-4}$  mols  $\text{PbS}$  at  $18^\circ$  (Weigel, Z phys Ch 1907 58 294)  
 1 l  $\text{H}_2\text{O}$  dissolves  $3 \times 10^{-4}$  g  $\text{PbS}$  at  $25^\circ$  (Hevesy, Z anorg 1913 82 325)  
 Insol in dilute acids-alkalis and alkali sulphides +  $\text{Aq}$  Decomp with solution in moderately dil  $\text{HNO}_3 + \text{Aq}$  With conc  $\text{HNO}_3$  or aqua regia,  $\text{PbSO}_4$  is formed Sol in hot conc  $\text{HCl} + \text{Aq}$   
 1 l  $\text{H}_2\text{O}$  sat with  $\text{H}_2\text{S}$  dissolves  $1.5 \times 10^{-4}$  g  $\text{PbS}$  at  $25^\circ$  (Hevesy, Z anorg 1913 82 325)  
 Insol in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  Bret  
 Somewhat sol in  $\text{H}_2\text{S} + \text{Aq}$  when heated therewith in a sealed tube (Stern, A ch (3) 32 168)  
 Insol in potassium thiocarb +  $\text{Aq}$  (Rosenblatt, Z anal 26 15)  
 Sol in  $\text{Na}_2\text{SO}_3 + \text{Aq}$  (Weigel, J Anal Ch 5 646)  
 Insol in liquid  $\text{NH}_3$  (Farrar, A J C P J 1898, 20 528)  
 Min *Galena*, *Galerite*

**Lead polysulphide,  $\text{PbS}_x$** 

Ppt insol in alkali +  $\text{Aq}$  Decomp by conc  $\text{HNO}_3$  (Bodroff, C P 130 1398)

**Lead platinum sulphide**

See Sulphoplatinate, lead

**Lead sulphide mercuric chloride  $2\text{PbS} \cdot 4\text{HgCl}_2$** 

Decomp by  $\text{H}_2\text{O}$  (Latta, C P 96 1666)

**Lead sulphobromide, chloride, or iodide**

See Lead bromosulphide, etc

**Lead disulphodumide,  $PbN_2S$ ,  $NH_3$** 

Ppt

Very stable in the air or in a vacuum

Sol in no solvent without decomp

When rapidly heated it explodes very violently at  $140^\circ$  (Ruff, B 1904, 37 1581)**Lead telluride,  $PbTe$** Insol in  $H_2O$  Sol in cold  $HNO_3 + Aq$  (Rose, Pogg 13 68)Min *Allaite* Easily sol in  $HNO_3 + Aq$ **"Leucone"**Wohler (A 127 268) gives this substance the formula  $H_{10}Si_3O_{10}$ , but it is identical with silicoformic anhydride,  $Si_2H_2O_3$ , which see**Lime***Quicklime*,  $CaO$  See Calcium oxide*Slaked lime*,  $CaO \cdot H_2O$  See Calcium hydroxide**Lithium,  $Li$** Decomposes  $H_2O$ Easily sol in dil acids Slowly attacked by conc  $H_2SO_4$ , rapidly by conc  $HNO_3 + Aq$   
Insol in hydrocarbons Sol in liquid  $NH_3$ , but not so easily as KSol in liquid  $NH_3$  (Franklin, Am Ch J 1898, 20 520)

1 gram atom dissolves

at	$0^\circ$	in	3 93	mol	liquid	$NH_3$
"	$-25^\circ$	"	3 93	"	"	"
"	$-50^\circ$	"	3 93	"	"	"
"	$-50^\circ$	"	3 93	"	"	"

(Ruff, B 1906, 39 510)

Sol in ethylamine Insol in propylamine and in secondary and tertiary amines (Kraus, J Am Chem Soc 1907, 29 1561)

**Lithium amalgam,  $LiHg$**  $LiHg$  is obtained at all temp up to  $100^\circ$   
Can be dist from  $Hg$  without decomp at any temp below  $100^\circ$  (Kerp, Z anorg 1900, 25 68)**Lithium amide,  $LiNH$** 

(Ruff, B 1911 44 505)

Decomp slowly in the air

Slowly decomp by cold, rapidly by hot  $H_2O$ Slowly decomp by  $HCl$ 

Slowly decomp by cold rapidly by hot abs alcohol (Lutherley Chem Soc 1894, 65 18)

**Lithium amide,  $Li_3NH$** Hydroscopic decomp by  $H_2O$  (Dafert, M 1910, 31 994)**Lithium ammonia,  $Li, NH_3$** Decomp by  $H_2O$  at ordinary temp, sol in liquid  $NH_3$  (Moissan, C R 1898, 127 689) $Li, 3NH_3$  (Moissan, C R 1901, 133 716)**Trilithium ammonium,  $Li_3NH_4$** Very hydroscopic, decomp by  $H_2O$  (Dafert, M 1910, 31 992)**Lithium antimonide,  $Li_3Sb$** Decomp by  $H_2O$  with evolution of  $H_2$   
Sol in liquid  $NH_3$  (Lebeau, C R 1902, 134 285)**Lithium arsenide,  $Li_3As$** Decomp by  $H_2O$ , decomp violently by fuming  $HNO_3$  (Lebeau, C R 1899, 129 50)**Lithium azoimide,  $LiN_3$** 

Deliquescent Stable in aq solution

36 12 pts are sol in 100 pts  $H_2O$  at  $10^\circ$ 62 07 " " " " 100 "  $H_2O$  "  $15.5^\circ$ 66 41 " " " " 100 "  $H_2O$  "  $16^\circ$ 20 26 " " " " 100 " abs alcohol at  $16^\circ$ 

Insol in ether (Curtius, J pr 1898, (2) 58 277)

+  $H_2O$  Very hydroscopic, decomp in the air Very sol in  $H_2O$  and alcohol (Dennis, Z anorg 1898, 17 18)**Lithium bromide,  $LiBr$** 

Deliquescent

100 pts  $H_2O$  dissolve at

$0^\circ$	$34^\circ$	$59^\circ$	$82^\circ$	$103^\circ$
143	196	222	244	270 pts $LiBr$

Sp gr of $LiBr + Aq$ at $19.5^\circ$	--	--	--	--
0	10	15	20	25
1 035	1 072	1 113	1 156	1 204

35	40	45	50	55%
1 309	1 368	1 432	1 500	1 580

(Kromers, Pogg 103 65 104 133 Gerlach, Z anal 8 255)

Temp of maximum  $\mu$ -mol  $LiBr$  dissolved density of  $LiBr + Aq$  in 1000 g  $H_2O$ 

1 921°	0 2911
0 881°	0 1383

(de Coppet, C R 1900, 131 178)

Moderately sol in liquid  $NH_3$  (Franklin, Am Ch J 1898, 20 828)

Sol in benzonitrile (Naumann, B 1914, 47 1369)

Solubility in glycol at  $117^\circ = 37.5\%$  (de Conninck, Belg Acad Bull 1905, 359)

Sol in acetone (Naumann, B 1904, 37 4328, Idmann, C C 1899, II 1014)

Sol in methyl acetate (Naumann, B 1909, 42 3789) ethyl acetate (Naumann, B 1904, 37 3601)

Difficultly sol in ethyl acetate (Nau-  
mann, B 1910, 43 314)  
+H<sub>2</sub>O 100 g H<sub>2</sub>O dissolve 209 g LiBr  
at 44° (Bogorodski, C C 1894, II 514)  
+2H<sub>2</sub>O (Bogorodski)  
+3H<sub>2</sub>O 100 g H<sub>2</sub>O dissolve 80 g LiBr  
at -30°, and 122 g at -10° (Bogorodski)

Lithium molybdenyl bromide, LiBr, MoOBr<sub>3</sub>  
+4H<sub>2</sub>O

Very hygroscopic (Weinland and Knoll,  
Z anorg 1905, 44 111)

### Lithium bromide ammonia

LiBr, NH<sub>3</sub> Sol in H<sub>2</sub>O with decomp  
LiBr, 2NH<sub>3</sub> " " " " "  
LiBr, 3NH<sub>3</sub> " " " " "  
LiBr, 4NH<sub>3</sub> " " " " "  
(Bonnetot, C R 1900, 130 1395)

### Lithium carbide, Li<sub>2</sub>C<sub>2</sub>

Insol in conc acids  
Sol in fused oxidizing agents, decomp H<sub>2</sub>O  
in the cold (Moissan, C R 1896, 122 363)

### Lithium subchloride, Li<sub>2</sub>Cl

Decomp by H<sub>2</sub>O (Guntz, C R 1895,  
121 945)

### Lithium chloride, LiCl

Very deliquescent Most deliquescent salt  
known to Berzelius Very sol in H<sub>2</sub>O Sol  
in 1 315 pts H<sub>2</sub>O at 15° (Gerlach)  
100 pts H<sub>2</sub>O dissolve at  
0° 20° 65° 80° 69° 140° 160°  
63 7 80 7 104 2 115 129 139 145 pts LiCl  
(Gerlach, Z anal 8 281)

Sp gr of LiCl+aq at 15° containing  
1 5 10 15 20% LiCl,  
1 006 1 030 1 058 1 086 1 117  
25 30 35 40% LiCl  
1 148 1 182 1 219 1 256  
(Gerlach, Z anal 8 281)

Sp gr of LiCl+aq at 18° containing  
5 10 20 30 40% LiCl  
1 0274 1 0563 1 115 1 181 1 255  
(Kohlrausch, W Ann 1879 1)

Sp gr of LiCl+aq at 25°

Concentration of LiCl+aq	Sp gr
1-normal	1 0243
1/100 "	1 0129
1/1000 "	1 0062
1/10000 "	1 0030

(Wagner, Z phys Ch 1890, 5 38)

### Sp gr of LiCl+aq

g LiCl in 1000 g of solution	Sp gr
0	1 000000
2 3923	1 001405
6 2360	1 003647
10 1093	1 005921

(Dijken, Z phys Ch 1897, 24 109)

Sp gr of LiCl+aq at 0°  
% LiCl 4 26 12 18 22 2 32 5 41 4 43 2  
Sp gr 1 026 1 073 1 133 1 203 1 267 1 282  
(Lemoine, C R 1897, 125 603)

### Sp gr of LiCl+aq at 20°

Normality of LiCl+aq	% LiCl	Sp gr
10 35	35 97	1 2230
7 17	26 40	1 1550
5 57	21 10	1 1215
2 98	11 83	1 0691
1 06	4 37	1 0232

(Forchheimer, Z phys Ch 1900, 34 25)

Sp gr 20° 4° of a normal solution of LiCl =  
1 022375 (Haigh, J Am Chem Soc 1912,  
34 1151)

Sp gr of dil LiCl+aq at 20 004°  
Conc = g equiv LiCl per l at 20 004°  
Sp gr compared with H<sub>2</sub>O at 20 004° = 1

Conc	Sp gr
0 0000	1 000 000 0
0 0001	1 000 002 5
0 0002	1 000 005 0
0 0005	1 000 012 5
0 0010	1 000 025 3
0 0020	1 000 050 5
0 0050	1 000 125 5
0 0100	1 000 251 0

(Lamb and Lee J Am Chem Soc 1915 35  
1655)

### B-pt of LiCl+aq

% LiCl	B pt	Sp gr
3 38	101°	16 60
6 54	102	19 55
13 04	105	21 5

(Skinner, Chem Soc 61 341)

Sat  $\text{LiCl} + \text{Aq}$  boils at  $171^\circ$  (Kremers)B-pt of  $\text{LiCl} + \text{Aq}$  P=pts  $\text{LiCl}$  to  
100 pts  $\text{H}_2\text{O}$ 

B pt	P	B pt	P	B pt	P
101°	3 5	124°	48 5	147°	87 5
102	7	125	50	148	90
103	10	126	51 5	149	92 5
104	12 5	127	53	150	95
105	15	128	54 5	151	97 5
106	17 5	129	56	152	100
107	20	130	57 5	153	102 5
108	22	131	59	154	105
109	24	132	60 5	155	107 5
110	26	133	62	156	110 5
111	28	134	63 5	157	113 5
112	30	135	65	158	116 5
113	32	136	66 5	158 5	117 96
114	33 5	137	68	159	119 5
115	35	138	69 75	160	122 5
116	36 5	139	71 5	161	125 5
117	38	140	73 25	162	128 5
118	39 5	141	75	163	131 5
119	41	142	77	164	135
120	42 5	143	79	165	138 5
121	44	144	81	166	142 5
122	45 5	145	83	167	146 5
123	47	146	85	168	151

(Gerlach, Z anal 26 437)

Cl+Aq at  $0^\circ$ 

	10 cc of solution			Sp gr of solution
	HCl	$\text{LiCl}$	HCl	
120	0 0	51 0	0 0	1 255
97 5	22 5	41 4	8 2	1 243
67 0	66 0	28 5	24 1	1 249
58 0	81 0	24 6	29 5	1 251

(Engel, A ch (6) 13 385)

See also  $\text{LiCl} + \text{H}_2\text{O}$ Sol in liq uid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Sol in absolute alcohol, ether, and alcohol-ether

B-pt of alcoholic solution of  $\text{LiCl}$ 

% $\text{LiCl}$	B pt	% $\text{LiCl}$	B pt
2 4	$78\ 43^\circ + 0\ 70^\circ$	9 93	$78\ 43^\circ + 5\ 55^\circ$
5 39	" +2 15	15 94	" +11 75
8 01	" +4 18		

(Skinner)

Solubility in alcohol+Aq decreases to 40% alcohol+60%  $\text{H}_2\text{O}$ . Curve shows minimum at 30%  $\text{H}_2\text{O}$  to 70% alcohol. The sat pure  $\text{H}_2\text{O}$  and pure alcohol solutions cooled to  $0^\circ$  deposit  $\text{LiCl}$ ,  $\text{H}_2\text{O}$  and  $\text{LiCl}$ ,  $4\text{C}_2\text{H}_5\text{O}$  respectively (Pina de Rubies, C A 1914 743, 3006)

Solubility in ethyl alcohol

Temp 1 06° 5 07° 13 0° 25 0° 40 6° 62 6°  
%  $\text{LiCl}$  14 14 13 14 15 18  
(Lemoine, C R 1897, 125 605)

100 g ethyl alcohol dissolve at

$0^\circ$  5° 10° 15° 17°  
14 42 15 04 16 77 18 79 20 31 g  $\text{LiCl}$   
The solid phase from  $0^\circ$ - $17^\circ$  is  $\text{LiCl}$ ,  $4\text{C}_2\text{H}_5\text{O}$

$20^\circ$  30° 40° 50° 60°  
24 28 25 10 25 38 24 40 23 46 g  $\text{LiCl}$   
The solid phase from  $20^\circ$ - $60^\circ$  is  $\text{LiCl}$   
(Turner and Bissett, Chem Soc 1913, 103 1907)

Solubility in ethyl alcohol+Aq at  $25^\circ$ 

100 g of the solution contain		
G $\text{C}_2\text{H}_5\text{OH}$	G $\text{H}_2\text{O}$	G $\text{LiCl}$
0	55 10	44 90
5 96	51 52	42 52
11 07	48 73	40 20
17 46	43 90	38 64
18 56	43 70	37 74
22 16	41 17	36 67
26 29	39 51	34 70
28 97	37 42	33 61
29 27	36 89	33 84
30 10	36 64	33 26
30 51	35 67	33 82
32 79	34 95	32 26
38 40	31 58	30 02
49 27	24 67	26 06
50 32	24 04	25 64
53 50	20 94	25 56
58 15	18 47	23 38
59 78	17 46	22 76
63 09	14 83	22 08
70 24	8 66	21 10
70 70	8 26	21 04
70 74	7 78	21 48
79 26	0	20 74

The solid phase in the mixtures which are richest in alcohol is  $\text{LiCl}$ , in the other mixtures the solid phase is  $\text{LiCl} + \text{H}_2\text{O}$

(Pina de Rubies, C C 1915, I 521)

Sp gr of  $\text{LiCl}$  in ethyl alcohol ( $\text{LiCl}$ ,  $2\text{C}_2\text{H}_5\text{O}$ )

% salt	Sp gr at $14^\circ$	Sp gr at $0^\circ$
0	0 797	0 809
5 2	0 839	0 851
10 1	0 871	0 881
14 6	0 903	0 903

(Lemoine, C R 1897, 125 605)

## Solubility in methyl alcohol at t°

t°	% LiCl in sat solution
1	26
23	27
50	30

(Lemoine, C R 1897, 125 604)

Sp gr of LiCl in methyl alcohol (LiCl, 3CH<sub>4</sub>O)

% salt	5.2	14.5	22.1
Sp gr at 21.5°	0.836	0.910	0.974
Sp gr " 0°	0.854	0.926	0.988

(Lemoine, C R 1897, 125 604)

15.86 g are sol in 100 g propyl alcohol (Schlamp, Z phys Ch 1894, 14 276)

Sol in 15 pts fusel oil (Gooch, Am Ch J 9 33)

100 g methyl alcohol dissolve 42.36 g LiCl at 25°

100 g ethyl alcohol dissolve 25.83 g LiCl at 25°

100 g propyl alcohol dissolve 16.22 g LiCl at 25°

100 g isoamyl alcohol dissolve 9.03 g LiCl at 25°

(Turner and Bissett, Chem Soc 1913, 103 1909)

## Solubility of fused LiCl in alcohols at 25°

Solvent	% LiCl
Water	45.0
Ethyl alcohol	2.475
Propyl alcohol	3.720
Butyl alcohol	9.56
Amyl alcohol	8.26
Allyl alcohol	4.20
Glycerine	4.14
Phenol (at 53°C)	1.89

(Patten and Mott, J phys Chem 1904, 8 158)

100 pts pyridine dissolve 7.78 pts LiCl at 15°, 14.26 pts LiCl at 100° (Laszczynski, B 1894, 27 2288)

Soluble in anhydrous pyridine, 97% pyridine+Aq, 95% pyridine+Aq, and 93% pyridine+Aq (Kahlenberg, J Am Chem Soc 1908, 30 1107)

Difficultly sol in methyl acetate (Naumann, B 1909, 42 3789), ethyl acetate (Naumann, B 1910, 43 314)

Sol in ethyl acetate (Naumann, B 1904, 37 3601)

Solubility in glycol at 15°=11% (de Coninck, Belg Acad Bull 1905, 359)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Sol in ethylamine (Shinn, J phys Chem 1907, 11 538)

Sol in acetone (Eidmann, C C 1899, II 1014)

## Solubility of LiCl in acetone

Pts sol in 100 pts acetone	t
4.60	0
4.40	12
4.11	25
3.76	46
3.12	53
2.14	58

(Laszczynski, B 1894, 27 2287)

+H<sub>2</sub>O 13.536 millimols are contained in 1 l sat solution at 25° (Herz, Z anorg 1912, 73 274)

## Solubility in HCl+Aq at 25°

Millimols HCl in 10 ccm	Millimols LiCl in 10 ccm
6.30	135.36
10.53	134.14
17.64	126.52
	122.58

(Herz, Z anorg 1912, 73 274)

+2H<sub>2</sub>O Sol in acetone (Krug and M'Elroy, J Anal Ch 6 184)+3H<sub>2</sub>O (Bogorodski, C C 1894, II 514)

## Lithium gold chloride

See Chloraurate, lithium

Lithium manganous chloride, LiCl, MnCl<sub>2</sub>+3H<sub>2</sub>ODecomp by H<sub>2</sub>O, stable only in excess of LiCl (Chassevant, A ch (6) 30 10)Lithium mercuric chloride, 2LiCl, HgCl<sub>2</sub>Very deliquescent and sol in H<sub>2</sub>O (Harth, Z anorg 1897, 14 323)Lithium nickel chloride, LiCl, NiCl<sub>2</sub>+3H<sub>2</sub>ODeliquescent Sol in H<sub>2</sub>O and alcohol (Chassevant)Lithium thallic chloride, 3LiCl, TlCl<sub>3</sub>+8H<sub>2</sub>OVery deliquescent Sol in H<sub>2</sub>O (Pratt, Am J Sci 1895, (3) 49 404)

## Lithium stannic chloride

See Chlorostannate, lithium

Lithium uranous chloride, Li<sub>2</sub>UCl<sub>6</sub>

As K salt (Aloy, Bull Soc 1899, (3) 21 264)

Lithium uranium chloride, UCl<sub>4</sub>, 2LiClVery hygroscopic, sol in H<sub>2</sub>O with decomp Sol in acetic acid Decomp by alcohol (Aloy, Bull Soc 1899, (3) 21 264)



**Lithium zinc chloride,  $\text{LiCl}$ ,  $\text{ZnCl}_2 + 3\text{H}_2\text{O}$** 

Extremely deliquescent (Ephraim, Z anorg 1908, 59 68)

$3\text{LiCl}$ ,  $\text{ZnCl}_2 + 10\text{H}_2\text{O}$  (?) Not obtained in solid state (Ephraim, Z anorg 1908, 59 69)

**Lithium chloride ammonia**

$\text{LiCl}$ ,  $\text{NH}_3$

$\text{LiCl}$ ,  $2\text{NH}_3$

$\text{LiCl}$ ,  $3\text{NH}_3$

$\text{LiCl}$ ,  $4\text{NH}_3$

Above salts are all decomp by  $\text{H}_2\text{O}$  (Bonnefont, C R 1898, 127 367-369)

**Lithium chloriodide,  $\text{LiCl}_2\text{I} + 4\text{H}_2\text{O}$** 

Deliquescent (Wells and Wheeler, Sill Am J 144 42)

**Lithium fluoride,  $\text{LiF}$** 

Very difficultly sol in  $\text{H}_2\text{O}$  (Berzelius, Pogg 1 17)

Two crystalline forms Only very sl sol in  $\text{H}_2\text{O}$  Very sl decomp by  $\text{H}_2\text{O}$  at red heat (Poulenc, Bull Soc 1894, (3) 11 17)

Sp gr of solution sat at  $18^\circ = 1.003$  and contains 0.27%  $\text{LiF}$  (Mylius, B 1897, 30 1718)

Sol in 800 pts  $\text{H}_2\text{O}$ , and the presence of  $\text{NH}_4\text{F}$  and  $\text{NH}_3$  decreases solubility to 1 3500 (Carnot, Bull Soc 1889, (3) 1 250)

Two crystalline forms are very sl sol in  $\text{HCl}$ , easily sol in  $\text{HNO}_3$  (Poulenc, Bull (3) 11 17)

Crystalline forms are insol in 95% (Poulenc)

in methyl acetate (Naumann, B 1910, 43 3790)

Difficultly sol in ethyl acetate (Naumann, B 1910, 43 314)

Insol in acetone (Naumann, B 1904, 37 4329, Ehdmann, C C 1899, II 1014)

**Lithium hydrogen fluoride,  $\text{LiHF}_2$** 

Difficultly sol in  $\text{H}_2\text{O}$ , but more easily than  $\text{LiF}$  (Berzelius)

**Lithium silicon fluoride**

See Fluosilicate, lithium

**Lithium stannic fluoride**

See Fluostannate, lithium

**Lithium tantalum fluoride**

See Fluotantalate, lithium

**Lithium uranyl fluoride,  $\text{UO}_2\text{F}_2$ ,  $4\text{LiF}$** 

(Ditte)

**Lithium zirconium fluoride**

See Fluozirconate, lithium

**Lithium hydride,  $\text{LiH}$** 

Not deliquescent Decomp by  $\text{H}_2\text{O}$  (Guntz, C R 1896, 123 997)

**Lithium hydrosulphide,  $\text{LiSH}$  (?)**

Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol (Berzelius, Pogg 6 439)

**Lithium hydroxide,  $\text{LiOH}$** 

Not so deliquescent as  $\text{NaOH}$ , and apparently not more sol in hot than cold  $\text{H}_2\text{O}$  (Gmelin, Galb 62 399)

Not deliquescent (Arfvedson, A ch 10 82)

The solubility of  $\text{LiOH}$  in  $\text{H}_2\text{O}$  can be expressed by  $y = 6.6750 + 0.00346t + 0.0003t^2$ , where  $y$  = the percentage of  $\text{Li}_2\text{O}$  in a saturated solution (Dittmar, Jour Soc Chem Ind 7 730)

**Solubility of  $\text{LiOH}$  in  $\text{H}_2\text{O}$  at  $t^\circ$** 

$t^\circ$	G per 100 g Solution		G $\text{LiOH}$ per 100 g $\text{H}_2\text{O}$
	$\text{Li}_2\text{O}$	$\text{LiOH}$	
0	6.67	10.64	12.7
10	6.74	10.80	12.7
20	6.86	10.99	12.8
25	6.95	11.14	12.9
30	7.05	11.27	12.9
40	7.29	11.68	13.0
50	7.56	12.12	13.3
60	7.96	12.76	13.8
80	8.87	14.21	15.3
100	10.02	16.05	17.5

(Seidell's Solubilities, 1st Ed 174)

A sat aq solution contains 7.09%  $\text{LiOH}$  (Schreinemakers, C C 1905, II 1486)

Sp gr of  $\text{LiOH} + \text{Aq}$  at  $18^\circ$  containing

1.25 2.5 5 7.5%  $\text{LiOH}$   
1.0132 1.0276 1.0547 1.0804

(Kohlrausch, W Ann 1879 1)

**Solubility in  $\text{Li}_3\text{SbS}_4 + \text{Aq}$  at  $30^\circ$** 

% $\text{LiOH}$	% $\text{Li}_3\text{SbS}_4$	Solid Phase
11.4	0	$\text{LiOH}$ , $\text{H}_2\text{O}$
9.1	8.3	"
2.3	29.9	"
2.1	48.3	"
2.1	52.1	$\text{LiOH}$ , $\text{H}_2\text{O} + \text{Li}_3\text{SbS}_4$ , $10\text{H}_2\text{O}$
1.4	51.8	$\text{Li}_3\text{SbS}_4$ , $10\text{H}_2\text{O}$
0	51.3	"

(Donk, Chem Weekbl 1908, 5 529, 629, 767)

Sl sol in alcohol, insol in alcohol-ether (Mayer)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3601)

Insol in acetone (Naumann, B 1904, **37** 4329, Eidmann, C C 1899, II 1014)

Cryst also with  $H_2O$ , and  $\frac{1}{2}H_2O$  (Gottig, B 20 2912)

### Lithium imide, $Li_2NH$

Decomp at high temp Insol in toluene, benzene, ether and ethyl acetate Decomp  $CHCl_3$  (Ruff, B 1911, **44** 506)

### Lithium iodide, $LiI$

Deliquescent

Solubility in 100 pts  $H_2O$  at

0° 19° 40° 59° 75° 80° 99° 120°

151 164 179 200 263 435 476 538 pts  $LiI$

Sp gr of  $LiI + Aq$  at 19.5° containing

5 10 15 20 25 30%  $LiI$ ,  
1 038 1 079 1 124 1 172 1 224 1 280

35 40 45 50 55 60%  $LiI$   
1 344 1 414 1 489 1 575 1 670 1 777

(Kremers, Pogg 104 133, 111 60 Gerlach, Z anal 8 295)

Sp gr of  $LiI + Aq$  at 18° containing

5 10 15 20 25%  $LiI$   
1 0361 1 0756 1 1180 1 1643 1 2138

(Kohlrausch, W Ann 1879 1)

Temp of maximum g-mol  $LiI$  dissolved  
density of  $LiI + Aq$  in 1000 g  $H_2O$

2 516° 0 1795

0 039° 0 4666

(de Coppet, C R 1900, **131** 178)

Very sol in liquid  $NH_3$  (Franklin, Am Ch J 1898, **20** 828)

100 g methyl alcohol dissolve 343.4 g  $LiI$  at 25°

100 g ethyl alcohol dissolve 250.8 g  $LiI$  at 25°

100 g propyl alcohol dissolve 47.52 g  $LiI$  at 25°

100 g isoamyl alcohol dissolve 112.50 g  $LiI$  at 25°

In the case of propyl alcohol the solid phase at 25° is  $LiI$ ,  $4C_3H_7O$  (Turner and Bissett, Chem Soc 1913, **103** 1909)

Solubility in organic solvents at t°

C = pts by wt of  $LiI$  in 100 cm of the sat solution

L = no of liters which at the saturation temp hold in solution 1 mol  $LiI$

Solvent	t	C	L
Furfural	25°	45.86	0.292
Nitromethane	25°	2.519	5.32
"	0°	1.219	10.98

(Walden, Z phys Ch 1906, **55** 718)

Solubility in glycol at 15.3° = 28% (de Coninck, Belg Acad Bull 1905, 359)

Sol in benzonitrile (Naumann, B 1914, **47** 1369)

Sol in methyl acetate (Naumann, B 1909, **42** 3789)

Difficultly sol in ethyl acetate (Naumann, B 1910, **43** 314)

Sol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, **37** 4328)

+  $H_2O$  Mpt below 200° (Bogorodsky, C C 1897, II 175)

+  $2H_2O$  Mpt 86-88° (Bogorodsky)

+  $3H_2O$  Mpt 75° (Bogorodsky)

Sol in absolute alcohol without decomp (Thirsoff, Chem Soc 1894, **66** (2) 234)

The composition of the hydrates formed by  $LiI$  at different dilutions is calculated from determinations of the lowering of the fr-pt produced by  $LiI$  and of the conductivity and sp gr of  $LiI + Aq$  (Jones, Am Ch J 1905, **34** 301)

### Lithium mercuric iodide, $2LiI, HgI_2 + 6H_2O$

Very deliquescent Decomp by  $H_2O$  Very sol without decomp in alcohols, glycerine, acetone, fuming formic acid, acetic acid, ethyl acetate, ethyl oxalate, etc Less sol in nitrobenzene Insol in benzene and methyl iodide (Duboin, C R 1905, **141** 1017)

+  $8H_2O$  Decomp by  $H_2O$  Very sol in alcohols, glycerine, acetone, fuming formic acid, acetic acid, ethyl acetate, etc without decomp Sol in nitrobenzene Insol in benzene and methyl iodide (Duboin, l c)  
+  $9H_2O$  Hydrosopic Sol in alcohol and acetone without decomp (Dobroserdoff, C C 1901, I 664)

### Lithium nitride, $Li_3N$

Sol in  $H_2O$  with decomp (Ouvrard, C R 114 120)

Very hydropscopic (Dafert, M 1910, **31** 987)

### Lithium oxide, $Li_2O$

Slowly sol in  $H_2O$  to form  $LiOH$

See Lithium hydroxide

### Lithium peroxide, $Li_2O_2$

(de Forcrand, C R 1900, **130** 1467)

### Lithium hydrogen peroxide, $Li_2O_2, H_2O_2 + 3H_2O$

Sol in  $H_2O$  Insol in alcohol (de Forcrand, C R 1900, **130** 1466)

### Lithium selenide, $Li_2Se$

Sol in  $H_2O$  (Fabre, C R 103 269)

+  $9H_2O$  Sol in  $H_2O$  (Fabre)

### Lithium silicide, $Li_6Si$

Decomp by  $H_2O$  and by dil acids Decomp by aqueous solutions of alkalis with evolution of  $H$  (Moissan, C R 1902, **134** 1083)

**Lithium monosulphide,  $\text{Li}_2\text{S}$** 

More sol in  $\text{H}_2\text{O}$  or alcohol than  $\text{LiOH}$

**Luteochromium bromide,  $\text{Cr}(\text{NH}_3)_6\text{Br}_3$** 

Less sol in  $\text{H}_2\text{O}$  than the chloride (Jorgensen, J pr (2) 30 1)

**— bromoplatinate,  $[\text{Cr}(\text{NH}_3)_6]_2(\text{PtBr}_6)_3 + 4\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  Insol in alcohol (Jorgensen)

**— chloride,  $\text{Cr}(\text{NH}_3)_6\text{Cl}_3 + \text{H}_2\text{O}$** 

Efflorescent, and very sol in  $\text{H}_2\text{O}$  (Jorgensen)

**— chloroplatinate**

(a)  $[\text{Cr}(\text{NH}_3)_6]_2(\text{PtCl}_6)_3 + 6\text{H}_2\text{O}$  Nearly completely insol in  $\text{H}_2\text{O}$  (Jorgensen)

(b)  $\text{Cr}(\text{NH}_3)_6\text{Cl}(\text{PtCl}_6) + 2\frac{1}{2}\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  into above, insol in alcohol (Jorgensen)

(c)  $[\text{Cr}(\text{NH}_3)_6]_2\text{Cl}_4(\text{PtCl}_6) + 2\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  into (a) (Jorgensen)

**— mercuric chloride,  $\text{Cr}(\text{NH}_3)_6\text{Cl}_3, \text{HgCl}_2$** 

Decomp by  $\text{H}_2\text{O}$ , sl sol in dil  $\text{HCl} + \text{Aq}$ , insol in alcohol

$\text{Cr}(\text{NH}_3)_6\text{Cl}_3, 3\text{HgCl}_2 + 2\text{H}_2\text{O}$  Decomp by dil  $\text{HCl} + \text{Aq}$  into above salt (Jorgensen)

**— isomcyanide,  $\text{Cr}(\text{NH}_3)_6\text{Cr}(\text{CN})_6$** 

precipitate

**— cobaltcyanide,  $\text{Cr}(\text{NH}_3)_6\text{Co}(\text{CN})_6$** 

Nearly insol in  $\text{H}_2\text{O}$  or in conc  $\text{HCl} + \text{Aq}$  (Jorgensen)

**— ferrocyanide,  $\text{Cr}(\text{NH}_3)_6\text{Fe}(\text{CN})_6$** 

Very sl sol in cold  $\text{H}_2\text{O}$  or dil acids (Jorgensen)

**— iodide,  $\text{Cr}(\text{NH}_3)_6\text{I}_3$** 

Sl sol in  $\text{H}_2\text{O}$  (Jorgensen, l c)

**— iodosulphate,  $\text{Cr}(\text{NH}_3)_6\text{SO}_4\text{I}$** 

Sol in  $\text{H}_2\text{O}$ , nearly insol in dil  $\text{NH}_4\text{OH} + \text{Aq}$  or alcohol (Jorgensen)

**— nitrate,  $\text{Cr}(\text{NH}_3)_6(\text{NO}_3)_3$** 

Sol in 35–40 pts  $\text{H}_2\text{O}$  Insol in cold dil  $\text{HNO}_3 + \text{Aq}$  or alcohol Can be crystallised out of  $\text{H}_2\text{O}$  containing a little  $\text{HNO}_3$  (Jorgensen, J pr (2) 30 1)

**— nitrate chloroplatinate,**

$\text{Cr}(\text{NH}_3)_6(\text{NO}_3)_2\text{PtCl}_6 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Jorgensen)

**— nitratosulphate,  $\text{Cr}(\text{NH}_3)_6(\text{NO}_3)\text{SO}_4$** 

Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Jorgensen)

**Luteochromium oxalate,  $[\text{Cr}(\text{NH}_3)_6]_2(\text{C}_2\text{O}_4)_3 + 4\text{H}_2\text{O}$** 

Nearly insol in cold  $\text{H}_2\text{O}$  (Jorgensen)

**— orthophosphate,  $\text{Cr}(\text{NH}_3)_6\text{PO}_4 + 4\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$ , easily sol in dil acids (Jorgensen)

**— sodium pyrophosphate,**

$\text{Cr}(\text{NH}_3)_6(\text{Na}_2\text{P}_2\text{O}_7) + 11\frac{1}{2}\text{H}_2\text{O}$

Nearly insol in cold  $\text{H}_2\text{O}$ , wholly insol in dil  $\text{NH}_4\text{OH} + \text{Aq}$  (Jorgensen)

**— sulphate,  $[\text{Cr}(\text{NH}_3)_6]_2(\text{SO}_4)_3 + 5\text{H}_2\text{O}$** 

Quite sol in  $\text{H}_2\text{O}$ , insol in alcohol (Jorgensen)

**— sulphate chloroplatinate,**

$[\text{Cr}(\text{NH}_3)_6(\text{SO}_4)]_2\text{PtCl}_6$

Nearly insol in  $\text{H}_2\text{O}$  (Jorgensen)

**Luteocobalt diamine chromium sulphocyanide**

See Diamine chromium luteocobalt sulphocyanide

**Luteocobaltic bromide,  $\text{Co}(\text{NH}_3)_6\text{Br}_3$** 

Sol in  $\text{H}_2\text{O}$  Precipitated from saturated  $\text{H}_2\text{O}$  solution by dil  $\text{HBr} + \text{Aq}$  (Jorgensen, J pr (2) 35 417)

**— brompermanganate,**

$\text{Co}(\text{NH}_3)_6\text{Br}_3(\text{MnO}_4)$

Easily sol in  $\text{H}_2\text{O}$  (Klobb, A ch (6) 12 5)

**— bromoplatinate,  $\text{Co}(\text{NH}_3)_6\text{Br}_3, \text{PtBr}_4 + \text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$ , can be recrystallised from hot  $\text{H}_2\text{O}$  containing  $\text{HBr}$  (Jorgensen)

**— bromosulphate,  $\text{Co}(\text{NH}_3)_6\text{Br}(\text{SO}_4)$** 

Nearly insol in  $\text{H}_2\text{O}$  Very sl sol in dil  $\text{NH}_4\text{OH} + \text{Aq}$  (Jorgensen)

**— carbonate,  $[\text{Co}(\text{NH}_3)_6]_2(\text{CO}_3)_3 + 7\text{H}_2\text{O}$** 

Efflorescent, easily sol in  $\text{H}_2\text{O}$

$[\text{Co}(\text{NH}_3)_6]_2(\text{CO}_3)_3, \text{H}_2\text{CO}_3 + 5\text{H}_2\text{O}$  Less sol in  $\text{H}_2\text{O}$  than the neutral salt (Gibbs and Genth)

**— chloride,  $\text{Co}(\text{NH}_3)_6\text{Cl}_3$** 

Sol in 17.09 pts  $\text{H}_2\text{O}$  at  $10.5^\circ$ , 16.81 pts at  $11.4^\circ$ , 16.48 pts at  $12^\circ$ , and more easily in hot  $\text{H}_2\text{O}$  (F Rose)

100 pts  $\text{H}_2\text{O}$  dissolve 4.26 pts at  $0^\circ$ , and 12.74 pts at  $46.6^\circ$  (Kurnakoff, J russ Soc 24 629)

Not appreciably sol in conc  $\text{HCl} + \text{Aq}$  (Jorgensen)

Insol in alcohol or solutions of the alkali chlorides (Gibbs and Genth)

Insol in  $\text{NH}_4\text{OH} + \text{Aq}$

Aqueous solution is pptd by alcohol, mineral acids, or alkali chlorides

**Luteocobaltic mercuric chloride**,  $\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $\text{HgCl}_2 + 1\frac{1}{2}\text{H}_2\text{O}$

Sol in hot  $\text{H}_2\text{O}$  (Krok, 1870)

By recrystallizing from hot  $\text{H}_2\text{O}$  containing  $\text{HCl}$  is converted into—

$\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $3\text{HgCl}_2 + \text{H}_2\text{O}$  Very sl sol in cold  $\text{H}_2\text{O}$  (Jorgensen)

$\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $2\text{HgCl}_2 + \frac{1}{2}\text{H}_2\text{O}$  Sol in hot  $\text{H}_2\text{O}$ , from which it crystallizes on cooling Insol in cold conc  $\text{HCl} + \text{Aq}$ , and is pptd from  $\text{H}_2\text{O}$  solution by  $\text{HCl}$  or alcohol (Carstanjen)

Does not exist (Jorgensen)

$+3\text{H}_2\text{O}$  More easily sol in cold  $\text{H}_2\text{O}$  and other solvents than the preceding comp (Carstanjen, Berlin, 1861)

Does not exist (Jorgensen)

— **stannous chloride**,  $2\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,

$3\text{SnCl}_2 + 10\text{H}_2\text{O}$

$+8\text{H}_2\text{O}$

— **chloraureate**,  $\text{Co}(\text{NH}_3)_6\text{Cl}_3$ ,  $\text{AuCl}_3$

Very sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  containing  $\text{HCl}$  (Gibbs and Genth, Sill Am J (2) 23 330)

— **chloriodate**,  $[\text{Co}(\text{NH}_3)_6\text{Cl}_2]_2\text{I}_4\text{O}_{11} + \text{H}_2\text{O}$

— **chlorirridite**,  $\text{Co}(\text{NH}_3)_6$ ,  $\text{IrCl}_6$

Insol in boiling  $\text{H}_2\text{O}$  or dil  $\text{HCl} + \text{Aq}$  (Gibbs)

— **chlorirridate**,  $2\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $3\text{IrCl}_4$

Insol in  $\text{H}_2\text{O}$  (Gibbs)

— **chlorochromate**,  $\text{Co}(\text{NH}_3)_6\text{CrO}_4\text{Cl} + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Klobb, Bull Soc 1901, (3) 25 1027)

— **chlorofluoride**,  $\text{Co}(\text{NH}_3)_6\text{Cl}_2\text{F}$

(Bohm, Z anorg 1905, 43 339)

— **chloropalladite**,  $2\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $3\text{PdCl}_2$

Easily sol in dil  $\text{HCl} + \text{Aq}$  (Gibbs, Sill Am J (2) 37 58)

— **chloroperchlorate**,  $\text{Co}(\text{NH}_3)_6\text{Cl}(\text{ClO}_4)_2$

(Millosevich, Gazz ch it 1901, 31 (2) 285)

— **chloropermanganate**,

$\text{Co}(\text{NH}_3)_6\text{Cl}_2(\text{MnO}_4)$

Can be recrystallized from  $\text{H}_2\text{O}$  (Klobb, C R 103 384)

— **chloropermanganate ammonium chloride**,  $\text{Co}(\text{NH}_3)_6\text{Cl}_2(\text{MnO}_4)$ ,  $\text{NH}_4\text{Cl}$

Easily sol in  $\text{H}_2\text{O}$  (Klobb)

**Luteocobaltic chloropermanganate potassium chloride**,  $\text{Co}(\text{NH}_3)_6\text{Cl}_2(\text{MnO}_4)$ ,  $\text{KCl}$

Very easily sol in  $\text{H}_2\text{O}$ , with decomp into constituents, sol in  $\text{KCl} + \text{Aq}$  (Klobb)

— **chloropermanganate sodium chloride**,  $\text{Co}(\text{NH}_3)_6\text{Cl}_2(\text{MnO}_4)$ ,  $\text{NaCl}$

Very sol in  $\text{H}_2\text{O}$  (Klobb)

— **chloroplatinate**,  $2\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $3\text{PtCl}_4 + 6\text{H}_2\text{O}$

Can be recrystallized from much hot  $\text{H}_2\text{O}$  (Gibbs and Genth)

$+21\text{H}_2\text{O}$  (Gibbs and Genth)

$\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $\text{PtCl}_4 + \frac{1}{2}\text{H}_2\text{O}$  Very sl sol in cold, decomp by hot  $\text{H}_2\text{O}$  into—

$2\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $\text{PtCl}_4 + 2\text{H}_2\text{O}$  By recrystallizing from hot  $\text{H}_2\text{O}$  containing  $\text{HCl}$  this salt is converted into the above salt (Jorgensen)

— **chlororhodite**

Nearly insol in boiling  $\text{H}_2\text{O}$  or dil acids Sol in conc  $\text{HCl} + \text{Aq}$  (Gibbs, Sill Am J (2) 37 57)

— **chlororuthenate**,  $2\text{Co}(\text{NH}_3)_6\text{Cl}_2$ ,  $3\text{RuCl}_4$

Sol in dil acids (Gibbs)

— **chloroselenate**,  $\text{Co}(\text{NH}_3)_6\text{ClSeO}_4 + 3\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Klobb, Bull Soc 1901, (3) 25 1029)

— **chlorosulphate**,  $\text{Co}(\text{NH}_3)_6\text{Cl}(\text{SO}_4)$

Sol in  $\text{H}_2\text{O}$

$+3\text{H}_2\text{O}$  Only sl sol in cold  $\text{H}_2\text{O}$  (Klobb, Bull Soc 1901, (3) 25 1025)

— **ammonium chlorosulphate**,

$[\text{Co}(\text{NH}_3)_6]_4\text{Cl}_4(\text{SO}_4)_6$ ,  $3(\text{NH}_4)_2\text{SO}_4 + 6\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Klobb, Bull Soc 1901, (3) 25 1027)

— **chlorosulphate chloroplatinate**,

$2\text{Co}(\text{NH}_3)_6\text{Cl}(\text{SO}_4)$ ,  $\text{PtCl}_4$

Very sl sol in cold pure  $\text{H}_2\text{O}$  Can be recrystallized out of  $\text{H}_2\text{O}$  containing  $\text{HCl}$  (Krok)

— **chlorosulphate mercuric chloride**,

$\text{Co}(\text{NH}_3)_6\text{Cl}(\text{SO}_4)$ ,  $\text{HgCl}_2$

Scarcely sol in pure  $\text{H}_2\text{O}$ , but can be crystallized from warm acidified  $\text{H}_2\text{O}$  (Krok)

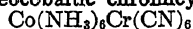
— **chlorosulphite**,  $\text{Co}(\text{NH}_3)_6(\text{SO}_3)\text{Cl} + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vortmann and Magdeburg, B 22 2637)

— **chromate**,  $[\text{Co}(\text{NH}_3)_6]_2(\text{CrO}_4)_3 + 5\text{H}_2\text{O}$

Ppt Sol in hot  $\text{H}_2\text{O}$

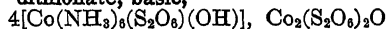
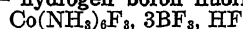
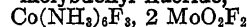
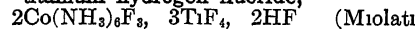
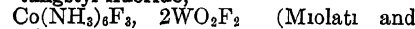
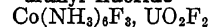
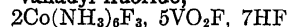
$[\text{Co}(\text{NH}_3)_6]_2(\text{Cr}_2\text{O}_7)_3 + 5\text{H}_2\text{O}$  Moderately sol in hot  $\text{H}_2\text{O}$

**Luteocobaltic chromicyanide,**

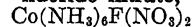
Ppt (Braun)

**— cobalticyanide,  $\text{Co}(\text{NH}_3)_6\text{Co}(\text{CN})_6$** 

Ppt

**— dithionate, basic,**Sol in  $\text{H}_2\text{O}$  and dil alcohol**— ferricyanide,  $\text{Co}(\text{NH}_3)_6\text{Fe}(\text{CN})_6 + \frac{1}{2}\text{H}_2\text{O}$** Insol in  $\text{H}_2\text{O}$  (Braun)**— fluoride,  $\text{Co}(\text{NH}_3)_6\text{F}_3$** Sl sol in cold  $\text{H}_2\text{O}$  Nearly insol in acids (Bohm, Z anorg 1905, 43 340)**— hydrogen fluoride,  $\text{Co}(\text{NH}_3)_6\text{H}_3\text{F}_6$** Sl sol in  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$  (Miolati and Rossi, Real Ac Linc 1896, (5) 5 II, 185)**— hydrogen boron fluoride,**Cryst from  $\text{H}_2\text{O}$  acidified with HF (Miolati and Rossi)**— molybdenyl fluoride,**Cryst from  $\text{H}_2\text{O}$  containing HF (Miolati and Rossi)**— silicon fluoride,****— titanium hydrogen fluoride,****— tungstyl fluoride,****— uranyl fluoride**Can be cryst from  $\text{H}_2\text{O}$  containing HF (Miolati and Rossi)**— vanadyl fluoride,**

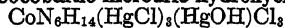
Ppt (Miolati and Rossi)

**— fluoride nitrate,**

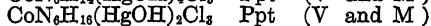
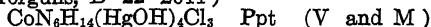
(Bohm, Z anorg 1905, 43 336)

**— hydroxide,  $\text{Co}(\text{NH}_3)_6(\text{OH})_3$** 

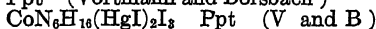
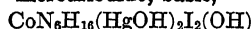
Known only in aqueous solution

**Luteocobaltic mercuric hydroxychloride,**

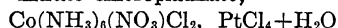
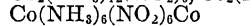
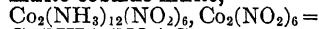
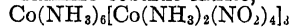
Ppt Easily decomp (Vortmann and Morgulis, B 22 2644)

**— iodide,  $\text{Co}(\text{NH}_3)_6\text{I}_3$** Insol in cold, but moderately sol in hot  $\text{H}_2\text{O}$ According to Jorgensen, contains  $\text{HNO}_3$  and has the formula  $\text{Co}_2(\text{NH}_3)_{12}\text{I}_4(\text{NO}_3)_2$ **— iodosulphate,  $\text{Co}(\text{NH}_3)_6\text{I}(\text{SO}_4)$** Can be recrystallized from hot  $\text{H}_2\text{O}$  Sl sol in warm, nearly insol in cold  $\text{H}_2\text{O}$  (Krok, B 4 711)**— mercuriodide,  $\text{Co}_2\text{N}_{12}\text{H}_{38}(\text{HgI})_3\text{I}_6$** 

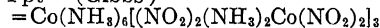
Ppt (Vortmann and Borsbach)

**— mercuriodide, basic,**Insol in  $\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Vortmann and Borsbach, B 23 2804)**— nitrate,  $\text{Co}(\text{NH}_3)_6(\text{NO}_3)_3$** Sol in  $\text{H}_2\text{O}$  Can be recrystallized from boiling  $\text{H}_2\text{O}$  Sol in about 60 pts  $\text{H}_2\text{O}$  Insol in conc  $\text{HNO}_3 + \text{Aq}$  (Jorgensen, J pr (2), 35 417)

Almost insol in acids (Rogojski, A ch (3), 41 454)

Insol in  $\text{NH}_4\text{OH}$ ,  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ , decomp by  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Gibbs and Genth) $\text{Co}(\text{NH}_3)_6(\text{NO}_3)_3$ ,  $\text{HNO}_3$  Decomp by  $\text{H}_2\text{O}$  or dil alcohol (Jorgensen, J pr (2), 44 63)**— nitrate chloroplatinate,**Not decomp by  $\text{H}_2\text{O}$  (Jorgensen)**— nitratosulphate,  $\text{Co}(\text{NH}_3)_6(\text{NO}_3)(\text{SO}_4)$** Sol in  $\text{H}_2\text{O}$  (Jorgensen)**— nitrite cobaltic nitrite,**Nearly insol in  $\text{H}_2\text{O}$  (Jorgensen)Much less sol in  $\text{H}_2\text{O}$  than the corresponding roseo salt (Gibbs)**— diamine cobaltic nitrite,**

Ppt (Gibbs)

Nearly insol in cold, sl sol in boiling  $\text{H}_2\text{O}$  (Jorgensen, Z anorg 5 179)**— oxalate,  $[\text{Co}(\text{NH}_3)_6]_2(\text{C}_2\text{O}_4)_3 + 4\text{H}_2\text{O}$** Insol in hot or cold  $\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$

**Luteocobaltic oxalate chloraurate,**  
 $2\text{Co}(\text{NH}_3)_6(\text{C}_2\text{O}_4)\text{Cl}, \text{AuCl}_3 + 4\text{H}_2\text{O}$   
 Easily sol in hot  $\text{H}_2\text{O}$  (Gibbs)

— **perchlorate,**  $\text{Co}(\text{NH}_3)_6(\text{ClO}_4)_3$   
 (Millosevich, Gazz ch it 1901, 31, (2) 285)

— **permanganate,**  $[\text{Co}(\text{NH}_3)_6]_2(\text{MnO}_4)_3$   
 Nearly insol in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  at  $0^\circ$   
 dissolve only 0.072 pt salt Moderately  
 sol in hot  $\text{H}_2\text{O}$  (Klobb, A ch, (6) 12 5)

— **persulphate sulphate,**  
 $[\text{Co}(\text{NH}_3)_6]_2\text{S}_2\text{O}_8(\text{SO}_4)_2$   
 Much less sol in  $\text{H}_2\text{O}$  than the sulphate  
 Sol in 641 pts  $\text{H}_2\text{O}$  at  $18.8^\circ$  and in 632  
 pts at  $20^\circ$  Not easily sol even in boiling  
 $\text{H}_2\text{O}$  (Jorgensen, Z anorg 1898, 17 459)

— **orthophosphate,**  $\text{Co}(\text{NH}_3)_6(\text{PO}_4) + 4\text{H}_2\text{O}$   
 Sl sol in cold  $\text{H}_2\text{O}$  Easily sol in dil acids  
 (Jorgensen)  
 $[\text{Co}(\text{NH}_3)_6]_3(\text{PO}_4)(\text{PO}_4\text{H})_3 + 5\frac{1}{2}\text{H}_2\text{O}$  (?)  
 Ppt (Braun)  
 $[\text{Co}(\text{NH}_3)_6]_2(\text{PO}_4\text{H})_3 + 4\text{H}_2\text{O}$  Ppt Easily  
 sol in very dil  $\text{HCl} + \text{Aq}$  (Jorgensen)

— **metaphosphate**  
 Ppt

— **pyrophosphate,**  $[\text{Co}(\text{NH}_3)_6]_2\text{P}_2\text{O}_{13} + 6\text{H}_2\text{O}$   
 (Gibbs, Am Acad Proc 11 29), or  
 $\text{Co}_2(\text{NH}_3)_{12}\text{P}_2\text{O}_{13}(\text{ONa})_2$  (Vortmann, B 11  
 2181), or  $\text{Co}(\text{NH}_3)_6(\text{P}_2\text{O}_7\text{Na}) + 11\frac{1}{2}\text{H}_2\text{O}$   
 (Jorgensen, J pr (2) 35 438)  
 Very nearly insol in  $\text{H}_2\text{O}$  With  $\text{H}_2\text{O}$  at  
 $80^\circ$  it is decomp into—  
 $[\text{Co}(\text{NH}_3)_6]_4(\text{P}_2\text{O}_7)_3 + 20\text{H}_2\text{O}$  Less easily  
 sol than the preceding salt

— **pyrophosphate, acid,**  $\text{Co}(\text{NH}_3)_6(\text{P}_2\text{O}_7\text{H})$   
 Wholly insol in  $\text{H}_2\text{O}$  Somewhat sol in  
 dil  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  Easily sol in  $\text{HCl} + \text{Aq}$   
 (Jorgensen)

— **sodium pyrophosphate,**  
 $\text{Co}(\text{NH}_3)_6(\text{P}_2\text{O}_7\text{Na}) + 11\frac{1}{2}\text{H}_2\text{O}$   
 Ppt Not wholly insol in cold  $\text{H}_2\text{O}$   
 Decomp by hot  $\text{H}_2\text{O}$  Less sol in  $\text{NH}_4\text{OH} +$   
 $\text{Aq}$  than in  $\text{H}_2\text{O}$  (Jorgensen)  
 $[\text{Co}(\text{NH}_3)_6]_4(\text{P}_2\text{O}_7)_3, 2\text{Co}(\text{NH}_3)_6(\text{NaP}_2\text{O}_7)$   
 $+ 39\text{H}_2\text{O}$  As above (Jorgensen)

— **selenate,**  $[\text{Co}(\text{NH}_3)_6]_2(\text{SeO}_4)_2 + 5\text{H}_2\text{O}$   
 Very sol in  $\text{H}_2\text{O}$  (Klobb, Bull Soc  
 1901, (3) 25 1028)

— **hydrogen selenate,**  
 $[\text{Co}(\text{NH}_3)_6]\text{H}(\text{SeO}_4)_2 + 2\frac{1}{2}\text{H}_2\text{O}$   
 Not decomp by  $\text{H}_2\text{O}$  (Klobb)

**Luteocobaltic ammonium selenate,**  
 $[\text{Co}(\text{NH}_3)_6]_2(\text{SeO}_4)_3, (\text{NH}_4)_2\text{SeO}_4 + 4\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$   
 $[\text{Co}(\text{NH}_3)_6]_2(\text{SeO}_4)_3, (\text{NH}_4)_2\text{SeO}_4 + 8\text{H}_2\text{O}$   
 Very sol in  $\text{H}_2\text{O}$  (Klobb)

— **sulphocyanide,**  $\text{Co}(\text{NH}_3)_6(\text{SCN})_3$   
 Decomp by hot  $\text{H}_2\text{O}$  (Miolati, Z anorg  
 1900, 23 241)

— **mercuric sulphocyanide,**  
 $\text{Co}(\text{NH}_3)_6(\text{SCN})_3, 2\text{Hg}(\text{SCN})_2$   
 Decomp by  $\text{H}_2\text{O}$   
 Cryst from dil  $\text{NH}_4\text{SCN} + \text{Aq}$  (Miolati)

— **platinum sulphocyanide,**  
 $[\text{Pt}(\text{SCN})_4]_3[\text{Co}(\text{NH}_3)_6(\text{SCN}_3)]_2$   
 Decomp by hot  $\text{H}_2\text{O}$  (Miolati)

— **silver sulphocyanide,**  
 $\text{Co}(\text{NH}_3)_6(\text{SCN})_3, 2\text{AgSCN}$   
 Decomp by hot  $\text{H}_2\text{O}$  (Miolati)

— **sulphate,**  $[\text{Co}(\text{NH}_3)_6] (\text{SO}_4)_3 + 5\text{H}_2\text{O}$   
 Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$   
 $+ 6\text{H}_2\text{O}$  (Krok, B 4 711)

— **hydrogen sulphate,**  
 $\text{Co}(\text{NH}_3)_6\text{H}(\text{SO}_4)_2$   
 Decomp by alcohol to sulphate (Jor-  
 gensen, Z anorg 1898, 17 458)

$4\{[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_3\}, 5\text{H}_2\text{SO}_4 + 10\text{H}_2\text{O}$   
 Very sol in  $\text{H}_2\text{O}$  with decomp into the normal  
 sulphate  
 When pulverized it seems to dissociate  
 slowly in contact with abs alcohol (Klobb,  
 Bull Soc 1901, (3) 25 1025)

— **ammonium sulphate,**  
 $[\text{Co}_6(\text{NH}_3)_{12}]_2(\text{SO}_4)_3, (\text{NH}_4)_2\text{SO}_4 + 8\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  with decomp (Klobb)

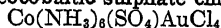
— **cerium sulphate,**  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_3,$   
 $\text{Ce}_2(\text{SO}_4)_3 + 1\frac{1}{2}\text{H}_2\text{O}$   
 Very sl sol in cold, and practically insol  
 in boiling  $\text{H}_2\text{O}$  Sol in acids (Gibbs, Am  
 Ch J 15 560)

$[\text{Co}(\text{NH}_3)_6] (\text{SO}_4)_3, 3\text{Ce}(\text{SO}_4)_2 + \text{H}_2\text{O}$  As  
 above (Wing, Sill Am J (2) 49 363)

— **lanthanum sulphate,**  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_3,$   
 $\text{La}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$   
 Sl sol in  $\text{H}_2\text{O}$  (Wing)

— **thallic sulphate,**  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_3,$   
 $\text{Tl}_2\text{O}(\text{SO}_4)_2 + 5\text{H}_2\text{O}$   
 Decomp by cold  $\text{H}_2\text{O}$  (Gibbs)

— **sulphate bromaurate,**  
 $\text{Co}(\text{NH}_3)_6(\text{SO}_4)(\text{AuBr}_4)$   
 Very sl sol in  $\text{H}_2\text{O}$  with apparent decomp  
 Insol in alcohol (Jorgensen)

**Luteocobaltic sulphate chloraurate,**Sl sol in  $\text{H}_2\text{O}$  (Jorgensen)

— **cobaltic sulphite**,  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_3)_3$ ,  
 $\text{Co}_2(\text{SO}_3)_3 + \text{H}_2\text{O} = \text{dichrocobaltic sulphite}$ ,  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_3)_3 + 2\text{H}_2\text{O}$ , which see

$[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_3)_3$ ,  $2\text{Co}_2(\text{SO}_3)_3 + 15\text{H}_2\text{O} =$   
**diamine cobaltic sulphite**,  $[\text{Co}(\text{NH}_3)_2]_2(\text{SO}_3)_2 + 5\text{H}_2\text{O}$ , which see

**Luteorhodium bromide,  $\text{Rh}(\text{NH}_3)_6\text{Br}_3$** 

Less sol in  $\text{H}_2\text{O}$  than the chloride (Jorgensen, J pr (2) 44 51)

— **chloride**,  $\text{Rh}(\text{NH}_3)_6\text{Cl}_3$

Sol in 7 to 8 pts  $\text{H}_2\text{O}$  at  $8^\circ$  (J) $+ \text{H}_2\text{O}$  Extremely efflorescent (J)

— **rhodium chloride**,  $\text{Rh}(\text{NH}_3)_6\text{Cl}_3$ ,  $\text{RhCl}_3$

Sol in  $\text{H}_2\text{O}$  (Jorgensen, Z anorg 5 174)

— **chloroplatinate**,  $2\text{Rh}(\text{NH}_3)_6\text{Cl}_3$ ,  $3\text{PtCl}_4 + 6\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in warm  $\text{HCl} + \text{Aq}$  (J)  
 $\text{Rh}(\text{NH}_3)_6\text{Cl}_3$ ,  $\text{PtCl}_4 + \frac{1}{2}\text{H}_2\text{O}$  Decomp  
 by  $\text{H}_2\text{O}$  into chloride and above salt (J)

— **nitrate**,  $\text{Rh}(\text{NH}_3)_6(\text{NO}_3)_3$

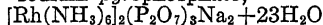
Sol in 48 to 49 pts  $\text{H}_2\text{O}$  at ord temp  
 $\text{HNO}_3 + \text{Aq}$  diluted with 5 vols  $\text{H}_2\text{O}$  ppts  
 the salt completely from aqueous solution  
 (Jorgensen, J pr (2) 44 51)

$\text{Rh}(\text{NH}_3)_6(\text{NO}_3)_3$ ,  $\text{HNO}_3$  Decomp by  
 $\text{H}_2\text{O}$  or dil alcohol (Jorgensen, J pr (2),  
 44 63)

— **orthophosphate**,  $\text{Rh}(\text{NH}_3)_6\text{PO}_4 + 4\text{H}_2\text{O}$

Sl sol in cold  $\text{H}_2\text{O}$  (J)

— **sodium pyrophosphate**,



Nearly wholly insol in  $\text{H}_2\text{O}$  Wholly insol  
 in  $\text{NH}_4\text{OH} + \text{Aq}$  (J)

— **sulphate**,  $[\text{Rh}(\text{NH}_3)_6]_2(\text{SO}_4)_3 + 5\text{H}_2\text{O}$

Sol in 43 pts  $\text{H}_2\text{O}$  at  $20^\circ$  (J)**Magnesium, Mg**

Does not decomp  $\text{H}_2\text{O}$  at ord temp, but  
 decomp slowly at  $100^\circ$   $\text{H}_2\text{O}$  containing  
 acids dissolves Mg easily Sol in cold dil  
 $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  Difficultly sol in cold  
 $\text{H}_2\text{SO}_4 + \text{Aq}$  (Bunsen) Cold nitrosulphuric  
 acid does not attack (Bunsen) Cold  
 $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{KOH} + \text{Aq}$ , or  $\text{NaOH} + \text{Aq}$  do  
 not attack (Maak, Phipps) Sol in  $\text{NH}_4\text{Cl}$   
 or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Wohler)

Very rapidly sol in  $\text{K}_2\text{S}_2\text{O}_8 + \text{Aq}$  and  
 $(\text{NH}_4)_2\text{S}_2\text{O}_8 + \text{Aq}$  with violent evolution of  
 gas (Levi, Gazz ch it 1908, 38 (1), 583)

Attacked by aqueous solution of  $\text{KCl}$ ,  
 $\text{NH}_4\text{Cl}$ ,  $\text{NaCl}$ ,  $\text{LiCl}$ ,  $\text{CuCl}_2$ ,  $\text{CdCl}_2$ ,  $\text{CoCl}_2$ ,  
 $\text{PbCl}_2$ ,  $\text{HgCl}_2$ ,  $\text{FeCl}_3$ ,  $\text{CrCl}_3$ ,  $\text{PtCl}_4$ ,  $\text{AuCl}_3$ ,  
 $\text{CuSO}_4$ ,  $\text{ZnSO}_4$ ,  $\text{FeSO}_4$  and  $\text{MnSO}_4$

Sl attacked by hot 30%  $\text{CaCl}_2 + \text{Aq}$ , not  
 by 30%  $\text{MgCl}_2 + \text{Aq}$ ,  $\text{BaCl}_2 + \text{Aq}$  and  $\text{SrCl}_2 +$   
 $\text{Aq}$  (Tommasi, Bull Soc 1899, (3), 21 886)

Not attacked by  $\text{NH}_4\text{F} + \text{Aq}$ , very slowly  
 by solutions of  $\text{BaCl}_2$ ,  $\text{CaCl}_2$ ,  $\text{KCl}$ ,  $\text{K}_3\text{Fe}(\text{CN})_6$ ,  
 $\text{NaNO}_3$ ,  $\text{Na}_2\text{S}_2\text{O}_3$  and  $\text{Na}_2\text{HPO}_4$  Solutions  
 of  $\text{NaC}_2\text{H}_3\text{O}_2$ ,  $\text{Na}_2\text{B}_4\text{O}_7$ , alum and chrome  
 alum attack vigorously Solutions of  
 $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{NH}_4\text{Cl}$ ,  $(\text{NH}_4)_2\text{C}_2\text{O}_4$ ,  $(\text{NH}_4)_2\text{S}$   
 and  $\text{Na}_2\text{CO}_3$  attack even more vigorously  
 (Mouraur, C R 1900, 130 140)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J  
 1898, 20 828)

Insol in liquid  $\text{HF}$  (Franklin, Z anorg  
 1905, 46 2)

Somewhat sol in liquid  $\text{NH}_3$ , if a clean  
 metallic surface is in contact with the pure  
 solvent (Kraus, J Am Chem Soc, 1907,  
 29 1561)

$\frac{1}{2}$ ccm oleic acid dissolves 0.0104 g  
 Mg in 6 days (Gates, J phys Chem 1911,  
 15 143)

**Magnesium arsenide,  $\text{Mg}_3\text{As}_2$** 

Decomp on air (Parkinson, Chem Soc  
 5 127)

**Magnesium azonide,  $\text{Mg}(\text{N}_3)_2$** 

Decomp by hot  $\text{H}_2\text{O}$  (Curtius, J pr  
 1898, (2) 58 292)

**Magnesium boride,  $\text{Mg}_3\text{B}_2$** 

Sol in  $\text{HCl} + \text{Aq}$  (Winkler, B 23 774)

**Magnesium bromide,  $\text{MgBr}_2$** 

Deliquescent Very sol in  $\text{H}_2\text{O}$  with evolu-  
 tion of heat

Sat  $\text{MgBr}_2 + \text{Aq}$  contains at

$-18^\circ$	$+17^\circ$	$48^\circ$	$62^\circ$	$97^\circ$
52	58	60	9	62
5 8 % $\text{MgBr}_2$				

(Etard, A ch 1894, (7), 2 541)

See also  $\text{MgBr}_2 + 6\text{H}_2\text{O}$ 

Sp gr of  $\text{MgBr}_2 + \text{Aq}$  at  $19.5^\circ$  containing

5	10	15	20	25 % $\text{MgBr}_2$
1.043	1.087	1.137	1.191	1.247

30	35	40	45	50 % $\text{MgBr}_2$
1.31	1.377	1.451	1.535	1.625

(Kremers, Pogg 108 118, calculated by  
 Gerlach, Z anal 8 285)

 $\text{MgBr}_2 + \text{Aq}$  is sl decomp by evaporation

Solubility of  $\text{MgBr}_2$  in alcohols

$\text{MgBr}_2$  forms with methyl alcohol a complex,  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{OH}$

Solubility of  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{OH}$  in  $\text{CH}_3\text{OH}$  at  $t^\circ$ 

$t^\circ$	% by weight of $\text{MgBr}_2$ $6\text{CH}_3\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2$ $6\text{CH}_3\text{OH}$
0	42 6	130	63 6
20	44 6	140	66 8
40	46 7	150	70 2
60	48 9	160	74 0
80	51 4	170	78 5
100	55 5	180	84 5
110	58 0	185	88 0
120	60 7	190 mpt	100

(Menschutkin, Z anorg 1907, 52 11)

$\text{MgBr}_2$  forms with ethyl alcohol a complex,  $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$

Solubility of  $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$  in  $\text{C}_2\text{H}_5\text{OH}$  at  $t^\circ$ 

$t^\circ$	% by weight of $\text{MgBr}_2$ $6\text{C}_2\text{H}_5\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2$ $6\text{C}_2\text{H}_5\text{OH}$
0	17 2	80	73 8
10	24 9	85	76 2
20	32 7	90	78 7
30	40 3	95	82 3
40	47 8	100	86 7
50	55 1	103	90 0
60	62 2	106	94 4
70	68 8	108 5 mpt	100
75	71 4		

(Menschutkin)

$\text{MgBr}_2$  forms with propyl alcohol a complex,  $\text{MgBr}_2 \cdot 6\text{C}_3\text{H}_7\text{OH}$

Solubility of  $\text{MgBr}_2 \cdot 6\text{C}_3\text{H}_7\text{OH}$  in  $\text{C}_3\text{H}_7\text{OH}$  at  $t^\circ$ 

$t^\circ$	% by weight of $\text{MgBr}_2$ $6\text{C}_3\text{H}_7\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2$ $6\text{C}_3\text{H}_7\text{OH}$
0	77 9	43	93 0
10	81 5	46	94 3
20	85 1	48	95 8
30	89 5	50	97 8
40	92 0	52 mpt	100

(Menschutkin)

$\text{MgBr}_2$  forms with isobutylalcohol a complex,  $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_4\text{H}_9\text{OH}$

Solubility of  $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_4\text{H}_9\text{OH}$  in  $\text{C}_4\text{H}_9\text{OH}$  at  $t^\circ$ 

$t^\circ$	% by weight of $\text{MgBr}_2$ $6(\text{iso})\text{C}_4\text{H}_9\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2$ $6(\text{iso})\text{C}_4\text{H}_9\text{OH}$
0	55 8	60	82 4
10	60 5	65	84 2
20	65 2	71	88 0
30	69 8	75	92 0
40	74 3	77	94 6
50	78 5	80 mpt	100

(Menschutkin)

$\text{MgBr}_2$  forms with isoamylalcohol a complex,  $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_5\text{H}_{11}\text{OH}$

Solubility of  $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_5\text{H}_{11}\text{OH}$  in  $\text{C}_5\text{H}_{11}\text{OH}$  at  $t^\circ$ 

$t^\circ$	% by weight of $\text{MgBr}_2$ $6(\text{iso})\text{C}_5\text{H}_{11}\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2$ $6(\text{iso})\text{C}_5\text{H}_{11}\text{OH}$
0	70 2	38	88 7
10	75 6	40	90 0
20	80 2	42	92 0
30	84 5	44	94 2
35	86 7	46 mpt	100

(Menschutkin)

Solubility in ether at  $t^\circ$ 

$t^\circ$	% $\text{MgBr}_2$	% $\text{MgBr}_2 \cdot 2\text{C}_4\text{H}_{10}\text{O}$
— 8	0 6	1 08
0	0 8	1 44
+10	1 27	2 3
14	1 64	2 95
16	1 93	3 48
18	2 3	4 14
20	2 7	4 86
22 mpt	3 22	5 80

(Menschutkin, Z anorg 1906, 49, 36)

Solubility of  $\text{MgBr}_2 \cdot 2\text{C}_4\text{H}_{10}\text{O}$  in ether at  $t^\circ$ 

"Lower solution" = the melted  $\text{MgBr}_2 \cdot 2\text{C}_4\text{H}_{10}\text{O}$  which does not mix with the ether above

$t^\circ$	Composition of lower solution		Composition of the upper layer	
	% $\text{MgBr}_2$	% $\text{MgBr}_2$ $2\text{C}_4\text{H}_{10}\text{O}$	% $\text{MgBr}_2$	% $\text{MgBr}_2$ $2\text{C}_4\text{H}_{10}\text{O}$
—10	42 0	75 7	1 8	3 2
0	41 0	73 9	2 3	4 1
+10	40 1	72 2	2 8	5 0
20	39 3	70 8	3 3	5 9
30	38 7	69 8	3 8	6 8
40	38 2	68 8	4 3	7 7
50	37 8	68 0	4 7	8 5
60	37 6	67 7	5 1	9 2
70	37 6	67 7	5 4	9 7
80	37 8	68 0	5 6	10 0
90	38 1	68 6	5 7	10 2

(Menschutkin)



Solubility of  $\text{MgBr}_2$  in formic acid  
 $\text{MgBr}_2$  forms with formic acid a complex,  
 $\text{MgBr}_2 \cdot 6\text{HCOOH}$

Solubility of  $\text{MgBr}_2 \cdot 6\text{HCOOH}$  in  $\text{HCOOH}$   
 at  $t^\circ$

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 6\text{HCOOH}$
0	49.8
20	57.5
40	65.1
60	73.1
70	78.1
80	86.0
86	95.0
88 mpt	100

(Menschutkin, Z anorg 1907, 54 90)

Solubility of  $\text{MgBr}_2$  in acetic acid  
 $\text{MgBr}_2$  forms with acetic acid a complex,  
 $\text{MgBr}_2 \cdot 6\text{CH}_3\text{COOH}$

Solubility of  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{COOH}$  in  
 $\text{CH}_3\text{COOH}$  at  $t^\circ$

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 6\text{CH}_3\text{COOH}$
17	0.3
30	1.5
50	4.5
60	7.9
70	16.2
80	38.5
85	49.5
90	57.7
100	71.8
105	80.0
110	89.5
112 mpt	100.0

(Menschutkin)

Solubility of  $\text{MgBr}_2$  in acetic anhydride  
 $\text{MgBr}_2$  forms with acetic anhydride a complex,  
 $\text{MgBr}_2 \cdot 6(\text{CH}_3\text{CO})_2\text{O}$

Solubility of  $\text{MgBr}_2 \cdot 6(\text{CH}_3\text{CO})_2\text{O}$  in  
 $(\text{CH}_3\text{CO})_2\text{O}$  at  $t^\circ$

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 6(\text{CH}_3\text{CO})_2\text{O}$
0	26.4
30	30.0
60	37.7
90	44.5
120	57.8
130	69.8
135	85.0
136-137 mpt	100

(Menschutkin, Z anorg 1909, 61 112)

Solubility of  $\text{MgBr}_2$  in acetone  
 $\text{MgBr}_2$  forms with acetone a complex,  
 $\text{MgBr}_2 \cdot 3\text{CH}_3\text{COCH}_3$

Solubility of  $\text{MgBr}_2 \cdot 3\text{CH}_3\text{COCH}_3$  in  
 $\text{CH}_3\text{COCH}_3$  at  $t^\circ$

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 3\text{CH}_3\text{COCH}_3$
0	0.2
30	0.8
60	1.45
70	2.0
72	3.7
73	5.5
74	14.0
75	50.0
76	71.6
80	83.3
84	89.8
88	95.2
92 mpt	100

(Menschutkin, Z anorg 1907, 53 30)

Solubility of  $\text{MgBr}_2$  in acetamide  
 $\text{MgBr}_2$  forms with acetamide a complex,  
 $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONH}_2$

Solubility of  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONH}_2$  in  
 $\text{CH}_3\text{CONH}_2$  at  $t^\circ$

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONH}_2$
50.5	56.0
70	57.8
90	60.5
110	65.0
130	71.5
150	80.0
160	85.5
165	90.0
169 mpt	100.0

(Menschutkin, Z anorg 1909, 61 106)

Solubility of  $\text{MgBr}_2$  in acetanilide  
 $\text{MgBr}_2$  forms with acetanilide a complex,  
 $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONHC}_6\text{H}_5$

Solubility of  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONHC}_6\text{H}_5$  in  
 $\text{CH}_3\text{CONHC}_6\text{H}_5$  at  $t^\circ$

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONHC}_6\text{H}_5$
107.5	9.0
140	19.3
170	29.6
185	39.0
195	49.0
200	59.5
205	73.2
209 mpt	100.0

(Menschutkin, Z anorg 1909, 61 109)

Solubility of  $\text{MgBr}_2$  in aniline

$\text{MgBr}_2$  forms with aniline three complexes,  
 $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$ ,  $\text{MgBr}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$ ,  
 $\text{MgBr}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$

## Solubility of these complexes in aniline

Solubility of  $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$  in  $\text{C}_6\text{H}_5\text{NH}_2$

$t^\circ$	% by weight of $\text{MgBr}_2$ $6\text{C}_6\text{H}_5\text{NH}_2$
10	3 2
30	3 9
50	5 1
70	7 5
90	12 8
100	18 5
103 5	27 5

Solubility of  $\text{MgBr}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$  in  $\text{C}_6\text{H}_5\text{NH}_2$

$t^\circ$	% by weight of $\text{MgBr}_2$ $4\text{C}_6\text{H}_5\text{NH}_2$
103	24 0
120	24 3
140	24 9
160	26 0
180	28 3
200	33 5
220	45 0
230	55 0
237	76 3

Solubility of  $\text{MgBr}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$  in  $\text{C}_6\text{H}_5\text{NH}_2$

$t$	% by weight of $\text{MgBr}_2$ $2\text{C}_6\text{H}_5\text{NH}_2$
237	76 3
250	77 3
260	78 1
270	79 0

(Menschutkin, Z anorg 1907, 52 159)

Solubility of  $\text{MgBr}_2$  in benzaldehyde

$\text{MgBr}_2$  forms with benzaldehyde a complex,  $\text{MgBr}_2 \cdot 3\text{C}_6\text{H}_5\text{CHO}$

Solubility of  $\text{MgBr}_2 \cdot 3\text{C}_6\text{H}_5\text{CHO}$  in  
 $\text{C}_6\text{H}_5\text{CHO}$  at  $t^\circ$

$t^\circ$	% by wt $\text{MgBr}_2$ $3\text{C}_6\text{H}_5\text{CHO}$	$t$	% by wt $\text{MgBr}_2$ $3\text{C}_6\text{H}_5\text{CHO}$
0	0 7	140	17 8
30	1 3	145	37 5
60	1 9	146	65 0
80	2 5	148	84 5
100	3 4	153	93 2
120	6 0	159 mpt	100
130	9 5		

(Menschutkin, Z anorg 1907, 53 26)

Solubility of  $\text{MgBr}_2$  in methylal

$\text{MgBr}_2$  forms with methylal a complex,  
 $\text{MgBr}_2 \cdot 2\text{CH}_2(\text{OCH}_3)_2$

Solubility of  $\text{MgBr}_2 \cdot 2\text{CH}_2(\text{OCH}_3)_2$  in  
 $\text{CH}_2(\text{OCH}_3)_2$  at  $t^\circ$

$t^\circ$	% by wt $\text{MgBr}_2$ $2\text{CH}_2(\text{OCH}_3)_2$
20	0 3
40	0 45
60	0 6
80	0 75
100	0 9
106	1 1
106	86 2
108	90 8
110	95 4
112 mpt	100

(Menschutkin, Z anorg 1907, 53 32)

Solubility of  $\text{MgBr}_2$  in dimethylcarbinol

$\text{MgBr}_2$  forms with dimethylcarbinol a complex,  $\text{MgBr}_2 \cdot 4(\text{CH}_3)_2\text{CHOH}$

Solubility of  $\text{MgBr}_2 \cdot 4(\text{CH}_3)_2\text{CHOH}$  in  
 $(\text{CH}_3)_2\text{CHOH}$  at  $t^\circ$

$t^\circ$	% by weight of $\text{MgBr}_2$ $4(\text{CH}_3)_2\text{CHOH}$	$t^\circ$	% by weight of $\text{MgBr}_2$ $4(\text{CH}_3)_2\text{CHOH}$
0	40 0	110	62 5
20	42 2	120	67 3
40	45 0	130	74 0
60	48 5	136	83 6
80	53 3	138	90 00
100	59 0	139 mpt	100

(Menschutkin)

Solubility of  $\text{MgBr}_2$  in trimethylcarbinol

$\text{MgBr}_2$  forms with trimethylcarbinol a complex,  $\text{MgBr}_2 \cdot 4(\text{CH}_3)_3\text{COH}$

Solubility of  $\text{MgBr}_2 \cdot 4(\text{CH}_3)_3\text{COH}$  in  
 $(\text{CH}_3)_3\text{COH}$  at  $t^\circ$

$t$	% by weight of $\text{MgBr}_2$ $4(\text{CH}_3)_3\text{COH}$	$t^\circ$	% by weight of $\text{MgBr}_2$ $4(\text{CH}_3)_3\text{COH}$
24 4	0 06	65	50 5
25	1 0	70	62 5
35	9 5	75	77 0
45	19 1	77 5	85 0
55	32 2	79	91 5
60	40 5	80 mpt	100

(Menschutkin)

Solubility of  $\text{MgBr}_2$  in phenylhydrazine

$\text{MgBr}_2$  forms with  $\text{C}_6\text{H}_5\text{NHNH}_2$  a complex,  
 $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NHNH}_2$

Solubility of  $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NHNH}_2$  in  $\text{C}_6\text{H}_5\text{NHNH}_2$  at  $t^\circ$

$t^\circ$	% by wt of $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NHNH}_2$
20	3 0
40	7 0
60	16 4
80	33 0
99	54 8
100	54 8
140	60 8
180	68 4
200	73 4

(Menschutkin, Z anorg 1907, 52 162)

Solubility of  $\text{MgBr}_2$  in urea

$\text{MgBr}_2$  forms with urea a complex,  $\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$

Solubility of  $\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$  in urea at  $t^\circ$

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$
108 5	24 2
115	29 8
120	35 0
125	41 6
127	45 5
130	60 0

(Menschutkin, Z anorg 1909, 61 116)

$\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$  decomposes at  $130^\circ$  giving  $\text{MgBr}_2 \cdot 4\text{CO}(\text{NH}_2)_2$

Solubility of  $\text{MgBr}_2 \cdot 4\text{CO}(\text{NH}_2)_2$  in urea at  $t^\circ$

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 4\text{CO}(\text{NH}_2)_2$
130	58 0
145	60 7
160	67 2
165	71 4
170	83 7
171	96 0

(Menschutkin, Z anorg 1909, 61 116)

Solubility of  $\text{MgBr}_2$  in urethane

$\text{MgBr}_2$  forms with urethane a complex,  $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$

Solubility of  $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$  in  $\text{NH}_2\text{COOC}_2\text{H}_5$  at  $t^\circ$

$t^\circ$	% by wt $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$
35	43 3
50	45 6
70	51 3
80	56 2
85	59 8
90	66 5
*91 5	75 5

\* Mpt of  $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$   
(Menschutkin, Z anorg 1909, 61 113)

$\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$  decomposes  $90.5-91^\circ$  forming  $\text{MgBr}_2 \cdot 4\text{NH}_2\text{COOC}_2\text{H}_5$

Solubility of  $\text{MgBr}_2 \cdot 4\text{NH}_2\text{COOC}_2\text{H}_5$  in  $\text{NH}_2\text{COOC}_2\text{H}_5$  at  $t^\circ$

$t$	% by wt $\text{MgBr}_2 \cdot 4\text{NH}_2\text{COOC}_2\text{H}_5$
91	69 4
100	73 8
110	80 0
115	84 1
120	90 0
123 mpt	100 0

(Menschutkin)

+ $6\text{H}_2\text{O}$

Solubility of  $\text{MgBr}_2 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	% by weight of $\text{MgBr}_2 + 6\text{H}_2\text{O}$	$t^\circ$	% by weight of $\text{MgBr}_2 + 6\text{H}_2\text{O}$
0	76 0	120	89 0
20	78 1	140	92 0
40	80 2	150	94 9
60	82 3	160	98 0
80	84 4	164 mpt	100
100	86 6		

(Menschutkin, Z anorg 1907, 52 153)

Sp gr of solution sat at  $18^\circ = 1.655$ , an contains 50.8%  $\text{MgBr}_2$  (Mylius and Funf B 1897, 30 1718)

Sl sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Sol in alcohol Sol in acetone (Naumann, B 1904, 37 4328, Eidmann, C C 1899, II 1014)

Difficultly sol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

+ $10\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Panfiloff, Chem Soc 26 234)

**Magnesium manganous bromide,  $\text{MgBr}_2 \cdot 2\text{MnBr}_2 + 12\text{H}_2\text{O}$**

Deliquescent (Saunders, Am Ch J 14 150)

**Magnesium mercuric bromide,  $\text{MgBr}_2 \cdot \text{HgBr}_2$**

Deliquescent

$\text{MgBr}_2 \cdot 2\text{HgBr}_2$  Not deliquescent

**Magnesium molybdenyl bromide,  $\text{MgBr}_2 \cdot \text{MoOBr}_3 + 7\text{H}_2\text{O}$**

(Weinland and Knoll, Z anorg 1905, 44 112)

**Magnesium potassium bromide,  $\text{MgBr}_2 \cdot 2\text{KBr} + 6\text{H}_2\text{O}$**

Easily sol in  $\text{H}_2\text{O}$ , from which  $\text{KBr}$  crystallises at  $75$  to  $87^\circ$  Alcohol dissolves out  $\text{MgBr}_2$  (Lowig, Repert 29 261)

Formula is  $\text{MgBr}_2$ ,  $\text{KBr} + 6\text{H}_2\text{O}$  De-  
liquescant (Lerch, J pr (2) 28 338)

### Magnesium stannic bromide

See Bromostannate, magnesium

### Magnesium chloride, $\text{MgCl}_2$

Deliquescent Very sol in  $\text{H}_2\text{O}$  with evolution of heat The solution decomposes on evaporation losing  $\text{HCl}$ , when less than 6 mols  $\text{H}_2\text{O}$  are present to 1 mol  $\text{MgCl}_2$  (Casaseca, C R 37 350)

Anhydrous Sol in 1 857 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach)

Sol in 1 pt cold  $\text{H}_2\text{O}$  (Fourcroy)  
Sat  $\text{MgCl}_2 + \text{Aq}$  at  $12.5^\circ$  contains 64.8%  $\text{MgCl}_2$  (Hassenfratz)  
100 pts  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 200 pts  $\text{MgCl}_2$  (Ure s Diet)

100 pts  $\text{H}_2\text{O}$  dissolve 52.2 pts  $\text{MgCl}_2$  at  $0^\circ$  and sp gr of sat solution = 1.3619 at  $15^\circ$  (Engel, Bull Soc (2) 47 318)

1000 mols  $\text{H}_2\text{O}$  dissolve 108 mols  $\text{MgCl}_2$  at  $25^\circ\text{C}$  (Löwenherz, Z phys Ch 1894, 13 479)

100 mols  $\text{MgCl}_2 + \text{Aq}$  contain at  $t^\circ$   
 $t^\circ$  67.5 68.5 68.7 79.5 79.95  
 Mol  $\text{MgCl}_2$  11.58 11.92 11.71 12.28 12.39  
 $t^\circ$  116.67 152.6 181.2 186  
 Mol  $\text{MgCl}_2$  16.2 18.24 23.8 24.1-24.4  
 (Vant Hoff and Meyerhoffer, B A B 1897, 73)

### Solubility of $\text{MgCl}_2$ in $\text{H}_2\text{O}$ at $t^\circ$

$t^\circ$	% $\text{MgCl}_2$	Solid phase
-10	11.4	Ice
-20	16	
-30	19.4	
-33.6	20.6	Ice + $\text{MgCl}_2 \cdot 12\text{H}_2\text{O}$
-20	26.7	
-16.4	30.5	$\text{MgCl}_2 \cdot 12\text{H}_2\text{O}$
-16.8	31.6	
-3.4	34.3	$\text{MgCl}_2 \cdot 12\text{H}_2\text{O} +$
		$\text{MgCl}_2 \cdot 8\text{H}_2\text{O}$
0	34.6	$\text{MgCl}_2 \cdot 8\text{H}_2\text{O} + \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
10	34.9	
20	35.3	"
22	35.6	
40	36.5	"
60	37.9	
80	39.8	"
100	42.2	
116.7	46.1	$\text{MgCl}_2 \cdot 6\text{H}_2\text{O} + \text{MgCl}_2 \cdot 4\text{H}_2\text{O}$
152.6	49.1	
181.5	55.8	$\text{MgCl}_2 \cdot 4\text{H}_2\text{O} + \text{MgCl}_2 \cdot 2\text{H}_2\text{O}$
186	56.1	

(Landolt-Bornstein, Tab 5th Ed 1912 480)

See also  $\text{MgCl}_2 + 6\text{H}_2\text{O}$

### Sp gr of $\text{MgCl}_2 + \text{Aq}$ at $15^\circ$

% $\text{MgCl}_2$	Sp gr	% $\text{MgCl}_2$	Sp gr	% $\text{MgCl}_2$	Sp gr
1	1.0084	13	1.1130	25	1.2274
2	1.0169	14	1.1220	26	1.2378
3	1.0253	15	1.1311	27	1.2482
4	1.0338	16	1.1404	28	1.2586
5	1.0422	17	1.1498	29	1.2690
6	1.0510	18	1.1592	30	1.2794
7	1.0597	19	1.1686	31	1.2903
8	1.0684	20	1.1780	32	1.3012
9	1.0772	21	1.1879	33	1.3121
10	1.0859	22	1.1977	34	1.3230
11	1.0949	23	1.2076	35	1.3340
12	1.1040	24	1.2175		

(Gerlach, Z anal 8 281)

### Sp gr of $\text{MgCl}_2 + \text{Aq}$ at $18^\circ$

% $\text{MgCl}_2$	Sp gr	% $\text{MgCl}_2$	Sp gr	% $\text{MgCl}_2$	Sp gr
5	1.0416	20	1.1764	34	1.3210
10	1.0859	30	1.2779		

(Kohlrausch, W Ann 1879 1)

Sp gr of  $\text{MgCl}_2 + \text{Aq}$  at  $0^\circ$  S = pts salt in 100 pts of solution,  $S_1$  = mols salt in 100 mols solution

S	$S_1$	Sp gr
29.2056	7.230	1.2788
20.9293	4.762	1.1927
15.7989	3.423	1.1427
11.3249	2.355	1.1007
6.2008	1.233	1.0545

(Charpy, A ch (6) 29 23)

### Sp gr of $\text{MgCl}_2 + \text{Aq}$ at $19.5^\circ$

Pts $\text{MgCl}_2$ in 100 pts $\text{H}_2\text{O}$	Sp gr	Pts $\text{MgCl}_2$ in 100 pts $\text{H}_2\text{O}$	Sp gr
10.7	1.0826	35.3	1.2388
22.0	1.1592	51.5	1.3235

(Kremers, Pogg 104 155)

Sp gr of  $\text{MgCl}_2 + \text{Aq}$  at  $14^\circ$ 

$\frac{\% \text{MgCl}_2}{\% + 6\text{H}_2\text{O}}$	Sp gr	$\frac{\% \text{MgCl}_2}{\% + 6\text{H}_2\text{O}}$	Sp gr	$\frac{\% \text{MgCl}_2}{\% + 6\text{H}_2\text{O}}$	Sp gr
0	0 9993	17	1 0682	34	1 1407
1	1 0033	18	1 0724	35	1 1451
2	1 0073	19	1 0765	36	1 1495
3	1 0113	20	1 0807	37	1 1540
4	1 0154	21	1 0849	38	1 1584
5	1 0194	22	1 0891	39	1 1628
6	1 0234	23	1 0933	40	1 1673
7	1 0274	24	1 0976	41	1 1718
8	1 0314	25	1 1018	42	1 1763
9	1 0355	26	1 1061	43	1 1809
10	1 0395	27	1 1103	44	1 1855
11	1 0435	28	1 1146	45	1 1901
12	1 0476	29	1 1189	46	1 1948
13	1 0517	30	1 1232	47	1 1995
14	1 0558	31	1 1275	48	1 2042
15	1 0599	32	1 1319		
16	1 0641	33	1 1363		

(Oudemans, Z anal 7 420)

Sp gr of  $\text{MgCl}_2 + \text{Aq}$  at  $24^\circ$ 

$\frac{\% \text{MgCl}_2}{\% + 6\text{H}_2\text{O}}$	Sp gr	$\frac{\% \text{MgCl}_2}{\% + 6\text{H}_2\text{O}}$	Sp gr	$\frac{\% \text{MgCl}_2}{\% + 6\text{H}_2\text{O}}$	Sp gr
2	1 0069	30	1 1062	58	1 2167
4	1 0138	32	1 1137	60	1 2252
6	1 0207	34	1 1212	62	1 2338
8	1 0276	36	1 1288	64	1 2425
10	1 0345	38	1 1364	66	1 2513
12	1 0415	40	1 1441	68	1 2602
14	1 0485	42	1 1519	70	1 2692
16	1 0556	44	1 1598	72	1 2783
18	1 0627	46	1 1677	74	1 2875
20	1 0698	48	1 1756	76	1 2968
22	1 0770	50	1 1836	78	1 3063
24	1 0842	52	1 1918	80	1 3159
26	1 0915	54	1 2000		
28	1 0988	56	1 2083		

(Gerlach, Z anal 8 283 Calculated from Schiff)

Sp gr of  $\text{MgCl} + \text{Aq}$  at  $25^\circ$ 

Concentration of $\text{MnCl}_2 + \text{Aq}$	Sp gr
1-normal	1 1375
$\frac{1}{2}$ - "	1 0188
$\frac{1}{4}$ - "	1 0091
$\frac{1}{8}$ - "	1 0043

(Wagner, Z phys Ch 1890, 5 38)

Sp gr of  $\text{MgCl}_2 + \text{Aq}$ 

$\frac{1}{2} \text{MgCl}_2 \text{ g in 1000 g of solution}$	Sp gr $16^\circ/16^\circ$
0	1 000000
0 4400	1 000372
0 8801	1 000741
1 7780	1 001458
3 4533	1 002888
7 4691	1 006219
14 7187	1 012235
29 6307	1 024647

(Dyken, Z phys Ch 1897, 24 108)

Sp gr of  $\text{MgCl}_2$  at  $20^\circ$ 

p = per cent strength of solution, d = o  
served density, w = volume conc in gram  
per cc  $\left(\frac{pd}{100} = w\right)$

p	d	w
28 83	1 2569	0 36237
25 59	1 2241	0 31327
20 31	1 1735	0 23842
15 79	1 1324	0 17877
10 185	1 0833	0 11033
8 058	1 0650	0 08583
5 919	1 0473	0 06198
3 913	1 0304	0 04022
3 903	1 0240	0 03210
1 743	1 0126	0 01765

(Barnes, J Phys Chem 1898, 2 546)

Sp gr of  $\text{MgCl}_2 + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	Concentration of $\text{MgCl}_2 + \text{Aq}$	Sp gr
23	1 pt $\text{MgCl}_2$ in 8 1874 pts $\text{H}_2\text{O}$	1 090
24	1 pt " " 102 1 " "	1 006

(Hittorf, Z phys Ch 1902, 39 628)

Sp gr of  $\text{MgCl}$  at  $0^\circ$ 

G  $\text{MgCl}_2$  in 100 ccm of solution 6 7158 9 950  
Sp gr 1 0591 1 08

G  $\text{MgCl}_2$  in 100 ccm of sol 13 8111 20 00  
Sp gr 1 1106 1 16

(Bremer, C C 1902, I 293)

Sp gr of  $\text{MgCl}_2 + \text{Aq}$  at  $20^\circ$  containing  
g mols  $\text{MgCl}_2$  per l

M 0 00493 0 007327 0 01 0 0310  
Sp gr 1 000344 1 000524 1 000842 1 0027

M 0 05108 0 07171 0 10 0 25  
Sp gr 1 004224 1 006036 1 008505 1 02090

M 0 50 0 75 0 9415  
Sp gr 1 038496 1 056905 1 069617

(Jones and Pearce, Am Ch J 1907, 38 690)

$\text{MgCl}_2 + \text{Aq}$  containing 10%  $\text{MgCl}_2$  boils at  $101.6^\circ$ , containing 20%  $\text{MgCl}_2$  boils at  $106.2^\circ$ , containing 30%  $\text{MgCl}_2$  boils at  $115.6^\circ$  (Gerlach)

Sat  $\text{MgCl}_2 + \text{Aq}$  forms a crust at  $122.5^\circ$ , and contains 52.9 pts  $\text{MgCl}_2$  to 100 pts  $\text{H}_2\text{O}$  (Gerlach, Z anal 26 426)

B-pt of  $\text{MgCl}_2 + \text{Aq}$  P=pts  $\text{MgCl}_2$  to 100 pts  $\text{H}_2\text{O}$

B-pt	P	B-pt	P	B-pt	P
101°	4 9	111°	34 6	121°	50 8
102	9 2	112	36 6	122	52 2
103	13 2	113	38 4	123	53 6
104	16 7	114	40 2	124	55 0
105	19 9	115	41 8	125	56 4
106	22 5	116	43 4	126	57 7
107	25 0	117	44 9	127	59 0
108	27 5	118	46 4	128	60 3
109	29 9	119	47 9	129	61 6
110	32 3	120	49 4	130	62 9

(Gerlach, Z anal 26 440)

B-pt of  $\text{MgCl}_2 + \text{Aq}$  containing %  $\text{MgCl}_2$

% $\text{MgCl}_2$	B-pt	% $\text{MgCl}_2$	B-pt
4 6	101°	11 6	103°
8 4	102	14 3	104

(Skinner, Chem Soc 61 341)

Sol in  $\text{KCl} + \text{Aq}$  at  $50^\circ$  (Uhlbg, C C 1913, II 749)

Sol in 7 pts alcohol at  $15^\circ$  (Bergmann)  
5 moderate heat (B)

100 pts alcohol of given sp gr dissolve pts  $\text{MgCl}_2$

Sp gr	Pts $\text{MgCl}_2$	Sp gr	Pts $\text{MgCl}_2$
0.900	21 25	0.834	36 25
0.848	23 7.5	0.817	50 00

(Kilwan)

$\text{MgCl}_2 + 6\text{H}_2\text{O}$  is sol in 5 pts alcohol of 0.90 sp gr and in 2 pts alcohol of 0.817 sp gr  
Sol in 0.1828 pt strong alcohol at  $82.5^\circ$  (Wenzel)

B-pt of an alcoholic solution of  $\text{MgCl}_2$

% $\text{MgCl}_2$	B-pt
5 56	$78.43^\circ + 0.73^\circ$
8 53	" +1 34
9 62	" +1 77
13 84	" +3 54

(Skinner, Chem Soc 61 341)

Even more sol in acetic ether than  $\text{CaCl}_2$  (Cann, C R 102 363)

Sol in boiling amyl alcohol (Riggs, Sill Am J 144 103)

Sol in anhydrous pyridine Sol in 97%, 95% and 93% pyridine + Aq (Kahlenberg, J Am Chem Soc 1908, 30 1107)

Insol in  $\text{CS}_2$  (Arcetowski, Z anorg 1894, 6 257)

Sl sol in benzonitrile (Naumann, B 1914, 47 1369)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

+  $2\text{H}_2\text{O}$  Very deliquescent (Ditte, A ch 1881, (5) 22 560)

+  $4\text{H}_2\text{O}$  (van't Hoff and Meyerhoffer)

+  $6\text{H}_2\text{O}$  Deliquescent Sol in 0.6 pt cold, and 0.273 pt hot  $\text{H}_2\text{O}$  (Casaseca, l c)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	1000 mols $\text{H}_2\text{O}$ dissolve mols $\text{MgCl}_2$	100 g $\text{H}_2\text{O}$ diss solve g $\text{MgCl}_2$
3 5	99 6	52 65
25 0	104 5	55 26
50 0	110 6	58 66

(Biltz and Marcus, Z anorg 1911, 71 169)

Solubility in  $\text{KCl} + \text{NH}_4\text{Cl} + \text{Aq}$  at  $25^\circ$  has been studied (Biltz and Marcus, Z anorg 1911, 71 178)

When the solid phases are  $\text{MgSO}_4 + 6\text{H}_2\text{O}$  and  $\text{MgCl}_2 + 6\text{H}_2\text{O}$ , 1000 mols  $\text{H}_2\text{O}$  dissolve 104 mols  $\text{MgCl}_2$  and 14 mols  $\text{MgSO}_4$  at  $25^\circ$  (Lowenherz, Z phys Ch 1894, 13 480)

Solubility of  $\text{MgCl}_2 + 6\text{H}_2\text{O}$  in  $(\text{NH}_4)\text{MgCl}_2 + 6\text{H}_2\text{O} + \text{Aq}$  at  $t^\circ$

$t^\circ$	Per 1000 mols $\text{H}_2\text{O}$	
	Mols $\text{NH}_4\text{Cl}$	Mols $\text{MgCl}_2$
3 5	0 5	99 5
25 0	0 5	103 8
50 0	0 8	111 2

(Biltz and Marcus, Z anorg 1911, 71 170)

Solubility data of  $\text{MgCl}_2 + \text{KCl} + \text{MgKCl}_2$  are given by van't Hoff and Meyerhoffer (Z phys Ch 1899, 30 64)

+  $8\text{H}_2\text{O}$  Pptd from an aqueous solution which contains about 10 mols  $\text{H}_2\text{O}$  to 1 mol  $\text{MgCl}_2$

+  $12\text{H}_2\text{O}$  Pptd from an aq solution which contains 1 mol  $\text{MgCl}_2$  in about 12.06 mols of  $\text{H}_2\text{O}$  (Bogorodsky, C C 1899, I 246)

Magnesium manganous chloride,  $\text{MgCl}_2, 2\text{MnCl}_2 + 12\text{H}_2\text{O}$

Deliquescent Very sol in  $\text{H}_2\text{O}$  and alcohol (Saunders, Am Ch J 14 148)

$2\text{MgCl}_2, \text{MnCl}_2 + 12\text{H}_2\text{O}$  Ppt Deliquesces in the air (Gossner, C C 1904, I 707)

Magnesium mercuric chloride,  $\text{MgCl}_2, \text{HgCl}_2 + 6\text{H}_2\text{O}$

Very deliquescent More sol than the following salt (v Bonsdorff, Pogg 17 133)

$\text{MgCl}_2, 3\text{HgCl}_2 + 5\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with-

out decomp Easily sol in alcohol (v Bonsdorff)

**Magnesium phosphoryl chloride,  $\text{MgCl}_2$ ,  $\text{POCl}_3$**

Deliquescent Sol in  $\text{H}_2\text{O}$  with evolution of heat and decomposition Very sl sol in warm  $\text{POCl}_3$  (Casselmann, A 98 223)

**Magnesium potassium chloride,  $\text{MgCl}_2$ ,  $2\text{KCl}+6\text{H}_2\text{O}$**

Deliquescent, forming a solution of  $\text{MgCl}_2$ , while  $\text{KCl}$  remains undissolved 100 pts  $\text{H}_2\text{O}$  dissolve 64.5 pts at  $18.75^\circ$  20 pts salt dissolved in 80 pts  $\text{H}_2\text{O}$  lower the temp  $1.75^\circ$  (Bischof) Alcohol dissolves out  $\text{MgCl}_2$  Decompose into the two salts by solution in  $\text{H}_2\text{O}$  (Marcet)

A sat solution in contact with solid  $\text{KCl}$  and  $\text{KCl}$ ,  $\text{MgCl}_2$ ,  $\text{H}_2\text{O}$  at  $50^\circ$  contains 79.5 mol  $\text{MgCl}_2$  and 14.9 mol  $\text{KCl}$  per 1000 mol  $\text{H}_2\text{O}$  A sat solution in contact with solid  $\text{MgCl}_2$ ,  $6\text{H}_2\text{O}$  and  $\text{KCl}$ ,  $\text{MgCl}_2$ ,  $\text{H}_2\text{O}$  at  $50^\circ$  contains 111.9 mol  $\text{MgCl}_2$  and 1.2 mol  $\text{KCl}$  per 1000 mol  $\text{H}_2\text{O}$  (Uhlir, Chem Soc 1913, 104 (2) 775, C B Miner 1913, 417)

Min *Carnallite*

**Magnesium rubidium chloride,  $\text{MgCl}_2$ ,  $\text{RbCl}+6\text{H}_2\text{O}$**

Not decomp by a small quantity of  $\text{H}_2\text{O}$  (Fet and Kubiersky, Ch Ztg 16 335)

**Magnesium sodium chloride,  $\text{MgCl}_2$ ,  $\text{NaCl}+2\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  (Poggiale)

**Magnesium thallic chloride,  $2\text{TiCl}_3$ ,  $\text{MgCl}_2+6\text{H}_2\text{O}$**

Hydroscopic Can be cryst from  $\text{H}_2\text{O}$  (Gewecke, A 1909, 366 224)

**Magnesium stannic chloride**

See Chlorostannate, magnesium

**Magnesium vanadium chloride,  $\text{MgCl}_2$ ,  $\text{VCl}_3+5\text{H}_2\text{O}$**

Difficultly sol in  $\text{H}_2\text{O}$  and alcohol (Stahler, B 1904, 37 4412)

**Magnesium zinc chloride,  $\text{MgCl}_2$ ,  $\text{ZnCl}_2+6\text{H}_2\text{O}$**

Deliquescent, sol in  $\text{H}_2\text{O}$  (Warner, C N 27 271)

**Magnesium chloride ammonia,  $\text{MgCl}_2$ ,  $4\text{NH}_3$**

Easily decomp (Clark, A 78 369)

**Magnesium chloride hydroxylamine,  $\text{MgCl}_2$ ,  $2\text{NH}_2\text{OH}+2\text{H}_2\text{O}$**

100 g of solution in  $\text{H}_2\text{O}$  contain 44.4% at  $20^\circ$  (Antonow, J Russ Phys Chem Soc 1905, 37 478)

**Magnesium fluoride,  $\text{MgF}_2$**

1 l  $\text{H}_2\text{O}$  dissolves 76 mg  $\text{MgF}_2$  at  $18^\circ$  (Kohlrausch, Z phys Ch 1904, 50 356)

87 mg are dissolved in 1 l of sat solution at  $18^\circ$  (Kohlrausch, Z phys Ch 1908, 64 168)

Scarcely sol in acids (Gay-Lussac and Thénard) Insol in excess of  $\text{HF}$  When precipitated, is sol in aqueous solution of ammonium and magnesium salts Sol in dil  $\text{HNO}_3+\text{Aq}$ , from which it is precipitated by alcohol

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Min *Sellaste*

**Magnesium potassium fluoride,  $\text{MgF}_2$ ,  $\text{KF}$**

Decomp by  $\text{H}_2\text{SO}_4$  (Duboin, C R 1895, 120 679)

$\text{MgF}_2$ ,  $2\text{KF}$  Decomp by  $\text{H}_2\text{SO}_4$  (Duboin)

**Magnesium sodium fluoride,  $\text{MgF}_2$ ,  $\text{NaF}$**

Insol in  $\text{H}_2\text{O}$  (Geuther, J B 1865 173)

**Magnesium stannic fluoride**

See Fluostannate, magnesium

**Magnesium titanium fluoride**

See Fluotitanate, magnesium

**Magnesium zirconium fluoride**

See Fluozirconate, magnesium

**Magnesium hydrosulphide,  $\text{MgS}_2\text{H}_2$**

Known only in aqueous solution, which decomposes on warming Solution containing 16%  $\text{MgS}_2\text{H}_2$  has sp gr 1.118 at  $12^\circ$  (Divers and Shimidzu, Chem Soc 45 699)

**Magnesium hydroxide,  $\text{MgO}_2\text{H}_2$**

$\text{MgO}$  is sol in 55 368 pts  $\text{H}_2\text{O}$  at ordinary temp and also at  $100^\circ$  (Fresenius A 59 117)

$\text{MgO}$  is sol in 5142 pts  $\text{H}_2\text{O}$  at  $15.5^\circ$  (Fyfe) in 5800 pts at  $15.8^\circ$  (Henry J Pharm 13 2) in 7900 pts (Kirwan) in 16 000 pts (Dalton) in 100 000-200 000 pts cold  $\text{H}_2\text{O}$  (Bineau) in 36 000 pts boiling  $\text{H}_2\text{O}$  (Fyfe Ed Phil J 5 305)

Calculated from electrical conductivity of  $\text{MgO}_2\text{H}_2+\text{Aq}$ , 1 l  $\text{H}_2\text{O}$  dissolves 9 mg  $\text{MgO}_2\text{H}_2$  at  $18^\circ$  (Kohlrausch and Rose, Z phys Ch 12 241)

Calculated from electrical conductivity, 1 l  $\text{H}_2\text{O}$  dissolves 0.076 g  $\text{MgO}_2\text{H}_2$  at  $18^\circ$  (Dupré and Brutus, Z angew Ch 1903, 16 55)

Presence of  $\text{CaO}_2\text{H}_2$  or  $\text{CaSO}_4$  does not decrease the solubility (Henry) Presence of the salts of the alkali metals, especially ammonium salts, increase the solubility Insol in conc  $\text{Na}_2\text{SO}_4$ ,  $\text{NaNO}_3$ ,  $\text{NaCl}$ , or  $\text{KNO}_3+\text{Aq}$  (Karsten) Sol in  $\text{NH}_4\text{OH}+\text{Aq}$ , but insol in  $\text{KOH}+\text{Aq}$  (Odling)

Easily sol in acids Sol in an aqueous solution of sugar Boiling alcohol dissolves traces

Solubility of  $\text{MgO}_2\text{H}_2$  in  $\text{NH}_4\text{Cl}+\text{Aq}$  at  $29^\circ$ 

Conc of $\text{NH}_4\text{Cl}+\text{Aq}$ (Normal)	Acid required for liberated $\text{NH}_3$ in 25 cc (Normal)	Normality of		G per l	
		$\text{MgO}_2\text{H}_2$	$\text{NH}_4\text{Cl}$	$\text{MgO}_2\text{H}_2$	$\text{NH}_4\text{Cl}$
0.7	0.09835	0.156	0.388	4.55	20.86
0.466	0.1108	0.108	0.250	3.15	13.39
0.35	0.09835	0.089	0.172	2.60	9.21
0.23	0.1108	0.0838	0.106	1.86	5.67
0.17	0.1108	0.049	0.0771	1.43	4.13

(Herz and Muhs, Z anorg 1909, **38** 140)Solubility of  $\text{MgO}_2\text{H}_2$  in  $\text{NH}_4\text{NO}_3+\text{Aq}$  at  $29^\circ$ 

Conc of $\text{NH}_4\text{NO}_3+\text{Aq}$ (Normal)	Acid required for liberated $\text{NH}_3$ in 25 cc (Normal)	Normality of		G per l	
		$\text{MgO}_2\text{H}_2$	$\text{NH}_4\text{NO}_3$	$\text{MgO}_2\text{H}_2$	$\text{NH}_4\text{NO}_3$
0.35	0.1108	0.0833	0.1834	2.43	14.69
0.175	0.1108	0.0495	0.076	1.45	6.09

(Herz and Muhs)

Completely insol in 16%  $\text{NaCl}+\text{Aq}$  in presence of 0.8 g  $\text{NaOH}$  (Maigret, Bull Soc (3) **33** 681)

Solubility of  $\text{MgO}_2\text{H}_2$  in  $\text{NaCl}+\text{NaOH}+\text{Aq}$ 

G $\text{NaCl}$ per l	G $\text{MgO}$ per l of solution with added	
	0.8 g $\text{NaOH}$ per l	4.0 g $\text{NaOH}$ per l
125	0.07	0.03
140	0.045	
160	None	None

(Maigret)

Freshly pptd  $\text{Mg}(\text{OH})_2$  is sol in  $\text{Th}(\text{NO}_3)_4+\text{Aq}$  forming a colloidal solution (Halla, Z anorg 1912, **79** 262)

Insol in acetone (Naumann, B 1904, **37** 4329, Eidmann, C C 1899, II, 1014)

See also Magnesium oxide

Min *Brucite* Sol in cold citric acid +  $\text{Aq}$  (Bolton, C N **37** 14)

$2\text{MgO}, 3\text{H}_2\text{O}$  (Bender, B **3** 932)

Magnesium iodide,  $\text{MgI}_2$ 

Very deliquescent

Solubility in  $\text{H}_2\text{O}$  See  $\text{MgI}_2+6$ , and  $8\text{H}_2\text{O}$ 

Sp gr of  $\text{MgI}_2+\text{Aq}$  at  $19.5^\circ$  containing  
 5 10 15 20 25 30%  $\text{MgI}_2$ ,  
 1.043 1.088 1.139 1.194 1.254 1.32

35 40 45 50 55 60%  $\text{MgI}_2$   
 1.395 1.474 1.568 1.668 1.78 1.915

(Kremers, Pogg **111** 62, calculated by Gerlach, Z anal **8** 285)

$\text{MgI}_2+\text{Aq}$  decomp slightly on evaporation

Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, **20** 828)

Sol in alcohol, ether, and wood-spirit

Solubility of  $\text{MgI}_2$  in alcohols

$\text{MgI}_2$  forms with methyl alcohol a complex,  $\text{MgI}_2, 6\text{CH}_3\text{OH}$

Solubility of  $\text{MgI}_2, 6\text{CH}_3\text{OH}$  in  $\text{CH}_3\text{OH}$  at  $t^\circ$ 

$t^\circ$	% by weight of $\text{MgI}_2, \text{CH}_3\text{OH}$	$t^\circ$	% by weight of $\text{MgI}_2, 6\text{CH}_3\text{OH}$
0	49.6	120	66.2
20	52.6	140	69.5
40	55.3	160	73.2
60	58.0	180	77.1
80	60.6	200	81.5
100	63.3		

(Menschutkin, Z anorg 1907, **52** 15)

$\text{MgI}_2$  forms with ethyl alcohol a complex,  $\text{MgI}_2, 6\text{C}_2\text{H}_5\text{OH}$

Solubility of  $\text{MgI}_2, 6\text{C}_2\text{H}_5\text{OH}$  in  $\text{C}_2\text{H}_5\text{OH}$  at  $t^\circ$ 

$t^\circ$	% by weight of $\text{MgI}_2, 6\text{C}_2\text{H}_5\text{OH}$	$t^\circ$	% by weight of $\text{MgI}_2, 6\text{C}_2\text{H}_5\text{OH}$
0	21.9	120	82.7
20	33.2	130	87.2
40	44.4	135	90.0
60	55.3	140	93.3
80	65.5	143	96.0
100	74.7	145	98.0
110	78.8	146.5 mpt	100

(Menschutkin)

$\text{MgI}_2$  forms with dimethylcarbinol a complex,  $\text{MgI}_2, 6(\text{CH}_3)_2\text{CHOH}$

Solubility of  $\text{MgI}_2, 6(\text{CH}_3)_2\text{CHOH}$  in  $(\text{CH}_3)_2\text{CHOH}$  at  $t^\circ$ 

$t^\circ$	% by weight of $\text{MgI}_2, 6(\text{CH}_3)_2\text{CHOH}$	$t^\circ$	% by weight of $\text{MgI}_2, 6(\text{CH}_3)_2\text{CHOH}$
10	57.1	110	76.2
30	60.0	120	79.4
50	63.3	130	84.8
70	67.0	136	91.7
90	71.2	138 mpt	100

(Menschutkin)

Solubility of  $\text{MgI}_2$  in ether at  $t^\circ$ 

$t^\circ$	% $\text{MgI}_2$	% $\text{MgI}_2, 2\text{C}_4\text{H}_{10}\text{O}$
5.4	1.45	2.2
11.8	2.43	3.7
15.6	3.46	5.3
18.1	5.4	8.3
20.4	7.55	11.6
22.2	11.28	17.3

(Menschutkin, Z anorg 1906, **49** 41)



t°	% MgI <sub>2</sub>	% MgI <sub>2</sub> 2C <sub>4</sub> H <sub>10</sub> O
	in lower layer	
14 8	35 5	54 4
17 6	35 5	54 4
20	35 8	54 8
28 4	35 5	54 4
33	35 7	54 7
35	35 3	54 1
in upper layer		
18 6	13 57	20 8
23 2	14 4	22 1
24 4	14 6	22 4
32 4	15 82	24 2
in solution when two layers mix		
37 3	19 4	29 3
38 5	22 45	34 4
38 5	26 07	39 9
38 5	29 8	45 7
38	32 8	50 3

(Menschutkin)

Solubility of MgI<sub>2</sub> in acetic acid  
forms with acetic acid a complex,  
I<sub>3</sub>COOH

Solubility of MgI<sub>2</sub>, 6CH<sub>3</sub>COOH in  
CH<sub>3</sub>COOH at t°

t°	% by wt MgI <sub>2</sub> 6CH <sub>3</sub> COOH
20	0 6
40	2 0
60	5 0
70	9 5
75	13 0
80	18 5
85	27 1
95	42 0
105	54 5
115	65 0
125	73 8
135	85 0
140	94 0
142 mpt	100 0

(Menschutkin, Z anorg 1907, 54 93)

Solubility of MgI<sub>2</sub> in acetone  
MgI<sub>2</sub> forms with acetone a complex, MgI<sub>2</sub>  
6CH<sub>3</sub>COCH<sub>3</sub>

Solubility of MgI<sub>2</sub>, 6CH<sub>3</sub>COCH<sub>3</sub> in  
CH<sub>3</sub>COCH<sub>3</sub> at t°

t°	% by wt MgI <sub>2</sub> 6CH <sub>3</sub> COCH <sub>3</sub>
0	4 9
30	6 7
50	8 3
60	10 2
70	15 2
80	28 6
85	40 0
90	59 2
95	80 0
100	92 5
105	98 5
106 5 mpt	100

(Menschutkin, Z anorg 1907, 53 30)

Solubility of MgI<sub>2</sub> in acetal  
MgI<sub>2</sub> forms with acetal a complex, MgI<sub>2</sub>,  
2CH<sub>3</sub>CH(OC<sub>2</sub>H<sub>5</sub>)<sub>2</sub>

Solubility of MgI<sub>2</sub>, 2CH<sub>3</sub>CH(OC<sub>2</sub>H<sub>5</sub>)<sub>2</sub> in  
CH<sub>3</sub>CH(OC<sub>2</sub>H<sub>5</sub>)<sub>2</sub> at t°

t°	% by wt MgI <sub>2</sub> 2CH <sub>3</sub> CH(OC <sub>2</sub> H <sub>5</sub> ) <sub>2</sub>
20	0 15
60	0 45
77	0 6
77	92 0
79	93 7
81	95 5
83	97 3
86 mpt	100

(Menschutkin, Z anorg 1907, 53 33)

Solubility of MgI<sub>2</sub> in acetamide  
MgI<sub>2</sub> forms with acetamide a complex,  
MgI<sub>2</sub>, 6CH<sub>3</sub>CONH<sub>2</sub>

Solubility of MgI<sub>2</sub>, 6CH<sub>3</sub>CONH<sub>2</sub> in  
CH<sub>3</sub>CONH<sub>2</sub> at t°

t	% by wt of MgI <sub>2</sub> 6CH <sub>3</sub> CONH <sub>2</sub>
49	56 5
80	63 4
110	70 5
130	76 0
150	82 1
160	85 5
170	90 8
175	96 2
177 mpt	100 0

(Menschutkin, Z anorg 1909, 61 108)

Solubility of  $\text{MgI}_2$  in acetonitrile  
 $\text{MgI}_2$  forms with acetonitrile a complex,  
 $\text{MgI}_2, 6\text{CH}_3\text{CN}$

Solubility of  $\text{MgI}_2, 6\text{CH}_3\text{CN}$  in  $\text{CH}_3\text{CN}$   
 at  $t^\circ$

$t^\circ$	% by wt $\text{MgI}_2, 6\text{CH}_3\text{CN}$
0	37.2
30	49.8
50	58.2
70	67.9
80	76.5
89	91.3

(Menschutkin, Z anorg 1909, 61 110)

Solubility of  $\text{MgI}_2$  in benzaldehyde  
 $\text{MgI}_2$  forms with benzaldehyde a complex,  
 $\text{MgI}_2, 6\text{C}_6\text{H}_5\text{CHO}$

Solubility of  $\text{MgI}_2, 6\text{C}_6\text{H}_5\text{CHO}$  in  $\text{C}_6\text{H}_5\text{CHO}$   
 at  $t^\circ$

$t^\circ$	% by wt $\text{MgI}_2, 6\text{C}_6\text{H}_5\text{CHO}$
0	3.2
20	3.8
40	5.3
60	7.7
80	11.0
100	18.5
110	26.5
120	40.0
125	53.0
130	74.5
133	86.0
136	94.2
139 mpt	100

(Menschutkin, Z anorg 1907, 53 28)

Solubility of  $\text{MgI}_2$  in methyl acetate  
 $\text{MgI}_2$  forms with methyl acetate a complex,  
 $\text{MgI}_2, 6\text{CH}_3\text{COOCH}_3$

Solubility of  $\text{MgI}_2, 6\text{CH}_3\text{COOCH}_3$  in  
 $\text{CH}_3\text{COOCH}_3$  at  $t^\circ$

$t^\circ$	% by wt $\text{MgI}_2, 6\text{CH}_3\text{COOCH}_3$
0	0.4
30	0.55
60	0.75
90	0.9
100	1.8
103	2.4
103	74.2
110	81.7
120	98.0
121 mpt	100.0

(Menschutkin, Z anorg 1909, 61 101)

Solubility of  $\text{MgI}_2$  in methyl acetate  
 $\text{MgI}_2$  forms with ethyl acetate a complex,  
 $\text{MgI}_2, 6\text{CH}_3\text{COOC}_2\text{H}_5$

Solubility of  $\text{MgI}_2, 6\text{CH}_3\text{COOC}_2\text{H}_5$  in  
 $\text{CH}_3\text{COOC}_2\text{H}_5$  at  $t^\circ$

$t^\circ$	% by wt $\text{MgI}_2, 6\text{CH}_3\text{COOC}_2\text{H}_5$
0	3.2
20	4.8
40	8.6
50	13.7
55	21.5
60	38.0
65	63.5
70	90.5
75	97.7
78.5 mpt	100.0

(Menschutkin)

Solubility of  $\text{MgI}_2$  in ethyl formate  
 $\text{MgI}_2$  forms with ethyl formate a complex,  
 $\text{MgI}_2, 6\text{HCOOC}_2\text{H}_5$

Solubility of  $\text{MgI}_2, 6\text{HCOOC}_2\text{H}_5$  in  
 $\text{HCOOC}_2\text{H}_5$  at  $t^\circ$

$t^\circ$	% by wt $\text{MgI}_2, 6\text{HCOOC}_2\text{H}_5$
0	15.1
10	17.4
20	20.5
30	25
40	31.8
50	44
60	68
70.5 mpt	100

(Menschutkin)

Solubility of  $\text{MgI}_2$  in isoamylacetate  
 $\text{MgI}_2$  forms with isoamylacetate a complex,  
 $\text{MgI}_2, 6\text{CH}_3\text{COO(iso)C}_5\text{H}_{11}$

Solubility of  $\text{MgI}_2, 6\text{CH}_3\text{COO(iso)C}_5\text{H}_{11}$  in  
 $\text{CH}_3\text{COO(iso)C}_5\text{H}_{11}$  at  $t^\circ$

$t$	% by wt $\text{MgI}_2, 6\text{CH}_3\text{COO(iso)C}_5\text{H}_{11}$
0	7.7
20	11.5
40	20.9
45	25.5
50	33.2
55	47.8
57.5	63.0
60 mpt	100.0

(Menschutkin)

Solubility of  $\text{MgI}_2$  in isobutyl acetate  
 $\text{MgI}_2$  forms with isobutylacetate a complex,  
 $\text{MgI}_2, 6\text{CH}_3\text{COOC}_4\text{H}_9$

Solubility of  $\text{MgI}_2$ ,  $6\text{CH}_3\text{COO}(\text{iso})\text{C}_4\text{H}_9$  in  $\text{CH}_3\text{COO}(\text{iso})\text{C}_4\text{H}_9$

t°	% by wt $\text{MgI}_2$ $6\text{CH}_3\text{COO}(\text{iso})\text{C}_4\text{H}_9$
0	10 5
20	13 6
40	17 6
50	20 4
60	24 9
70	33 7
75	40 5
80	52 0
85	89 0
87 5 mpt	100 0

(Menschutkin)

Solubility of  $\text{MgI}_2$  in propyl acetate

$\text{MgI}_2$  forms with propyl acetate a complex,  $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOC}_3\text{H}_7$

Solubility of  $\text{MgI}_2$ ,  $6\text{CH}_3\text{COOC}_3\text{H}_7$  in  $\text{CH}_3\text{COOC}_3\text{H}_7$  at t°

t°	% by wt $\text{MgI}_2$ $6\text{CH}_3\text{COOC}_3\text{H}_7$
0	4 1
20	5 4
30	6 5
35	7 8
40	19 0
45	46 0
50	72 5
55	88 2
60	96 0
65 mpt	100 0

(Menschutkin)

Solubility of  $\text{MgI}_2$  in urethane

$\text{MgI}_2$  forms with urethane a complex,  $\text{MgI}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$

Solubility of  $\text{MgI}_2$ ,  $6\text{NH}_2\text{COOC}_2\text{H}_5$  in  $\text{NH}_2\text{COOC}_2\text{H}_5$  at t°

t°	% by wt $\text{MgI}_2$ $6\text{NH}_2\text{COOC}_2\text{H}_5$
32	51 8
50	59 4
70	70 7
80	78 8
84	85 0
87 mpt	100 0

(Menschutkin)

+6H<sub>2</sub>O

Solubility of  $\text{MgI}_2 + 6\text{H}_2\text{O}$  in H<sub>2</sub>O at t°

t°	% by weight of $\text{MgI}_2 + 6\text{H}_2\text{O}$	t°	% by weight of $\text{MgI}_2 + 6\text{H}_2\text{O}$
43°	89 8	160°	91 7
80°	90 3	200°	93 4
120°	90 9	215°	94 3

(Menschutkin, Z anorg 1907, 52 156)

+8H<sub>2</sub>O Sp gr of solution of  $\text{MgI}_2 + 8\text{H}_2\text{O}$  sat at 18° containing 59.7%  $\text{MgI}_2 = 1.909$  (Mylus, B 1897, 30 1718)

Solubility of  $\text{MgI}_2 + 8\text{H}_2\text{O}$  in H<sub>2</sub>O at t°

t°	% by weight of $\text{MgI}_2 + 8\text{H}_2\text{O}$
0	76 0
20	81 0
40	88 0
43 5	90 8

(Menschutkin)

+10H<sub>2</sub>O Sol in H<sub>2</sub>O (Panfiloff, C C 1894, II 610)

**Magnesium mercuric iodide,  $\text{MgI}_2$ ,  $\text{HgI}_2$**

Known only in solution

+9H<sub>2</sub>O Very deliquescent (Duboin, C R 1906, 142 1338)

Very sol in ethyl, methyl, propyl, butyl, isobutyl, amyl, isopropyl and allyl alcohols, ethyl, amyl, propyl and isobutyl acetates, ethyl cyanide and acetone Sol in benzyl alcohol Decomp by glycerine Sl sol in ethyl benzoate, amyl benzoate, nitrobenzene Decomp by ethyl oxalate Insol in toluene, benzene, ethyl iodide,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , ethylene bromide, monochlor and monobrombenzene (Duboin, A ch 1909, (8) 16 276)

$\text{MgI}_2$ ,  $2\text{HgI}_2$  Decomp by H<sub>2</sub>O into  $\text{HgI}_2$  and above compound, which remains in solution (Boullay)

+7H<sub>2</sub>O Sat solution in H<sub>2</sub>O at 17.8° has the composition  $\text{MgI}_2$ , 1.29  $\text{HgI}_2$ , 11.06 H<sub>2</sub>O (Duboin, C R 1906, 142 1338)

**Magnesium potassium iodide,  $\text{MgI}_2$ ,  $\text{KI} + 6\text{H}_2\text{O}$**

Deliquescent (Lerch, J pr (2) 28 338)

Very hygroscopic (de Schulten, Bull Soc 1900 (3) 23 158)

**Magnesium iodide ammonia,  $\text{MgI}_2$ ,  $6\text{NH}_3$**

Practically insol in liquid  $\text{NH}_3$  (Franklin, J Am Chem Soc 1913, 35 1459)

**Magnesium nitride,  $\text{Mg}_3\text{N}_2$**

Decomp by moist air or H<sub>2</sub>O Sol in dil or conc  $\text{HCl} + \text{Aq}$ , or  $\text{HNO}_3 + \text{Aq}$  Sol in warm  $\text{H}_2\text{SO}_4$  Insol in alcohol, ethyl iodide or phosphorus oxychloride (Briegleb and Geuther, A 123 236)

Decomp by H<sub>2</sub>O (Smits, R t c 1894, 12 198)

Easily decomp H<sub>2</sub>O when finely powdered (Rossel, C R 1895, 121 942)

**Magnesium suboxide (?)**

Decomp H<sub>2</sub>O Sol in dil acids (Beetz, Pogg 127 45)

**Magnesium oxide,  $\text{MgO}$**

Sol in 50 000–100 000 pts H<sub>2</sub>O (Bineau C R 41 510) in 55 388 pts cold or hot H<sub>2</sub>O (Fresenius A 59 123) in 100 000–200 000 pts H<sub>2</sub>O (Bunsen) in 16 000 pts H<sub>2</sub>O at ord temp (Dalton) in 7900 pts H<sub>2</sub>O at ord temp (Kirwan) in 5760 pts H<sub>2</sub>O at 15.5° and 36 000 pts at 100° (Fyfe)

Calc from electrical conductivity of  $\text{MgO} + \text{Aq}$  1 pt  $\text{MgO}$  is sol in 172,000 pts  $\text{H}_2\text{O}$  at  $18^\circ$  (Dupré, Zeit angew Ch 1903, 16 55)  
 "Heavy"  $\text{MgO}$  is more sol in  $\text{H}_2\text{O}$  than "light"  $\text{MgO}$ . The temp of preparation affects the rate of solution, the rate being diminished as the temp of preparation is increased (Anderson, Chem Soc 1905, 87 265)

Easily sol in acids, even in  $\text{H}_2\text{SO}_4 + \text{Aq}$

Solubility in  $\text{P}_2\text{O}_5 + \text{Aq}$  at  $25^\circ$

Composition of the solution		Sp. gr. $25^\circ/25^\circ$	Solid phase
G $\text{MgO}$ per l	G $\text{P}_2\text{O}_5$ per l		
0 207	0 486		
0 280	0 732		
0 553	1 917		
1 438	4 85		
2 23	7 35	1 006	
4 73	16 84	1 017	
11 19	38 59	1 042	
17 33	61 21	1 069	
26 09	93 09	1 109	
37 40	130 7	1 144	
75 5	281 8	1 285	
109 5	439 0		
122 6	498 4	1 470	
129 9	546 5		
140 0	584 0		
146 8	623 3	1 595	
147 3	625 9		
150 3	645 8		
155 5	680 7		
87 1	779 6	1 626	
77 1	809 6	1 644	
70 6	835 1	1 654	

$\text{MgHPO}_4 \cdot 3\text{H}_2\text{O}$

$\text{MgH}_2(\text{PO}_4)_2 \cdot x\text{H}_2\text{O}$

(Cameron, J phys Chem 1907, 11 364)

Sol in  $\text{NH}_4$  salts,  $\text{NaCl}$ , or  $\text{KCl} + \text{Aq}$  (Fresenius)

Solubility in  $\text{MgCl}_2 + \text{Aq}$  at  $25^\circ$

% $\text{MgCl}_2$	% $\text{MgO}$ as $\text{Mg}(\text{OH})_2$
2 36	0 00008
4 47	0 00028
6 79	0 00048
9 02	0 00080
13 14	0 00115
15 15	0 00195
17 53	0 00240
18 52	0 00250
22 04	0 00245
23 78	0 00235
25 13	0 00230
26 88	0 00250
28 34	0 00230
29 80	0 00240
30 04	0 00250
34 22	0 0030

(Robinson, J phys Chem 1909, 13 676)

More sol in  $\text{K}_2\text{SO}_4$ , and  $\text{Na}_2\text{SO}_4 + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Warrington)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Sol in methyl alcohol to form a colloidal solution containing 16%  $\text{MgO}$  (Neuberg and Rewald (Biochem Z 1908, 9 547))

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3602)

Insol in acetone (Naumann, B 1904, 37 4329)

Insol in acetone and in methylal (Eidmann, C C 1899, II 1014)

Solubility in (calcium succrate+sugar)+Aq

1 l solution containing 418.6 g sugar and 34.3 g  $\text{CaO}$  dissolves 0.30 g  $\text{MgO}$ , containing 296.5 g sugar and 24.2 g  $\text{CaO}$  dissolves 0.24 g  $\text{MgO}$  containing 174.4 g sugar and 14.1 g  $\text{CaO}$  dissolves 0.22 g  $\text{MgO}$  (Bodenbender, J B 1865 600)

See also Magnesium hydride  
 Min Perchlorate

Magnesium peroxide,  $\text{MgO}_2$

Sol in 14,550 pts  $\text{H}_2\text{O}$  at  $20^\circ$  (Foregger and Philipp, J Soc Chem Ind 1906, 25 298)

$5\text{MgO}, 2\text{MgO}_2 + 3\text{H}_2\text{O}$

$3\text{MgO}, 2\text{MgO} + 3\text{H}_2\text{O}$

$2\text{MgO}, 2\text{MgO}_2 + 3\text{H}_2\text{O}$

$4\text{MgO}, 2\text{MgO} + 3\text{H}_2\text{O}$

Above salts are decomp by  $\text{H}_2\text{O}$

(Carrasco, Gazz ch it 1909, 39, (1) 47)

Magnesium oxybromide,  $\text{MgBr} \cdot 3\text{MgO} - 12\text{H}_2\text{O}$

Decomp in the air and also by  $\text{H}_2\text{O}$ , alcohoh and most reagents (Tassilly, C R 1897, 125 607)

Magnesium oxychloride,  $\text{MgOCl} - 16\text{H}_2\text{O}$

Easily decomp by  $\text{H}_2\text{O}$  and alcohol (Andre, A ch (6) 3 80)

$+6\text{H}_2\text{O}$  (Andre)

$2\text{MgO}, \text{HCl}, 5\text{H}_2\text{O}$  or  $3\text{MgO}, \text{MgCl} - 10\text{H}_2\text{O}$  Solubility determinations show that this salt is the solid phase in equilibrium at  $25^\circ$  with solutions of  $\text{MgCl}$  and  $\text{MgO}$  containing from 10-15%  $\text{MgCl}$  (Robinson J phys Chem 1909, 13 677)

$\text{Mg}_6\text{OCl} + 6, 8, 14$  or  $17\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$ , which dissolves out  $\text{MgCl}$  (Bender, B 3 932)

$\text{Mg}_{11}\text{O}_{10}\text{Cl} + 14$ , or  $18\text{H}_2\text{O}$  Krause A 165 38)

$\text{Mg}_{10}\text{O}_9\text{Cl} + 24\text{H}_2\text{O} = 9\text{MgO} + \text{MgCl} + 24\text{H}_2\text{O}$   $\text{H}_2\text{O}$  removes all  $\text{MgCl}$  by long digesting (Bender, A 159 341)

$+10$ , and  $15\text{H}_2\text{O}$  (Bender)

Magnesium oxysulphide,  $\text{MgOS}$

(Reichel, J pr (2) 12 55)

**Magnesium phosphide,  $Mg_3P_2$** 

Decomp by  $H_2O$ , dil  $HCl+Aq$ , or  $HNO_3+Aq$  (Parkinson, Chem Soc 5 (2) 125 and 309)

Insol in moderately dil cold  $HCl+Aq$ , or boiling dil  $H_2SO_4+Aq$  Difficulty and slowly sol in aqua regia (Blunt, Chem Soc 3 (2) 106)

Decomp by  $H_2O$ ,  $HCl$ , conc  $H_2SO_4$  and by  $HNO_3$  (Gautier, C R 1899, 128 1169)

**Magnesium silicide,  $Mg_2Si$** 

Slowly decomp by warm  $H_2O$  Slowly decomp by cold, rapidly by hot  $NH_4Cl+Aq$  Decomp by cold dil  $HCl+Aq$  (Geuther, J pr 95 425)

$Mg_2Si$  Decomp by  $HCl+Aq$  with residue of  $Si$  (Wohler, A 107 113)

Slowly decomp by  $H_2O$  at ord temp Violently decomp by  $HCl$  (Lebeau and Bossuet, C R 1908, 146 284)

**Magnesium sulphide,  $MgS$** 

Decomp by  $H_2O$  (Reichel, J pr (2) 12 55)

Sl sol in  $H_2O$  with rapid decomp (Freymy) Sol in acids with decomp

*Anhydrous Crystalline* Only very sl sol in cold  $H_2O$  Sol in  $HNO_3$  and  $H_2SO_4$  at ord temp Sol in  $PCl_3$  and in chromyl chloride (Mourlot, C R 1898, 127 182)

**Magnesium polysulphide,  $MgS_x$** 

Known only in solution (Reichel)

**Magnus' green salt**

See Platodiamine chloroplatinite

**Manganese, Mn**

Decomposes  $H_2O$  even in the cold, more rapidly when hot (Regnault)

Decomposes cold water violently (Bunsen)

Sol in all dil acids Slowly sol in cold  $H_2SO_4$  (John)

Insol in cold, but rapidly sol in hot  $H_2SO_4$ , Very easily sol in dil  $H_2SO_4$ , or  $HCl+Aq$ ,  $HNO_3$ , or  $HC_2H_3O_2+Aq$  (Brunner)

Pure manganese is unaltered in dry air, even when finely powdered Slowly attacked by cold, quickly by hot  $H_2O$  Very sl attacked by cold  $H_2SO_4$ , rapidly on warming, rapidly attacked by cold dil  $H_2SO_4+Aq$ , violently by conc  $HNO_3+Aq$ , and rapidly by dil  $HNO_3$ ,  $HCl$ ,  $HC_2H_3O_2+Aq$ , and also  $NaOH+Aq$  Sol in  $NH_4Cl+Aq$  (Prelinger, W A B 102, 2b 359)

Insol in liquid  $NH_3$  (Gore, Am Ch J 1898, 20 828)

$\frac{1}{2}$  cem oleic acid dissolves 0.0276 g Mn in 6 days (Gates, J phys Chem 1911, 15 143)

**Manganese antimonide,  $MnSb$** 

Sol in hot aqua regia (Wedekind, B 1907, 40 1266)

**Manganese azomide, basic,  $Mn(OH)N_3$** 

Only sl sol in  $H_2O$  with decomp (Curtius, J pr 1898, (2) 58 293)

**Manganese bismuthide,  $MnBi$** 

Very sensitive towards acids with the exception of conc  $HCl$  (Wedekind, B 1911, 44 2665)

**Manganese boride,  $MnB$** 

Attacked by cold  $H_2O$  and by acids (Jassonex, C R 1904, 139 1210)

Easily attacked by  $HCl$ ,  $H_2SO_4$ , and  $HF$  with evolution of  $BH_3$  (Wedekind, B 1905, 38 1231)

$MnB_2$  Sol in acids, with evolution of  $H_2$  (Troost and Hautefeuille, A ch (5) 9 65)

Slowly decomp by  $H_2O$  Sol in dil  $HCl$  and other dil acids with evolution of  $BH_3$  (Wedekind, B 1905, 38 1229)

**Manganous bromide,  $MnBr_2$** 

*Anhydrous* Very deliquescent

Sat  $MnBr_2+Aq$  contains at

$-21^\circ +7^\circ 11^\circ 18^\circ 38^\circ 52^\circ$

52 1 56 5 57 0 59 1 62 7 64 2%  $MnBr_2$ ,

$64^\circ 76^\circ 89^\circ 97^\circ 105^\circ$

68 2 70 1 69 7 69 2 70 2%  $MnBr_2$

(Étard, A ch 1894, (7) 2 541)

Insol in liquid  $NH_3$  (Franklin, Am Ch J 1898, 20 828)

$+H_2O$  (Lescœur, A ch 1894, (7) 2 104)

$+4H_2O$  More deliquescent than  $MnCl_2$

Melts in crystal water when heated (Berthelot)

$+6H_2O$  (Kuznetsoff, C C 1897, II 329)

**Manganous mercuric bromide**

Deliquescent

**Manganous palladium bromide**

See Bromopalladite, manganous

**Manganous stannic bromide**

See Bromostannate, manganous

**Manganese carbide,  $MnC$** 

(Brown, J pr 17 492)

$MnC_2$

$MnC_3$  (Troost and Hautefeuille, A ch (5) 9 60)

Decomp by  $H_2O$  and by dil acids (Moissan, C R 1896, 122 422)

**Manganous chloride,  $MnCl_2$** 

*Anhydrous* Deliquescent

100 pts H <sub>2</sub> O at t° dissolve pts MnCl <sub>2</sub>			
t°	Pts MnCl <sub>2</sub>	t°	Pts MnCl <sub>2</sub>
10	62 16	87 5	122 22
31 25	85 72	106 25	123 81
62 5	122 22		

or, sat MnCl<sub>2</sub>+Aq at t° contains

t°	% MnCl <sub>2</sub>	t°	% MnCl <sub>2</sub>
10	38 33	87 5	55 0
31 25	46 15	106 25	55 32
62 5	55 0		

(Brandes, Pogg 22 263)

See also below under +2H<sub>2</sub>O, and +4H<sub>2</sub>O

Sp gr of MnCl<sub>2</sub>+Aq at 15° a=sp gr if %  
is MnCl<sub>2</sub>, b=sp gr if % is MnCl<sub>2</sub>+  
4H<sub>2</sub>O

%	a	b	%	a	b
5	1 045	1 0285	40	1 443	1 250
10	1 091	1 057	45	1 514	1 290
15	1 138	1 086	50		1 331
20	1 189	1 116	55		1 375
25	1 245	1 147	60		1 419
30	1 306	1 180	65		1 463
35	1 372	1 214	70		1 508

(Gerlach, Z anal 28 476)

Sp gr of MnCl <sub>2</sub> +Aq at room temp	
% MnCl <sub>2</sub>	Sp gr
8 007	1 0960
15 650	1 1963
30 330	1 3372
40 132	1 4530

(Wagner, W Ann 1883, 18 273)

Sp gr of MnCl <sub>2</sub> +Aq at t°		
t°	% MnCl <sub>2</sub>	Sp gr
14 5	5 0	1 0457
14 5	11 99	1 1076
14 0	14 98	1 1379
14 5	19 92	1 1891
14 0	23 10	1 2246
14 6	28 51	1 2888

(Long, W Ann 1880, 11 38)

Sp gr of MnCl <sub>2</sub> +Aq at 25°	
Concentration of MnCl <sub>2</sub> +Aq	Sp gr
1-normal	1 0513
1/2- "	1 0259
1/4- "	1 0125
1/8- "	1 0063

(Wagner, Z phys Ch 1890, 5 38)

### Solubility of MnCl<sub>2</sub>+KCl in H<sub>2</sub>O at t°

t°	% MnCl <sub>2</sub>	% KCl	Solid phase
6	40 23 35 94	9 41 23 06	MnCl <sub>2</sub> , 4H <sub>2</sub> O MnCl <sub>2</sub> , 4H <sub>2</sub> O+MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O+KCl KCl
28 4	44 46 43 28 38 65	8 66 13 79 26 91	MnCl <sub>2</sub> , 4H <sub>2</sub> O MnCl <sub>2</sub> , 4H <sub>2</sub> O+MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O MnCl <sub>2</sub> , 4H <sub>2</sub> O+MnCl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O+KCl KCl
52 8	50 14	6 01	MnCl <sub>2</sub> , 4H <sub>2</sub> O+MnCl <sub>2</sub> , 2H <sub>2</sub> O+MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O
62 6	51 86 49 95 44 05 36 85	6 67 12 49 18 77 31 57	MnCl <sub>2</sub> , 2H <sub>2</sub> O MnCl <sub>2</sub> , 2H <sub>2</sub> O+MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O+MnCl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O MnCl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O+MnCl <sub>2</sub> , 4KCl KCl

(Suss, Z Kryst Min 1912, 51 262)

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 828)

Solutions of MnCl<sub>2</sub> in 75% alcohol saturated at t° contain

t	% MnCl <sub>2</sub>	t	% MnCl
10	23 1	43 75	37 5
25	36 1	87 5	32 2
		(B-pt)	

Solutions of  $\text{MnCl}_2$  in absolute alcohol saturated at  $t^\circ$  contain

$t^\circ$	% $\text{MnCl}_2$	$t^\circ$	% $\text{MnCl}_2$
11 25	33 3	76 25	36 2
37 5	33 3	(B-pt)	

(Brandes, *l c*)

$\text{MnCl}_2$  crystallises from above solutions on standing

When 15–20 vols ether are added to 1 vol absolute alcohol sat with  $\text{MnCl}_2$ ,  $\text{MnCl}_2$  is completely pptd (Dobereiner)

Insol in oil of turpentine

Sol in urethane (Castoro, *Z anorg* 1899, 20 61)

Sl sol in benzonitrile (Naumann, *B* 1914, 47 1369)

Difficultly sol in methyl acetate (Naumann, *B* 1909, 42 3790)

Insol in ethyl acetate (Naumann, *B* 1910, 43 314)

$+\text{H}_2\text{O}$  Solubility in  $\text{HCl}+\text{Aq}$  decreases with increasing amt of  $\text{HCl}$ . It is greater when hot than cold, but is not considerable even when  $\text{HCl}$  is conc 1 l conc  $\text{HCl}+\text{Aq}$  sat at  $12^\circ$  dissolves 190 g  $\text{MnCl}_2$  from  $\text{MnCl}_2+\text{H}_2\text{O}$  (Ditte, *C R* 1881, 92 243)

$+\frac{5}{3}\text{H}_2\text{O}$   $\text{MnCl}_2+4\text{H}_2\text{O}$  effloresces to  $\text{MnCl}_2+\frac{5}{3}\text{H}_2\text{O}$  in a dry atmosphere and under low pressure and not to  $\text{MnCl}_2+2\text{H}_2\text{O}$  (Sabatier, *Bull Soc* 1894, (3) 11 547)

$+2\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{MnCl}_2$ per 100 pts $\text{H}_2\text{O}$	Sp gr of sat solution
60	108 6	1 6108
70	110 6	1 6134
80	112 7	

(Dawson and Williams, *Z phys Ch* 1899, 31 63)

Sat aqueous solution of  $\text{MnCl}_2+2\text{H}_2\text{O}$  Contains 51 86%  $\text{MnCl}_2$  at  $62.6^\circ$  (Suss, *Z Krist* 1912, 51 262)

$+4\text{H}_2\text{O}$  Deliquescent

100 pts  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve

$t^\circ$	Pts $\text{MnCl}_2$ $+4\text{H}_2\text{O}$	$t^\circ$	Pts $\text{MnCl}_2$ $+4\text{H}_2\text{O}$
8	151	87 5	641
31 25	265	106 25	656
62 5	641		

(Brandes, *l c*)

Sol in 0.8 pt  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abi)

Pptd from solution in 9.17 mols  $\text{H}_2\text{O}$  (Kuznetsoff, *C C* 1899, I 246)

Sat aq solution contains at

$-22^\circ$	$-5^\circ$	$+7^\circ$	$17^\circ$	$19^\circ$	
34 7	37 8	40 4	41 2	42 3	% $\text{MnCl}_2$
35°	55°	57°	80°	100°	140°
44 4	48 2	50 0	51 0	53 7	54 7 % $\text{MnCl}_2$

(Étard, *A ch* 1894, (7) 2 537)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{MnCl}_2$ per 100 pts $\text{H}_2\text{O}$	Sp gr of sat solution
25	77 18	1 4991
30	80 71	1 5049
40	88 59	1 5348
50	98 15	1 5744
*57 65	105 40	1 6097

\* Temp of transition into  $\text{MnCl}_2+2\text{H}_2\text{O}$  (Dawson and Williams, *Z phys Ch* 1899, 31 63)

Sat aqueous solution of  $\text{MnCl}_2+4\text{H}_2\text{O}$  contains 40 23%  $\text{MnCl}_2$  at  $6^\circ$ , 44 6%  $\text{MnCl}_2$  at  $28.4^\circ$  (Suss, *Z Krist* 1912, 51 262)

100 pts 75% alcohol dissolve at  $t^\circ$

$t^\circ$	Pts $\text{MnCl}_2$ $+4\text{H}_2\text{O}$	$t^\circ$	Pts $\text{MnCl}_2$ $+4\text{H}_2\text{O}$
10	53	43 75	144
25	132	87 5	100 1

(Brandes, *l c*)

Insol in absolute ether, which also does not abstract crystal  $\text{H}_2\text{O}$

Insol in boiling oil of turpentine (Brandes)

Sol in conc  $\text{HNO}_3+\text{Aq}$

$+5\text{H}_2\text{O}$  (Muller-Erbach, *B* 1889, 22 3181)

$+6\text{H}_2\text{O}$  Pptd from solution in 11.7 mol  $\text{H}_2\text{O}$  at  $-21^\circ$  (Kuznetsoff, *C C* 1899, 246)

**Manganese trichloride,  $\text{MnCl}_3$**

Immediately decomp by  $\text{H}_2\text{O}$ , sol in abs ether and in abs alcohol (Holmes, *J An Chem Soc* 1907, 29 1285)

**Manganese tetrachloride,  $\text{MnCl}_4$**

Has not been isolated

Sol in  $\text{H}_2\text{O}$ , alcohol, or ether (Nickle *J B* 1865 225)

Composition is  $\text{Mn}_2\text{Cl}_8$  (Christensen, *pr* (2) 34 41)

**Manganese hydrogen tetrachloride (chloromanganic acid),  $\text{MnCl}_4 \cdot 2\text{HCl}$**

Sol in ether, decomp by  $\text{H}_2\text{O}$  (Frank (2) 36 31)

**Manganese heptachloride,  $\text{MnCl}_7(?)$**

Decomp by  $\text{H}_2\text{O}$  (Dumas, Berz *J B* 112)

Has the formula  $\text{MnO}_2\text{Cl}$  (?) (Aschoff, J pr 81 29)

**Manganous mercuric chloride**,  $\text{MnCl}_2, \text{HgCl}_2 + 4\text{H}_2\text{O}$

Deliquescent in moist air Easily sol in  $\text{H}_2\text{O}$  (v Bonsdorff)  
 $\text{MnCl}_2, 2\text{HgCl}_2$  (Varet, C R 1896, 123, 422)

**Manganous potassium chloride**,  $\text{MnCl}_2, \text{KCl} + 2\text{H}_2\text{O}$

Deliquescent Very sol in  $\text{H}_2\text{O}$ , but is decomp thereby (Remsen and Saunders, Am Ch J 14 129)

$\text{MnCl}_2, 2\text{KCl} + 2\text{H}_2\text{O}$  (Suss, Z Kryst 1912, 51 262)

**Manganic potassium chloride**,  $\text{MnCl}_3, 2\text{KCl} + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{HCl}$  apparently without decomp (Rice, Chem Soc 1898, 73 261)

$\text{MnCl}_4, 2\text{KCl}$  Very easily decomp (Meyer and Best, Z anorg 1899, 22 186)

$\text{MnCl}_4, \text{MnCl}_3, 5\text{KCl}$  Easily decomp (Meyer and Best, Z anorg 1899, 22 185)

**Manganous rubidium chloride**,  $\text{MnCl}_2, 2\text{RbCl}$

(Godeffroy)  
 $+ 3\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol, conc  $\text{HCl}$  + ppt anhydrous salt from aqueous solution (Godeffroy, Arch Pharm (3) 12 40)

Contains only  $2\text{H}_2\text{O}$  (Saunders, Am Ch J 14 139)

**Manganous thalic chloride**,  $\text{MnCl}_2, 2\text{TiCl}_3 + 6\text{H}_2\text{O}$

Can be crvst from  $\text{H}_2\text{O}$  (Gewecke, A 1909, 366 224)

**Manganous stannic chloride**

See Chlorostannate, manganous

**Manganous chloride hydrazine**,  $\text{MnCl}_2, 2\text{N}_2\text{H}_4$

Ppt (Franzen, Z anorg 1908, 60 285)

**Manganous chloride hydroxylamine**,  $\text{MnCl}_2, 2\text{NH}_2\text{OH}$

Very stable, insol in alcohol (Feldt, B 1894, 27 405)

**Manganous fluoride**,  $\text{MnF}_2$

Only sol in  $\text{H}_2\text{O}$  containing  $\text{HF}$  (Berzelius)

Insol in  $\text{H}_2\text{O}$ , decomp by boiling with  $\text{H}_2\text{O}$ , sl sol in liquid  $\text{NH}_3$ , easily sol in cold or hot conc  $\text{HNO}_3$  and  $\text{HCl}$ , slowly sol in dil  $\text{HCl}$ , decomp by fused  $\text{K}_2\text{CO}_3$ ,  $\text{KOH}$ ,  $\text{KNO}_3$ , and  $\text{KClO}_3$ , insol in alcohol and

ether Slowly sol in acetic acid (Moissan, C R 1900, 130 1160)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 828)

Insol in acetone (Naumann, B 1904, 37 4329)

**Manganese trifluoride**,  $\text{MnF}_3$

Completely sol in a little  $\text{H}_2\text{O}$ , but decomp by dilution or boiling (Berzelius)

$+ 6\text{H}_2\text{O}$  Efflorescent (Christensen, J pr (2) 35 57)

Sol in  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ , decomp by  $\text{H}_2\text{O}$ , insol in most organic solvents (Moissan, C R 1900, 130 626)

**Manganomanganic fluoride**,  $\text{Mn}_2\text{F}_7 + 10\text{H}_2\text{O}$

Sol in a little  $\text{H}_2\text{O}$ , but decomp by dilution (Nickles, C R 67 448)

**Manganese tetrafluoride**,  $\text{MnF}_4$

Not isolated Sol in absolute alcohol or ether, decomp by  $\text{H}_2\text{O}$  (Nickles, C R 65 107)

Probably does not exist (Christensen, J pr (2) 35 161)

**Manganese heptafluoride**,  $\text{MnF}_7$

Sol in  $\text{H}_2\text{O}$  with decomp (Wohler)

**Manganese sesquifluoride with MF**

See also Fluomanganate, M

**Manganic nickel fluoride**,  $2\text{NiF}_3, \text{MnF}_2 - 5\text{H}_2\text{O}$

(Christensen, J pr (2) 34 41)

**Manganic potassium fluoride**,  $\text{MnF}_2, 4\text{KF} - 2\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  Sol in conc  $\text{HCl} - \text{Aq}$ , dil  $\text{HNO}_3 + \text{Aq}$ , conc  $\text{H}_2\text{SO}_4 + \text{Aq}$ ,  $\text{H}_3\text{PO}_4 - \text{Aq}$ ,  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ ,  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 - \text{Aq}$ , and an  $\text{HF} + \text{Aq}$  (Christensen, J pr 2 35 72)

$\text{MnF}_4, 2\text{KF}$  Difficultly sol in  $\text{H}_2\text{O}$  Decomp by much  $\text{H}_2\text{O}$  (Nickles, C R 65 107)

True composition is  $\text{MnF}_2, 4\text{KF}$ , also with  $2\text{H}_2\text{O}$  (Christensen J pr 2 34 41)

$\text{MnF}_4, 4\text{KF}$  (Nickles)  
 See also Fluomanganate, potassium

**Manganic rubidium fluoride**

See Fluomanganate, rubidium

**Manganic silver fluoride**,  $2\text{AgF}, \text{MnF}_2 - 14\text{H}_2\text{O}$

Sol in  $\text{HF} + \text{Aq}$  (Christensen, J pr 2) 34 41)

**Manganic sodium fluoride**,  $\text{MnF}_2, 4\text{NaF}$

Decomp by much  $\text{H}_2\text{O}$  Not as sol in  $\text{HF} + \text{Aq}$  as the K salt (Christensen J pr 2) 35 161)



**Manganomanganic thalious fluoride, 5TlF,  $2\text{MnF}_3$ ,  $\text{MnF}_2$** Decomp by  $\text{H}_2\text{O}$ 

Sl sol in dil, easily sol in conc HF

Sol in conc HCl, dil  $\text{HNO}_3$ , and cold or hot conc  $\text{H}_2\text{SO}_4$ Sol in warm  $\text{H}_2\text{O}_2$  containing  $\text{H}_2\text{SO}_4$ 

Sol in dil tartaric and oxalic acids (Ephraim, B 1909, 42 4458)

**Manganous stannic fluoride**

See Fluostannate, manganous

**Manganic zinc fluoride,  $2\text{ZnF}_2$ ,  $\text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$** 

See Fluomanganate, zinc

**Manganous zirconium fluoride**

See Fluozirconate, manganous

**Manganous fluoride ammonia,  $3\text{MnF}_3$ ,  $2\text{NH}_3$** 

(Moissan, C R 1900, 130 1161)

**Manganous hydroxide,  $\text{MnO}_2\text{H}_2$** 2.15 x  $10^{-5}$  g-mol are sol. in 1 l  $\text{H}_2\text{O}$  at  $18^\circ$  (Sackur, Z Elektrochem, 1909, 15 846)Solubility in  $\text{H}_2\text{O} = 0.6 \times 10^{-4}$  g mol (Herz, Z anorg 1899, 22 284)1 l  $\text{H}_2\text{O}$  dissolves  $2 \times 10^{-4}$  mol  $\text{MnO}_2\text{H}_2$  (Tamm, Z phys Ch 1910, 74 500)Very sl sol in  $\text{H}_2\text{O}$  or alkalies (Fresenius) Easily sol in acids Insol in NaOH, or KOH+Aq Sol in  $\text{NH}_4$  salts+Aq Insol in  $\text{NH}_4\text{OH}$ +Aq Sol in NaOH+Aq in presence of glycerine (Donath, Dingl 229 542)Not pptd by  $\text{NH}_4\text{OH}$ +Aq in presence of  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$ , by KOH+Aq in presence of cane sugar, by KOH+Aq in presence of Na citrateSolubility of  $\text{MnO}_2\text{H}_2$  in organic Na salts+Aq (0.5 normal)

Na tartrate, 0.0068 mol per l

Na malate, 0.0042 " " "

Na citrate, 0.0126 " " "

(Tamm, Z phys Ch 1910, 74 496)

Min Pyrochroite

**Manganomanganic hydroxide,  $\text{Mn}_3\text{O}_4$ ,  $x\text{H}_2\text{O}$** Not attacked by boiling  $\text{NH}_4\text{Cl}$ +Aq Behaves towards acids as  $\text{Mn}_2\text{O}_3$ **Manganic hydroxide,  $\text{Mn}_2\text{O}_3$ ,  $\text{H}_2\text{O}$** Insol in hot or cold dil  $\text{H}_2\text{SO}_4$ +AqSol in conc  $\text{H}_2\text{SO}_4$  at somewhat over  $100^\circ$  (Carius)

Sol in tartaric, oxalic, and malic acids, with subsequent decomp Insol in formic, acetic, benzoic, or hippuric acids (Hermann, Pogg 74 303)

Insol in  $\text{NH}_4\text{Cl}$ +Aq Insol in cane sugar +Aq (Pescher)Min Manganite Sol in conc HCl+Aq Sl sol in conc  $\text{H}_2\text{SO}_4$ **Manganese dihydroxide,  $\text{MnO}_2$ ,  $\text{H}_2\text{O}$** 

See Manganous acid.

**Manganous iodide,  $\text{MnI}_2$** *Anhydrous* Nearly insol in  $\text{AsBr}_3$  (Walden, Z anorg 1902, 29 374)Sol in  $\text{POCl}_3$  (Walden, Z anorg 1900, 25 212)Moderately sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)+ $4\text{H}_2\text{O}$  Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Kuznetsoff, C C 1900, II 525)+ $9\text{H}_2\text{O}$  (Kuznetsoff)**Manganous mercuric iodide,  $\text{MnI}_2$ ,  $2\text{HgI}_2 + 6\text{H}_2\text{O}$** Decomp by  $\text{H}_2\text{O}$  Sol without decomp in alcohol and acetone (Dobroserdoff, C C 1901, I 363) $3\text{MnI}_2$ ,  $5\text{HgI}_2 + 20\text{H}_2\text{O}$ A sat solution in  $\text{H}_2\text{O}$  at  $17^\circ$  has composition 1.4  $\text{MnI}_2$ ,  $\text{HgI}_2 + 10.22 \text{H}_2\text{O}$  and sp gr = 2.98 (Duboin, C R 1906, 142 1338)Very sol without decomp in methyl, propyl, isopropyl, isobutyl, and allyl alcohols, ethyl acetate and ethyl cyanide Somewhat less sol in amyl, propyl and isobutyl acetates, acetone, acetic acid, formic acid (with ppt of  $\text{HgI}_2$ ), ethyl benzoate, ethyl oxalate, butyl alcohol, amyl alcohol and nitrobenzene Sl decomp by glycerine Insol in ethyl nitrate, ethylene bromide, toluene, benzene,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , ethyl iodide, monobrom- and monochlorobenzene (Duboin, A ch 1909, (8), 16 278)**Manganese nitride,  $\text{Mn}_3\text{N}_2$** Sol in  $\text{HNO}_3$  only on heating  $\text{HCl}$ +Aq dissolves only in presence of Pt Aqua regia dissolves slowly  $\text{H}_2\text{SO}_4$  acts only when hot and conc Insol in acetic acid (Prelinger, M 1894, 15 398) $\text{Mn}_3\text{N}_2$  Sol in  $\text{NH}_4\text{Cl}$ +Aq and  $\text{NH}_4\text{OH}$ +Aq, insol in HCl, sol in  $\text{HNO}_3$ +Aq with decomp (Prelinger, M 1894, 15 398) $\text{Mn}_3\text{N}_2$  Easily attacked by acids and alkalies (Wedekind, B 1908, 41 3772)**Manganous oxide,  $\text{MnO}$** Insol in  $\text{H}_2\text{O}$  Easily sol in acids Readily sol in  $\text{NH}_4\text{Cl}$ +Aq**Manganic oxide (Manganese sesquioxide),  $\text{Mn}_2\text{O}_3$** Decomp by boiling with  $\text{HNO}_3$ +Aq into  $\text{MnO}$ , which dissolves, and  $\text{MnO}_2$ , which is insol (Berthier), also by boiling with dil  $\text{H}_2\text{SO}_4$ +Aq (Turner) Sol in hot conc  $\text{H}_2\text{SO}_4$  or  $\text{HCl}$ +Aq Sol in cold  $\text{HCl}$ +Aq without decomp If perfectly pure, is insol in dil  $\text{H}_2\text{SO}_4$ +Aq, but if it contains any  $\text{MnO}$ , it dissolves (Rose) Insol in boiling  $\text{NH}_4\text{Cl}$ +Aq

Insol in acetone (Naumann, B 1904, 37 4329)

**Solubility in (calcium succate+sugar)+Aq**

1 l solution containing 418.6 g sugar and 34.3 g CaO dissolves 0.50 g  $MnO_2$ , containing 296.5 g sugar and 24.2 g CaO dissolves 0.37 g  $Mn_2O_3$ , containing 174.4 g sugar and 14.1 g CaO dissolves 0.32 g  $Mn_2O_3$  (Bodenbender, J B 1865 600)

*Min Braumite*

**Colloidal Solution in H<sub>2</sub>O** containing 0.21 g to a litre is precipitated by  $KNO_3$ +Aq (1 1000),  $K_2SO_4$ +Aq (1 1100),  $(NH_4)_2SO_4$ +Aq (1 1500),  $NaCl$ +Aq (1 1580),  $MgSO_4$ +Aq (1 40,983),  $BaCl_2$ +Aq (1 58,823),  $MnSO_4$ +Aq (1 147,929),  $(NH_4)_2Al_2(SO_4)_4$ +Aq (1 362,318),  $K_2Cr(SO_4)_4$ +Aq (1 416,668),  $HCl$ +Aq (1 61,350),  $HC_2H_3O_2$  (1 17,262),  $H_2SO_4$  (1 62,500) (Spring and de Boeck, Bull Soc (2) 48 170)

**Manganomanganic oxide,  $Mn_2O_4$**

Insol in  $H_2O$  Boiling dil or conc  $HNO_3$ +Aq dissolves out  $MnO$  (Berthier), also boiling dil  $H_2SO_4$ +Aq (Turner) Sol in hot  $HCl$ +Aq (Otto)  $NH_4Cl$ +Aq dissolves out  $MnO$  (Rose) Sol without decomp in hot very conc  $H_3PO_4$ +Aq, and cold conc  $H_2SO_4$ ,  $HCl$ , oxalic, and tartaric acids+Aq

*Min Hausmannite*

**Manganese dioxide,  $MnO_2$**

*Min Pyrolusite* Insol in  $H_2O$  Very slowly sol in conc  $H_2SO_4$  with evolution of  $O_2$  Sol in cold  $HCl$ +Aq, decomp by hot  $HCl$ +Aq Sol in aqua regia Sol in  $SO_2$ +Aq or  $N_2O_5$ +Aq (Karsten)

Insol in  $HNO_3$ , or dil  $H_2SO_4$ +Aq, except in presence of organic reducing substances Decomp by citric acid, and more easily by oxalic acid (Bolton)

Sl sol in hot conc, but insol in dil  $HNO_3$ +Aq (Deville) When pure it is insol in cold dil  $H_2SO_4$ +Aq, but if a small quantity of  $MnO$  is added much  $MnO$  dissolves (Carius)

Not decomp by boiling  $NH_4Cl$ +Aq Easily sol in a mixture of nitrosulphuric acid and conc  $HCl$ +Aq (Borntrager, Rep anal Ch 1887 741)

Insol in acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

**Manganese oxides,  $Mn_2O_3$ ,  $Mn_2O_{11}$ , etc**

*See Manganite, manganous*

**Manganese trioxide,  $MnO_3$**

Deliquescent Sol in  $H_2O$ , with subsequent decomp Decomp by ether Sol in conc  $H_2SO_4$  (Franke, J pr (2) 36 31)

**Manganese tetroxide,  $MnO_4$  (?)**

Sl sol in  $H_2O$  with decomp Decomp by  $H_2SO_4$  or ether (Franke, J pr (2) 36 166)

**Manganese hexoxide,  $Mn_2O_7$**

Very unstable takes up  $H_2O$  from air Sol in  $H_2O$  with evolution of heat and rapid decomposition Sol in conc  $H_2SO_4$  without decomp (Aschoff)

**Manganese oxychloride,  $3Mn_2O_3 \cdot MnCl_2$**

Insol in  $H_2O$  Saint-Gilles (C R 85 329)  $MnCl_2$ ,  $MnO$  Gorgeu, A ch 6 4. 515)

$MnO_2Cl$  *See Manganyl chloride*

**Manganic oxyfluoride,  $MnOF$**

Sol in absolute ether  $MnOF_2 \cdot 2HF$ =fluoromanganic acid (Nickles, C R 659 107)

**Manganic oxyfluoride potassium fluoride**

*See Fluorymanganate, potassium.*

**Manganic sesquioxo-fluoride potassium fluoride**

*See Sesquifluorymanganate, potassium*

**Manganous oxyiodide,  $MnI \cdot MnO \cdot H_2O$**

Sol in  $H_2O$  with decomp Kallitzsch, C C 1913, I 1004

**Manganese oxysulphide,  $MnO \cdot MnS$**

Sol in acid Arvedson, P 1 1

**Manganese phosphide,  $MnP$**

Insol in all acids Wedekind B 1907 40 128 Sol in aqua regia er C P 1897 124

$MnP$   $HC$  leaves  $MnP$  Wohler a M A 86

Not easily sol in  $HNO_3$  (Wedekind) B 1907 40

$2MnP$   $Mn$   $P$  partly sol in  $H_2SO_4$  pr 79 521

$MnP$   $HC$  + Aq Schrotter W A 1849 1

**Manganous phosphoselenide**

Insol in  $H_2O$  Sol in  $HC$  + Aq Insol in conc  $H_2SO_4$  + Aq Hahn J pr 93 40  $2MnSe$ ,  $PSe$  Insol in hot  $HCl$ +Aq Not easily sol  $2MnSe$ ,  $PSe$  (Hahn)

**Manganese selenide, MnSe**

Decomp by  $H_2O$  and min acids (Wedekind, B 1911, 44 2667)

*Cryst* Sl decomp by  $H_2O$  at  $100^\circ$ , easily sol in dil acids (Fonzes-Diacon, C R 1900, 130 1025)

**Manganese silicide**

Sol in HF, only very sl sol in other acids (Warren, C N 1898, 78 319)

$Mg_2Si_2$  Sol in  $HCl + Aq$  with evolution of  $SiH_4$  (Wohler, A 106 54)

$Mn_2Si$  Insol in  $H_2O$  (Vigouroux, C R 1895, 121 772)

Easily sol in HF (Wedekind, B 1911, 44 2668)

Easily sol in dil acids, HF and  $HNO_3$ , Insol in  $KOH + Aq$  (Vigouroux, A ch 1897, (7) 12 179)

Easily sol in HF when heated, in  $HCl$  when red hot Sol in dil min acids with decomp (Vigouroux, C R 1895, 121 772)

Insol in  $HNO_3$ , sol in dil or conc  $HCl$  Slowly decomp by alkali hydroxides (Lebeau, C R 1903, 136 91)

$Mn_2Si$  Easily sol in molten alkali (Vigouroux, C R 1895, 121 772)

$MnSi$  Slowly attacked by hot conc  $HCl$  Not acted upon by dil or conc  $HNO_3$  or  $H_2SO_4$  (Lebeau, C R 1903, 136 91)

$MnSi_2$  Not attacked by  $HNO_3$  or  $H_2SO_4$  Easily sol in cold HF, decomp by conc alkalis +  $Aq$  (Lebeau, C R 1903, 136 233)

**Manganous sulphide,  $MnS$** 

*Anhydrous* Insol in  $H_2O$  Sol in weak acids, even in acetic acid

1 l  $H_2O$  dissolves  $71.60 \times 10^{-6}$  moles  $MnS$  at  $18^\circ$  (Weigel, Z phys Ch 1907, 58 294)

Insol in acetone (Naumann, B 1904, 37 4329)

Min *Alabandite* Sol in  $HCl + Aq$  +  $\frac{1}{2}H_2O$  *Green* Decomp by boiling with  $H_2O$  Sol in weak acids, as acetic or sulphurous acid Very sl sol in  $(NH_4)_2S + Aq$  (Wackenroder)

Sol in  $NH_4$  salts +  $Aq$  100 ccm of sat  $NH_4Cl + Aq$  at  $12^\circ$  dissolve 0.43 g  $MnS$  (Clermont and Guyot, C R 85 37)

+  $\frac{3}{2}H_2O$  *Flesh colored* Less sol in  $NH_4$  salts, or acetic acid +  $Aq$  than the preceding salt 100 ccm of sat  $NH_4Cl + Aq$  at  $12^\circ$  dissolve 0.088 g (Clermont and Guyot)

Neither green nor flesh-coloured  $MnS$  contains  $H_2O$  (Antony and Donnini, Gazz ch it 23 560)

$MnS$  is not pptd in presence of alkali citrates, tartrates, or grape sugar, cane or milk sugar do not prevent precipitation (Spiller) Not pptd in presence of  $Na_4P_2O_7$  (Rose)

**Manganese sulphide,  $Mn_2S_4$** 

Decomp by  $H_2O$  Sol in cold dil acids (Gautier and Hallopeau, C R 1889, 108 809)

**Manganese disulphide,  $MnS_2$** 

(Senarmont, J pr 51 385)

Min *Hauerite* Decomp by hot  $HCl + Aq$  with separation of S

**Manganous phosphorus sulphide,  $MnS, P_2S$** 

Sol in  $HCl + Aq$  with decomp (Berzelius, A 46 147)

**Manganous potassium sulphide,  $3MnS, K_2S$** 

Nearly insol in water, alcohol, or ether Easily sol in acids (Völcker, A 59 35)

**Manganous sodium sulphide,  $3MnS, Na_2S$** 

Insol in  $H_2O$ , alcohol, or ether Sol in dil acids, and  $SO_2 + Aq$  (Volcker)

$2MnS, Na_2S$  Decomp by  $H_2O$  (Schneid er, Pogg 151 446)

**Manganese telluride,  $MnTe$** 

Decomp by  $H_2O$  and min acids (Wedekind, B 1911, 44 2667)

**Manganic acid,  $H_2MnO_4$** 

Known only in solution, which decomposes rapidly (Franke, J pr (2) 36 31)

**Barium manganate,  $BaMnO_4$** 

Insol in  $H_2O$ , decomp by acids (Mitscherlich)

**Didymium manganate,  $D_{12}(MnO_4)_3$** 

Insol in  $H_2O$  Sol in  $H_2SO_4 + Aq$  (Frerichs and Smith, A 191 331)

Does not exist (Cleve, B 11 912)

**Lanthanum manganate,  $La_2(MnO_4)_3$** 

Ppt (Frerichs and Smith, A 191 331)

Does not exist (Cleve, B 11 912)

**Manganese manganate,  $Mn_2O_3, MnO_3 = 3MnO_2$** 

See *Manganese dioxide*

**Lead manganate,  $PbMnO_4 + 2H_2O$** 

Ppt (Jolles, C C 1888 58)

**Potassium manganate,  $K_2MnO_4$** 

Sol in water containing alkalis without decomp, but decomp by pure  $H_2O$  Can be recrystallised from dil  $KOH + Aq$

## Solubility in KOH + Aq at t°

Solvent	t°	Mol $K_2MnO_4$ in 1 l of sat solution
2-N KOH	0	0 907
	10	1 013
	20	1 140
	30	1 252
	45	1 424
4-N KOH	0	0 554
	17	0 681
	25	0 733
	30	0 772
	40	0 852
	45	0 889
	51	0 938
	60	1 003
	70	1 074
	80	1 143
6-N KOH	0	0 155
	15	0 224
	23	0 261
	30	0 303
	40	0 362
	45	0 388
	60	0 469
	70	0 528
	80	0 587
8-N KOH	0	0 063
	10	0 070
	20	0 078
	30	0 096
	40	0 119
	50	0 142
	60	0 167
	70	0 196
	80	0 222
10-N KOH	0	0 0145
	10	0 0152
	20	0 0160
	30	0 0215
	40	0 0305
	50	0 0462
	63	0 0620
	70	0 0700
	80	0 0830

(Sackur, Z Elektrochem 1912, 18 724)

Sol in ethyl acetate (Naumann, B 1910, 43 314)

**Potassium manganate permanganate,**  
 $K_2MnO_4, KMnO_4$ 

Sol without decomp in 20% KOH + Aq (Gorgeu, A ch (3) 61 355)

**Sodium manganate,**  $Na_2MnO_4 + 10H_2O$ Sol in  $H_2O$ , with partial decomp (Gen-tele, J pr 82 58)**Strontium manganate,**  $SrMnO_4$ Insol in  $H_2O$  (Fromherz)**Permanganic acid**

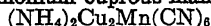
See Permanganic acid

**Manganicyanhydric acid,**  $H_3Mn(CN)_6$ 

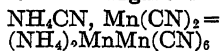
Not known in the free state

**Barium manganicyanide,**  $Ba_3[Mn(CN)_6]_2$ Sol in  $H_2O$  (Fittig and Eaton)**Barium potassium manganicyanide barium cyanide,**  $2KBaMn(CN)_6, 3Ba(CN)_2 + 8H_2O$ Decomp by  $H_2O$  (Lehmann, Dissert 1898)**Calcium manganicyanide,**  $Ca_3[Mn(CN)_6]_2$ Sol in  $H_2O$  (Fittig and Eaton)**Potassium manganicyanide,**  $K_3Mn(CN)_6$ Sol in  $H_2O$  (Christensen, J pr (2) 31 163)**Sodium manganicyanide,**  $Na_3Mn(CN)_6 + 2H_2O$ Sol in  $H_2O$  (Fittig and Eaton)**Manganumanganic acid****Barium manganumanganate,**  $Ba_3Mn_2O_8 + H_2O$ Insol in  $H_2O$  Identical with Rosenstiehl's "basic barium manganate," (J Pharm 1864, 46 344) (Auger and Billy, C R 1904, 138 501)**Lithium manganumanganate,**  $Li_3Mn_2O_8 + H_2O$ Insol in  $H_2O$  (Auger and Billy)**Manganoperiodic acid,**  $H_2O, Mn_2O_3, I_2O_7$ Wholly insol in  $H_2O$ , in hot dil or conc  $HNO_3$  and in hot dil  $H_2SO_4$  (Price, Am Ch J 1903, 30 182)**Potassium manganoperiodate,**  $K_2O, Mn_2O_3, I_2O_7$ Apparently entirely insol and unchanged when boiled with  $H_2O$ , dil or conc  $HNO_3$ , or dil  $H_2SO_4$  (Price)**Sodium manganoperiodate,**  $Na_2O, Mn_2O_3, I_2O_7$ Apparently insol and unchanged when treated with boiling  $H_2O$ , boiling dil or conc  $HNO_3$  and boiling dil  $H_2SO_4$  (Price)**Manganocyanhydric acid,**  $H_4Mn(CN)_6$ 

Most easily decomp Sl sol in alcohol Insol in ether (Descamps, A ch (5) 24 185)

**Ammonium cuprous manganocyanide,**

Sol in  $\text{H}_2\text{O}$ , decomp by acids and alkalis, very unstable (Straus, Z anorg 1895, 9 14)

**Ammonium manganous manganocyanide,**

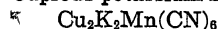
Sol in  $\text{NH}_4\text{CN} + \text{Aq}$  (Fittig and Eaton, A 145 157)

**Barium manganocyanide,  $\text{Ba}_2\text{Mn}(\text{CN})_6$** 

Sol in cold  $\text{H}_2\text{O}$  (Fittig and Eaton)

**Calcium manganocyanide,  $\text{Ca}_2\text{Mn}(\text{CN})_6$** 

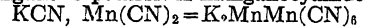
Very deliquescent Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Fittig and Eaton)

**Cuprous potassium manganocyanide,**

Sol in  $\text{H}_2\text{O}$  with sl decomp Easily decomp by acids and alkalis (Straus, Z anorg 1895, 9 12)

**Cuprous sodium manganocyanide,**

Sol in  $\text{H}_2\text{O}$  with only sl decomp Partially decomp by acids (Straus)

**Manganous potassium manganocyanide,**

Ppt Sol in  $\text{KCN} + \text{Aq}$

**Potassium manganocyanide,  $\text{K}_4\text{Mn}(\text{CN})_6 + 3\text{H}_2\text{O}$** 

Very efflorescent Sol in  $\text{H}_2\text{O}$ , decomp by boiling

**Potassium manganocyanide chloride,**

Easily sol in  $\text{H}_2\text{O}$  (Descamps)

**Sodium manganocyanide,  $\text{Na}_4\text{Mn}(\text{CN})_6 + 8\text{H}_2\text{O}$** 

Very efflorescent Easily sol in  $\text{H}_2\text{O}$  (Fittig and Eaton)

**Strontium manganocyanide,  $\text{Sr}_2\text{Mn}(\text{CN})_6$** 

As the Ba comp (Descamps)

**Permanganomolybdic acid**

See Permanganomolybdic acid

**Permanganotungstic acid**

See Permanganotungstic acid

**Manganosulphuric acid**

See Sulphate, manganic

**Manganous acid,  $\text{H}_2\text{MnO}_3 = \text{MnO}_2, \text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Franke, J pr (2) 36 451)  
 $2\text{MnO}_2, \text{H}_2\text{O}$  (?) Min Wad

**Barium manganite,  $\text{BaO}, 5\text{MnO}_2$** 

Sl sol in  $\text{HCl} + \text{Aq}$ , less sol in  $\text{HNO}_3 + \text{Aq}$  (Rissler, Bull Soc (2) 30 111)

$\text{BaO}, 7\text{MnO}_2$  (Rousseau, C R 104 786)

$\text{BaO}, 2\text{MnO}_2$  Insol in  $\text{H}_2\text{O}$

$\text{BaO}, \text{MnO}_2$  Insol in  $\text{H}_2\text{O}$  (Rousseau, C R 102 425)

$\text{Ba}(\text{H}_2\text{Mn}_2\text{O}_{10})_2$  (Morawski and Stengl, J pr (2) 18 92)

**Calcium manganite,  $\text{CaO}, 5\text{MnO}_2$** 

Easily sol in  $\text{HCl} + \text{Aq}$ , less in  $\text{HNO}_3 + \text{Aq}$  (Rissler)

$3\text{CaO}, \text{MnO}_2$  (?) Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  with evolution of  $\text{Cl}$  Scarcely sol in cold  $\text{HNO}_3$ , but sol on heating (Du fau, A ch 1897, (7) 12 275)

$2\text{CaO}, \text{MnO}_2$  Sol in dil mm acids (Rousseau, C R 116 1060)

$\text{CaO}, 2\text{MnO}_2$  (Rousseau, C R 102 425)

$\text{CaO}, 3\text{MnO}_2$

$\text{CaO}, \text{MnO}_2$  Sol in fuming  $\text{HCl} + \text{Aq}$ , but not in dil  $\text{HNO}_3 + \text{Aq}$  (Rousseau, C R 116 1060)

**Chromium manganite,  $\text{Cr}_2\text{O}_3, 3\text{MnO}_2 = \text{Cr}_2(\text{MnO}_3)_3$** 

Slowly decomp by acids (Groger, Z anorg 1905, 44 458)

**Cobaltous manganite,  $\text{CoO}, \text{MnO}_2 + 2\text{H}_2\text{O}$** 

Ppt (Salinger, Z anorg 1903, 33 352)  
 $+ 4\text{H}_2\text{O}$  Ppt (Salinger)

**Cobalt copper manganite,  $\text{CoO}, \text{CuO}, 2\text{MnO} + 4\text{H}_2\text{O}$** 

Min *Asbolite* Sol in  $\text{HCl} + \text{Aq}$ , with evolution of  $\text{Cl}$

**Cupric manganite,  $\text{CuO}, 4\text{MnO}$** 

(Gorgeu, Bull Soc 1903, (3) 29 1167)

$\text{CuO}, 8\text{MnO}_2 + 3\text{H}_2\text{O}$  (Baubigny, C R 1897, 124 955)

**Cupric manganous manganite,  $4\text{CuO}, \text{Mn} 7\text{MnO}_2 + 8\text{H}_2\text{O}$** 

Ppt (Salinger, Dissert 1902)

$\text{Mn}_2\text{O}_3, 3\text{CuO}$  Sol in  $\text{HCl} + \text{Aq}$  (Schneider, Am Ch J 9 269)

**Lead manganite,  $\text{PbO}, 5\text{MnO}_2$** 

Not attacked by conc acids, sol in aqu regia (Rissler)

**Magnesium manganite,  $2\text{MgO}, \text{MnO}_2$** 

(Lemone, Ann Min (7) 3 5)

$+ x\text{H}_2\text{O}$  (Vollard)

**Manganous manganite,  $\text{Mn}_2\text{O}_3 = \text{MnO}, 2\text{MnO}_2$** 

(Reissig, A 103 27)

$\text{Mn}_2\text{O}_{11} = \text{MnO}, 5\text{MnO}_2$  (Veley, Chen Soc 38 581)

$3\text{MnO}_2, 2\text{MnO}$  Decomp by dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Franke, J pr (2) 36 166)  
 $3\text{MnO}_2, \text{MnO} + \text{H}_2\text{O}$  Min *Varnvite*

**Manganous zinc manganite**,  $\text{MnO}, \text{ZnO}, \text{MnO}_2$   
 (Gorgeu, Bull Soc 1903, (3) 29 1168)  
 $2\text{MnO}, \text{ZnO}, 2\text{MnO}_2$  (Gorgeu)

**Potassium manganite**,  $\text{K}_2\text{O}, 2\text{MnO}_2$   
 Insol in  $\text{H}_2\text{O}$   
 $\text{K}_2\text{O}, 5\text{MnO}_2$   
 $\text{K}_2\text{O}, 7\text{MnO}_2 + 3\text{H}_2\text{O}$   
 $\text{K}_2\text{O}, 8\text{MnO}_2 + 3\text{H}_2\text{O} = \text{KH}_3\text{Mn}_4\text{O}_{10}$  (Morawski and Stengl, J pr (2) 18 91)  
 Does not exist (Wright and Menke, Chem Soc 37 22)  
 $\text{K}_2\text{O}, 10\text{MnO}_2$   
 $\text{K}_2\text{O}, 16\text{MnO}_2 + 6\text{H}_2\text{O}$  Sol in conc  $\text{HCl} + \text{Aq}$  (Rousseau, C R 114 72)

**Silver manganite**,  $\text{AgH}_3\text{Mn}_4\text{O}_{10}$   
 (Morawski and Stengl, J pr (2) 18 92)  
 $\text{Ag}_2\text{MnO}_3$  Ppt (Gorgeu, C R 110 958)

**Silver (argenteous) manganite**,  $\text{Ag}_4\text{O}, \text{Mn}_2\text{O}_3$  (?)  
 Insol in cold dil  $\text{HNO}_3 + \text{Aq}$ , and separates  $\text{Mn}_2\text{O}_3$  on warming. Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Rose, Pogg 101 229)

**Silver (argentoargentic) manganite**,  $\text{Ag}_4\text{O}, 2\text{Ag}_2\text{O}, \text{Mn}_2\text{O}_3$  (?)  
 (Rose)

**Sodium manganite**,  $\text{Na}_2\text{O}, 5\text{MnO}_2$   
 Insol in  $\text{H}_2\text{O}$  (Rousseau, C R 103 261)  
 $\text{Na}_2\text{O}, 12\text{MnO}_2$  Insol in  $\text{H}_2\text{O}$  (Rousseau)  
 $+ 4\text{H}_2\text{O}$  (Rousseau, C R 112 525)  
 $\text{Na}_2\text{O}, 8\text{MnO}_2 + 5\text{H}_2\text{O}$  (Rousseau)  
 $\text{Na}_2\text{O}, 16\text{MnO}_2 + 8\text{H}_2\text{O}$  (Rousseau)

**Strontium manganite**,  $\text{MnO}_2, \text{SrO}$   
 Insol in  $\text{H}_2\text{O}$   
 $2\text{MnO}_2, \text{SrO}$  Insol in  $\text{H}_2\text{O}$  (Rousseau, C R 101 167)  
 $\text{MnO}_2, 5\text{SrO}$  Sol in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$  (Russler, Bull Soc (2) 30 110)

**Zinc manganite**,  $\text{ZnO}, 5\text{MnO}_2$   
 Insol in  $\text{H}_2\text{O}$  (Russler)  
 $\text{ZnO}, 4\text{MnO}_2$  (Gorgeu, Bull Soc 1903, (3) 29 1168)  
 $3\text{ZnO}, \text{MnO}_2 + 7\frac{1}{2}\text{H}_2\text{O}$  (Salinger, Dissert 1902)  
 $27\text{ZnO}, 2\text{MnO}_2 + 25\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Salinger)

**Manganyl chloride**,  $\text{MnO}_3\text{Cl}$   
 Decomp by  $\text{H}_2\text{O}$  (Aschoff, J pr 81 29)

**Melanocobaltic chloride**,  
 $\text{Co}_2(\text{NH}_3)_6\text{Cl}_4\text{NH Cl}$ , or  
 $\text{Co}_2(\text{NH}_3)_6\text{Cl}_5\text{NH}_2$

Very sl sol in cold  $\text{H}_2\text{O}$  or very dil  $\text{HCl} + \text{Aq}$ . Decomp by long standing or warming. Cold conc  $\text{HCl}$  or dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  does not attack, but decomp on warming.  $\text{HNO}_3 + \text{Aq}$  decomp on warming. Sol in cold  $\text{H}_2\text{SO}_4$  or  $\text{NH}_4\text{OH} + \text{Aq}$ , from both solutions it can be precipitated by  $\text{HCl} + \text{Aq}$  (Vortmann, B 10 1455)

— **chloroplatinate**,  $\text{Co}_2(\text{NH}_3)_6\text{NH}_2\text{Cl}_5$ ,  
 $\text{PtCl}_4$   
 Ppt (Vortmann, B 15 1902)  
 $\text{Co}_2(\text{NH}_3)_6\text{NH}_2\text{Cl}_5(\text{OH})_2$ ,  $\text{PtCl}_4$  Ppt  
 (Vortmann)

— **mercuric chloride**,  
 $\text{Co}_2(\text{NH}_3)_6(\text{NH}_2)\text{Cl}_5(\text{OH})_2, 3\text{HgCl}_2 + \text{H}_2\text{O}$

Ppt. Difficultly sol in cold  $\text{H}_2\text{O}$ , quite easily in warm  $\text{H}_2\text{O}$  acidified with  $\text{HCl}$  (Vortmann)

— **chloride chromate**,  
 $\text{Co}_2(\text{NH}_3)_6\text{NH}_2\text{Cl}_5\text{Cr}_2\text{O}_7 + \text{H}_2\text{O}$   
 Sol in hot  $\text{H}_2\text{O}$  (Vortmann)

**Mercuriammonium comps**  
*See Mercury ammonium comps*

**Mercuriammonium bromide**,  $\text{Hg}(\text{NH}_2)\text{Br}$   
*See Dimercuriammonium ammonium bromide*

**Mercuriammonium chloride**,  $\text{Hg}(\text{NH}_2)\text{Cl}$   
*See Dimercuriammonium ammonium chloride*

**Mercuriammonium oxydimercuriammonium chloride**,  $4\text{Hg}(\text{NH}_2)\text{Cl}, \text{NH}_2(\text{HgOHg})\text{Cl}$  (Millon)

Correct composition is *Dimercuriammonium ammonium chloride*,  $\text{NHg}_2\text{Cl}, \text{NH}_4\text{Cl}$ , which see (Balestra, Gazz ch it 21, 2 294)

$\text{Hg}(\text{NH}_2)\text{Cl}, 2\text{NH}_2(\text{HgOHg})\text{Cl}$  (Millon)  
 Correct composition is *Dimercuriammonium mercuric chloride*,  $2\text{NHg}_2\text{Cl}, \text{HgCl}_2 + \text{H}_2\text{O}$ , or *Dimercuriammonium hydrogen chloride*,  $\text{NHg}_2\text{Cl}, \text{HCl}$  (Balestra)

**Mercuriammonium nitrate**,  $2\text{NH}_3, 2\text{HgO}, \text{N}_2\text{O}_5 = \text{NH}_2\text{HgNO}_3 + \frac{1}{2}\text{H}_2\text{O}$

Easily decomp by  $\text{HCl}$ , or alkali sulphides +  $\text{Aq}$ . Sl sol in  $\text{HNO}_3 + \text{Aq}$ . Insol in  $\text{H}_2\text{SO}_4, \text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$  (Mitscherlich)

Is *dimercuriammonium ammonium nitrate*,  $\text{NHg}_2\text{NO}_3, \text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$  (Pesci, Gazz ch it 20 485)

**Dimercuriammonium chloride,  $\text{NH}_2\text{Cl}$** 

Not attacked by boiling  $\text{H}_2\text{O}$  Sl attacked by cold dil  $\text{HCl} + \text{Aq}$ , but is gradually dissolved thereby Decomp by hot  $\text{KOH} + \text{Aq}$  (Weyl)

Sol in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  with evolution of  $\text{NH}_3$

+  $\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$ , easily sol in  $\text{HNO}_3$ , and  $\text{HCl} + \text{Aq}$  Not decomp by  $\text{KOH} + \text{Aq}$  Decomp by  $\text{KCl}$ ,  $\text{NaCl}$ , or  $\text{KI} + \text{Aq}$  (Rammelsberg, Pogg 48 181)

**— hydrogen chloride,  $\text{NH}_2\text{Cl}$ ,  $2\text{HCl}$** 

Correct composition of mercuric chloramide chloride (Balestra, Gazz ch it 21, 2 299)

Decomp by  $\text{H}_2\text{O}$

$\text{NH}_2\text{Cl}$ ,  $\text{HCl}$  Decomp by  $\text{H}_2\text{O}$  (Balestra, l c)

$\text{NH}_2\text{Cl}$ ,  $4\text{HCl}$  Sol in  $\text{H}_2\text{O}$  (Ray, Proc Chem Soc 1901, 17 96)

**— ammonium chloride,  $\text{NH}_2\text{Cl}$ ,  $\text{NH}_4\text{Cl}$  (Insoluble white precipitate)**

Correct composition of what has been called mercuric chloramide,  $\text{Hg}(\text{NH}_2)\text{Cl}$  (Rammelsberg, J pr 38 558)

Insol in cold, decomp by hot  $\text{H}_2\text{O}$  (Milton, A ch (3) 18 413) Sol in 600 pts  $\text{H}_2\text{O}$  (Wittstein) Sol in 719.98 pts  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abt) Insol in alcohol

Sol in acids, even in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , also in  $\text{NH}_4\text{NO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , and  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Pelouze and Fremy)

Sol in warm  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett)

Sl sol in alkali chlorides +  $\text{Aq}$ , which partially decomp (Mahle, A ch (3) 5 180)

Decomp by  $\text{KOH} + \text{Aq}$  Sol in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ , with evolution of  $\text{NH}_3$  (Balestra)

When freshly prepared is sol in conc,  $\text{NH}_4\text{OH} + \text{Aq}$  (Schn and Choudhuri, Z anorg 1910, 67 359)

Sol in excess of  $(\text{NH}_4)_2\text{HPO}_4 + \text{Aq}$  Insol in excess of  $\text{Na HPO}_4 + \text{Aq}$  (Carnegie and Burt, C N 1897, 76 175)

Insol in excess of  $\text{NH}_4\text{OH} + \text{Aq}$  (Carnegie and Burt)

 **$\text{NH}_2\text{Cl}$ ,  $3\text{NH}_4\text{Cl}$  (Fusible white precipitate)**

Correct composition of what has been called mercuridammonium chloride,  $\text{Hg}(\text{NH}_2)_2\text{Cl}_2$  (Rammelsberg, J pr (2) 38 558)

Decomp by hot  $\text{H}_2\text{O}$  Sol in acids, even  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  Not decomp by cold, but by boiling  $\text{KOH} + \text{Aq}$  (Weyl)

Sol in warm, less in cold  $\text{NH}_4\text{OH} + \text{Aq}$  (Mitscherlich)

Sol in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ , with evolution of  $\text{NH}_3$  (Balestra)

Sol in 10%  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and acetic acid (Hofmann and Marburg, A 1899, 305 198)

**Dimercuriammonium mercuric chloride,  $2\text{NH}_2\text{Cl}$ ,  $\text{HgCl}_2$** 

Insol in, and not decomp by boiling  $\text{H}_2\text{O}$ , alkalis, conc  $\text{HNO}_3$ , or dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Sol in boiling  $\text{HCl} + \text{Aq}$  (Mitscherlich, J pr 19 453)

Sl decomp by  $\text{H}_2\text{O}$ , readily by  $\text{KOH} + \text{Aq}$  (Gaudechon, A ch 1911, (8) 22 212)

Ppt Sol in  $\text{HBr}$  (Ray, Proc Chem Soc 1902, 18 86)

**— chloride ammonia,  $\text{NH}_2\text{Cl}$ ,  $\frac{1}{2}\text{NH}_3$** 

Decomp by water and by  $\text{NH}_4\text{OH} + \text{Aq}$  (Gaudechon, A ch 1911, (8) 22 212)

**— chromate**

See Oxydmercuriammonium chromate

**— hydroxide,  $\text{NH}_2\text{OH}$** 

Takes up  $\text{H}_2\text{O}$  to form  $\text{NH}_2\text{OH} + \text{H}_2\text{O}$  or  $(\text{NH}_2\text{OH})_2\text{OH}$ , oxydmercuriammonium hydroxide, which also see

Sol in warm  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$

**— iodate,  $\text{NH}_2\text{IO}_3$ ,  $2\text{NH}_4\text{IO}_3$** 

Insol in  $\text{HNO}_3$  (Rammelsberg, J pr (2) 38 568)

**— iodide,  $\text{NH}_2\text{I}$** 

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  Decomp by boiling with  $\text{KOH} + \text{Aq}$  or  $\text{KCl} + \text{Aq}$  (Weyl, Pogg 121 601) Decomp by hot  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Balestra)

Decomp by dilute  $\text{HCl}$  Sol in ammonium salts +  $\text{Aq}$  (Franklin, Z anorg 1905, 46 21)

+  $\text{H}_2\text{O}$  See Oxydmercuriammonium iodide

**— ammonium iodide,  $\text{NH}_2\text{I}$ ,  $3\text{NH}_4\text{I}$** 

Correct composition of mercuridammonium iodide,  $\text{Hg}(\text{NH}_2)_2\text{I}_2$  (Pesci, Gazz ch it 20 485)

$3\text{NH}_2\text{I}$ ,  $8\text{NH}_4\text{I}$ ,  $4\text{HgI}_2$  Correct formula for mercuridammonium mercuric iodide,  $\text{Hg}(\text{NH}_2)_2\text{I}_2$ ,  $\text{HgI}_2$  (Pesci)

**— nitrate,  $\text{NH}_2\text{NO}_3$** 

Insol in  $\text{H}_2\text{O}$  (Rammelsberg, J pr (2) 38 566)

Sol in  $\text{KI}$ , or  $\text{N}_2\text{S O}_3 + \text{Aq}$ , with evolution of  $\text{NH}_3$  (Balestra, Gazz ch it 22, 2 560)

+  $\text{H}_2\text{O}$  (Hofmann and Marburg, A 1899, 305 212)

Sl sol in  $\text{HNO}_3$  (Ray, Z anorg 1902, 33 209)

**— ammonium nitrate,  $\text{NH}_2\text{NO}_3$ ,  $\text{NH}_4\text{NO}_3$  +  $\text{H}_2\text{O}$** 

Correct formula for mercuridammonium nitrate,  $\text{NH}_2\text{HgNO}_3 + \frac{1}{2}\text{H}_2\text{O}$  (Pesci, Gazz ch it 20 485)

$\text{NH}_2\text{NO}_3$ ,  $2\text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$  Correct for-

**Mercuriammonium oxydimercuri ammonium nitrate**,  $3\text{HgO}$ ,  $2\text{NH}_3$ ,  $\text{N}_2\text{O}_5 = \text{NH}_2\text{HgNO}_3$  ( $\text{NHg}_2\text{OH}_2$ ) $\text{NO}_3 + \text{H}_2\text{O}$

Decomp by boiling with  $\text{H}_2\text{O}$ , which dissolves out  $\text{NH}_4\text{NO}_3$ . Sol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  containing  $\text{NH}_4\text{OH}$  (Mitscherlich)

Is dimercuri ammonium ammonium nitrate,  $3\text{NHg}_2\text{NO}_3$ ,  $\text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$  (Pesci, Gazz ch it 20 485)

**Mercuriammonium oxydimercuri ammonium sulphate**,  $(\text{NH}_2\text{Hg})_2\text{SO}_4$ ,  $3(\text{NHg}_2\text{OH}_2)_2\text{SO}_4$

Boiling  $\text{H}_2\text{O}$  dissolves out  $\text{H}_2\text{SO}_4$ . Gradually decomp by boiling  $\text{KOH} + \text{Aq}$ . Completely sol in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol in conc or dil  $\text{HCl}$ , or very dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol in conc or dil  $\text{HNO}_3 + \text{Aq}$  or conc  $\text{H}_2\text{SO}_4$  (Schneider)

Correct formula is  $7(\text{NHg}_2)_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4 + 12\text{H}_2\text{O}$ , dimercuri ammonium ammonium sulphate (Pesci, Gazz ch it 20 485)

**Mercuridiammonium chloride (fusible white precipitate)**,  $\text{Hg}(\text{NH}_3)_2\text{Cl}_2$

Is dimercuri ammonium ammonium chloride,  $\text{Hg}_2\text{NCl}$ ,  $3\text{NH}_4\text{Cl}$ , which see (Rammelsberg J pr 38 558)

**Mercuridiammonium mercuric chloride**,

$\text{Hg}(\text{NH}_3)_2\text{Cl}_2$ ,  $\text{HgCl}$

Insol in  $\text{H}_2\text{O}$ , but gradually decomp by boiling therewith (Rose, Pogg 20 158)  
Partly sol in  $\text{H}_2\text{O}$  (Kane)

**Mercuridiammonium iodide**,  $\text{Hg}(\text{NH}_3)_2\text{I}_2$

$\text{H}_2\text{O}$  extracts all the  $\text{NH}_3$ . Partly sol in little alcohol. Partly sol in ether without decomp (Nessler)

Correct composition is dimercuri ammonium ammonium iodide,  $\text{NHg}_2\text{I}$ ,  $3\text{NH}_4\text{I}$  (Pesci, Gazz ch it 20 485)

**Mercuridiammonium cupric iodide**,  $4\text{NH}_3$ ,  $\text{CuI}_2$ ,  $\text{HgI}_2$

Decomp by  $\text{H}_2\text{O}$ . Sol in alcohol +  $\text{HC H}_3\text{O}_2$  (Jorgensen, J pr (2) 2 347)  
 $2\text{Hg}(\text{NH}_3)_2\text{I} + \text{CuI}$  (Decomp by  $\text{H}_2\text{O}$ ) (Jorgensen)

**Mercuridiammonium iodide**,  $\text{Hg}(\text{NH}_3)_2\text{I}$

Decomp by  $\text{H}_2\text{O}$ . Partly sol in a little alcohol. Partly sol in ether (Nessler)

Correct composition is dimercuri ammonium ammonium iodide  $\text{NHg}_2\text{I}$ ,  $3\text{NH}_4\text{I}$  (Pesci)

**Mercuridiammonium mercuric iodide**,

$\text{Hg}(\text{NH}_3)_2$ ,  $\text{HgI}_2$ , or  $\text{NH}_3$ ,  $\text{HgI}_2$

Decomp by  $\text{H}_2\text{O}$  or dil acids (Caillot and Corniol, J Pharm 9 381)

Correct composition is dimercuri ammonium ammonium mercuric iodide,  $3\text{NHg}_2\text{I}$ ,  $8\text{NH}_4\text{I}$ ,  $4\text{HgI}$  (Pesci, Gazz ch it 20 485)

**Mercuridiammonium sulphate**,  $\text{Hg}(\text{NH}_3)_2\text{SO}_4$

Decomp with  $\text{H}_2\text{O}$

Does not exist (Pesci, Gazz ch it 20 485)

+  $\text{H}_2\text{O}$  Decomp, by  $\text{H}_2\text{O}$ . Easily sol in  $\text{HCl}$ , very dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ , or  $\text{HNO}_3 + \text{Aq}$ . Insol in conc  $\text{HNO}_3 + \text{Aq}$ . Sol in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  or  $\text{NH}_4\text{Cl} + \text{Aq}$ . Decomp by  $\text{KOH} + \text{Aq}$  (Schneider, J pr 75 136)

Correct composition is  $(\text{NHg})_2\text{SO}_4$ ,  $3(\text{NH}_4)_2\text{SO}_4 + 12\text{H}_2\text{O}$ , dimercuri ammonium ammonium sulphate (Pesci)

**Dimercuri ammonium acetate**,

$\text{NHg}_2\text{C}_2\text{H}_3\text{O}_2$

Insol in  $\text{H}_2\text{O}$  or alcohol. Sol in  $\text{HCl}$  or  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Balestra, Gazz ch it 22, 2 563)

**Dimercuri ammonium ammonium acetate**

$\text{NHg}_2\text{C}_2\text{H}_3\text{O}_2$ ,  $3\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{H}_2\text{O}$

Deliquescent, sol in a little  $\text{H}_2\text{O}$  without decomp, but decomp into  $\text{NHg}_2\text{C}_2\text{H}_3\text{O}_2$  and  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  by excess of  $\text{H}_2\text{O}$  (Balestra)

— arsenate,  $\text{NHg}_2\text{H}_2\text{AsO}_4$

(Hirzel, Zeit Pharm 1863 3)

— bromate,  $\text{NHg}_2\text{BrO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$

Ppt (Rammelsberg, Pogg 55 82)

Is oxydimercuri ammonium bromate,  $(\text{NH}_2\text{Hg O})\text{BrO}_3$

— bromide,  $\text{NHg}_2\text{Br}$

Insol in  $\text{H}_2\text{O}$  or  $\text{HNO}_3$ . Sol in  $\text{HCl} + \text{Aq}$  (Pesci, Gazz ch it 19 509)

Sol in  $\text{KI}$ , or  $\text{Na}_2\text{S O}_3 + \text{Aq}$  with evolution of  $\text{NH}_3$  (Balestra, Gazz ch it 22, 2 558)

Sol in ammoniacal solutions of ammonium salts and in  $\text{aq}$  acids (Franklin J Am Chem Soc 1905, 27 839)

— ammonium bromide,  $\text{NHg Br}$ ,  $\text{NH}_4\text{Br}$

Decomp by  $\text{H}_2\text{O}$  (Pesci, Gazz ch it 19 511)

$4\text{NHg}_2\text{Br}$ ,  $5\text{NH}_4\text{Br}$ . Decomp by  $\text{H}_2\text{O}$ . Insol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Sol in conc or dil  $\text{HCl} + \text{Aq}$ . Insol in  $\text{HNO}_3 + \text{Aq}$  (Pesci)

$\text{NHg}_2\text{Br}$ ,  $3\text{NH}_4\text{Br}$ . Decomp by  $\text{H}_2\text{O}$ . Easily sol in  $\text{HCl} + \text{Aq}$ . Insol in alcohol (Pesci)

Sol in  $\text{NH}_4\text{Br}$ ,  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{I} + \text{Aq}$  sol in  $\text{KI}$ , or  $\text{Na}_2\text{S O}_3 + \text{Aq}$

— mercuric bromide,  $2\text{NHg Br}$ ,  $\text{HgBr}$

Ppt. Sol in  $\text{HBr}$  and in  $\text{HCl}$  (Ray Chem Soc 1902, 81 649)

— carbonate,  $(\text{NHg}_2)_2\text{CO}_3 + 2\text{H}_2\text{O}$

Ppt. Not decomp by  $\text{KOH} + \text{Aq}$ , but easily by  $\text{K}_2\text{S}$ , or  $\text{KI} + \text{Aq}$  (Rammelsberg J pr (2) 38 567)



mula for oxydmercuriammonium ammonium nitrate,  $(\text{NHg}_2\text{OH}_2)\text{NO}_3$ ,  $2\text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$  (Pesci)

$\text{NHg}_2\text{NO}_3$ ,  $3\text{NH}_4\text{NO}_3$  Decomp by cold  $\text{H}_2\text{O}$ , sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Pesci)

$3\text{NHg}_2\text{NO}_3$ ,  $\text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$  Correct formula for mercuriammonium oxydmercuriammonium nitrate,  $\text{NH}_2\text{HgNO}_3$ ,  $(\text{NHg}_2\text{OH}_2)\text{NO}_3 + \text{H}_2\text{O}$  (Pesci)

*Dimercuriammonium nitrite*,  $\text{NHg}_2\text{NO}_2$

Readily sol in warm  $\text{HCl}$  or  $\text{HBr}$  (Rây, Chem Soc 1902, 81 648)

$+ \frac{1}{2}\text{H}_2\text{O}$  Ppt Sol in  $\text{HCl}$  (Rây, Proc Chem Soc 1902, 18 85)

$+ \text{H}_2\text{O}$  (Hofmann and Marburg, A 1899, 305 214)

— oxide,  $(\text{NHg}_2)_2\text{O}$

Slowly decomp by  $\text{H}_2\text{O}$  Sol in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$  Decomp by hot  $\text{KOH}$ , or  $\text{KCl} + \text{Aq}$  (Weyl, Pogg 121 601)

Sol in  $\text{KCN} + \text{Aq}$  by heating 4-5 hours at  $130^\circ$  Not completely sol in  $\text{HCl}$  owing to formation of  $\text{Hg}_2\text{Cl}_2$  (Gaudechon, C R 1907, 144 1419)

— phosphate,  $(\text{NHg}_2)_2\text{PO}_4$ ,  $2\text{NHg}_2\text{OH} +$

sberg, J pr (2) 38 567)

*mercuriammonium phosphate*

— ammonium salicylate,

$2\text{NHg}_2\text{C}_6\text{H}_4\text{OHC}\text{O}_2$ ,  $5\text{NH}_4\text{C}_6\text{H}_4\text{OHC}\text{O}_2$

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ ,  $\text{HCl}$ , or  $\text{KI} + \text{Aq}$  (Balestra)

— selenate,  $(\text{NHg}_2)_2\text{SeO}_4 + 2\text{H}_2\text{O}$

Ppt Insol in  $\text{H}_2\text{O}$ , sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Cameron and Davy, C N 44 63)

— sulphate,  $(\text{NHg}_2)_2\text{SO}_4 + 2\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HCl} + \text{Aq}$  (Rammelsberg, J pr (2) 38 565) Sol (Kane), insol (Hirzel) in  $\text{HNO}_3 + \text{Aq}$

Sol in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  with evolution of  $\text{NH}_3$  (Balestra)

$+ \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl}$  (Rây, Chem Soc 1905, 87 9)

— ammonium sulphate,  $(\text{NHg}_2)_2\text{SO}_4$ ,

$3(\text{NH}_4)_2\text{SO}_4 + 4\text{H}_2\text{O}$

Correct formula for mercuridiammonium sulphate,  $2\text{NH}_3$ ,  $\text{HgO}$ ,  $\text{SO}_3 + \text{H}_2\text{O}$  (Pesci, Gazz ch it 20 485)

$5(\text{NHg}_2)_2\text{SO}_4$ ,  $14(\text{NH}_4)_2\text{SO}_4 + 16\text{H}_2\text{O}$  (Pesci)

$7(\text{NHg}_2)_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4 + 12\text{H}_2\text{O}$  Correct formula for mercuriammonium oxydmercuriammonium sulphate,  $(\text{NHg}_2)_2\text{SO}_4$ ,  $3(\text{NHg}_2\text{OH}_2)_2\text{SO}_4$  (Pesci)

*Dimercuriammonium tartrate*,

$(\text{NHg}_2)_2\text{C}_4\text{H}_4\text{O}_6 + 2\frac{1}{2}\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl}$ ,  $\text{KI}$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , or  $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$  (Balestra, Gazz ch it 22, 2 563)

— ammonium tartrate,  $2(\text{NHg}_2)_2\text{C}_4\text{H}_4\text{O}_6$ ,  $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6 + \text{H}_2\text{O}$

As above (B)

*Trimercuriammonium sulphate*,

$(\text{NHg}_2)(\text{NHg}_2\text{H}_2)\text{SO}_4 + 2\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Millon)

Does not exist (Pesci, Gazz ch it 20 485)

*Dimercuriarsonium mercuric chloride*,

$\text{AsHg}_2\text{Cl}_3 = \text{AsHg}_2\text{Cl}$ ,  $\text{HgCl}_2$

Decomp by  $\text{H}_2\text{O}$  Decomp by warm  $\text{HNO}_3 + \text{Aq}$  (Rose, Pogg 51 423)

*Mercurimidosulphonic acid*,

$(\text{HO}_2\text{S})_2\text{N}_2\text{Hg}$

Very unstable (Berglund, B 9 256)

*Barium mercurimidosulphonate*,

$\text{Ba}_2(\text{SO}_3)_4\text{N}_2\text{Hg} + 5\text{H}_2\text{O}$

(Berglund, B 9 256)

*Cadmium* —,  $\text{Cd}_2\text{HgN}_2(\text{SO}_3)_4 + 12\text{H}_2\text{O}$

Unstable, sl sol in  $\text{H}_2\text{O}$  (Berglund, Bull Soc (2) 25 452)

*Cobalt* —,  $\text{Co}_2\text{HgN}_2(\text{SO}_3)_4 + 15\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (B)

*Copper* —,  $\text{Cu}_2\text{HgN}_2(\text{SO}_3)_4 + 15\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (B)

*Magnesium* —,  $\text{Mg}_2\text{HgN}_2(\text{SO}_3)_4 + 15\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (B)

*Manganous* —,  $\text{Mn}_2\text{HgN}_2(\text{SO}_3)_4 + 10\text{H}_2\text{O}$

Unstable (B)

*Mercuric* —,  $(\text{Hg}_2\text{O})_2\text{HgN}_2(\text{SO}_3)_4$

Nearly insol in  $\text{H}_2\text{O}$  (B)

*Nickel* —,  $\text{Ni}_2\text{HgN}_2(\text{SO}_3)_4 + 15\text{H}_2\text{O}$

(B)

*Potassium* —,  $(\text{KO}_2\text{S})_4\text{N}_2\text{Hg} + 4\text{H}_2\text{O}$

Precipitate (Raschig, A 241 161)

*Potassium silver* —,  $(\text{AgSO}_3)_2(\text{KSO}_3)_2\text{HgN}_2 + 3\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Berglund)

*Sodium* —,  $(\text{NaSO}_3)_4\text{HgN}_2 + 5\text{H}_2\text{O}$

More sol in  $\text{H}_2\text{O}$  than K salt (Berglund)

*Strontium* —,  $\text{Sr}_2(\text{SO}_3)_4\text{HgN}_2 + 15\text{H}_2\text{O}$

More sol than Ba salt (B)

**Zinc mercuriodisulphonate,**  
 $\text{Zn}_2(\text{SO}_3)_4 \cdot \text{HgN}_2 + 15\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (B)

**Dimercuriphosphonium mercuric bromide,**  $2\text{PHg}_2\text{Br}$ ,  $\text{HgBr}_2$   
 (Lemoult, C R 1907, 145 1176)

**Dimercuriphosphonium mercuric chloride,**  
 $\text{HgCl}_2$ ,  $\text{PHg}_2\text{Cl}$   
 (Lemoult, C R 1907, 145 1176)  
 $+1\frac{1}{2}\text{H}_2\text{O}$  Decomp by hot, slowly by cold  $\text{H}_2\text{O}$  into  $\text{Hg}$ ,  $\text{HCl}$ , and  $\text{H}_3\text{PO}_3$ . Decomp by acids or alkalis (Rose, Pogg 40 75)

**Dimercuriphosphonium mercuric iodide,**  
 $\text{HgI}_2$ ,  $\text{PHg}_2\text{I}$

Slowly decomp by cold or warm  $\text{H}_2\text{O}$ , quickly by  $\text{MOH} + \text{Aq}$ . Not attacked by  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Rapidly attacked by  $\text{HNO}_3$  and aqua regia (Lemoult, C R 1904, 139 479)

**Dimercuriphosphonium mercuric nitrate,**  
 $\text{P}_2\text{Hg}_3$ ,  $6\text{HgO}$ ,  $3\text{N}_2\text{O}_5 = 2[\text{PHg}_2\text{NO}_3]$ ,  
 $\text{Hg}(\text{NO}_3)_2$ ,  $3\text{HgO}$   
 (Rose, Pogg 40 75)

**Dimercuriphosphonium mercuric sulphate,**  
 $\text{P}_2\text{Hg}_3$ ,  $6\text{HgO}$ ,  $4\text{SO}_3 + 4\text{H}_2\text{O} = (\text{PHg}_2)_2\text{SO}_4$ ,  
 $3\text{HgSO}_4$ ,  $2\text{HgO} + 4\text{H}_2\text{O}$   
 Sol in aqua regia (Rose, Pogg 40 75)

## Mercuric acid

**Calcium mercurate (?)**

(Berthollet, A ch 1 61)

**Potassium mercurate,**  $\text{K}_2\text{O}$ ,  $2\text{HgO}$

Gradually decomp by  $\text{H}_2\text{O}$ , less rapidly by absolute alcohol (St Meumer, C R 60 557)

**Sodium mercurate,**  $\text{Na}_2\text{O}$ ,  $\text{HgO}$

(Bettokoff, Bull Soc (2) 34 328)

**Mercuroammonium chloride,**

$\text{Hg}(\text{NH}_3)\text{Cl}$

(Rose, Pogg 20 158)

Mixture of  $\text{Hg}$ ,  $\text{HgNH}_2\text{Cl}$ , and  $\text{NH}_4\text{Cl}$   
 (Barfoed, J pr (2) 39 201)

— **nitrate,**  $(\text{NHg}_2\text{H}_2)\text{NO}_3$ , "*Hahnemann's soluble mercury*"

Sol in hot  $\text{HCl}$ , and  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Decomp by  $\text{NH}_4\text{OH} + \text{Aq}$ , or  $\text{NH}_4$  salts +  $\text{Aq}$ . Probably mixture of mercurous salts and  $\text{Hg}$

**Mercurodiammonium chloride,**

$\text{Hg}_2(\text{NH}_3)_2\text{Cl}_2$

Easily decomp (Rose, Pogg 20 158)

Mixture of  $\text{Hg}$ ,  $\text{NH}_2\text{HgCl}$ , and  $\text{NH}_4\text{Cl}$   
 (Barfoed, J pr (2) 39 201)

**Mercurodiammonium fluoride,**

$\text{Hg}_2(\text{NH}_3)_2\text{F}_2$  (?)

Decomp by  $\text{H}_2\text{O}$  (Finkener, Pogg 110 147)

**Mercurosulphonic acid**

**Mercurosulphonates,**  $\text{Hg}(\text{SO}_3\text{M})_2$

Correct composition for the double sulphates,  $\text{HgSO}_3$ ,  $\text{M}_2\text{SO}_3$  (Drivers and Shimidzu, Chem Soc 49 583, Barth, Z phys Ch 9 195)

**Mercuroxy-comps**

See Oxymercur-comps

**Mercury, Hg**

Not attacked by  $\text{H}_2\text{O}$ . Not attacked by boiling conc  $\text{HCl}$  or dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily sol in dil or conc  $\text{HNO}_3 + \text{Aq}$ , also in  $\text{HBr}$  or  $\text{HI} + \text{Aq}$

Not attacked by pure  $\text{HNO}_3$  unless heated, but readily attacked by cold dil  $\text{HNO}_3 + \text{Aq}$  containing  $\text{NO}$  (Millon)

Anhydrous  $\text{H}_2\text{SO}_4$  attacks  $\text{Hg}$  gradually at ord temp (Berthelot, C R 1897, 125 749)

$\text{H}_2\text{SO}_4$  attacks only when hot and conc (Ditte, A ch 1890, (6) 19 68)

Conc  $\text{H}_2\text{SO}_4$  does not attack dry or moist  $\text{Hg}$  either with or without air (Pitman, J Am Chem Soc 1898, 20 100)

$\text{H}_2\text{SO}_4$  attacks  $\text{Hg}$  at  $20^\circ$  if it contains 99.7%, does not attack if it contains only 95.6% (Baskerville, J Am Chem Soc 1898, 20 515)

Insol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  alone or in presence of  $\text{HCl}$  or dil  $\text{H}_2\text{SO}_4$  (Berthelot, A ch 1898, (7) 14 198)

Not attacked by  $\text{HF} + \text{Aq}$  at any temp (Gay-Lussac)

$\text{HI}$  dissolves  $\text{Hg}$  rapidly at ord temp (Norris and Cottrell, Am Ch J 1896, 18 99)

More rapidly attacked by  $\text{HBr} + \text{Aq}$  than by  $\text{HCl} + \text{Aq}$ . Rapidly acted upon by  $\text{HI}$  in absence of  $\text{O}$  (Bailey, Chem Soc 1888, 53 760)

Not attacked by pure  $\text{HCl} + \text{Aq}$ , but in presence of  $\text{O}$ ,  $\text{Hg}_2\text{OCl} + \text{H}_2\text{O}$  is formed. Action is apparently less in sunlight than in the dark (Bailey, Chem Soc 1888, 53 759)

Small amts of ferric salts hinder action of  $\text{HNO}_3$  on  $\text{Hg}$ , but it is hastened by presence of  $\text{Mn}(\text{NO}_3)_2$  or  $\text{NaNO}_3$  (Rav, Chem Soc 1911, 99 1015)

$\text{HNO}_3$  under 33% does not attack  $\text{Hg}$  if metal and acid are kept in motion and  $\text{HNO}_2$  is absent (Velej, B 1895, 28 928)

Rapidly sol in  $\text{HClO}$  (Balard, Dissert 1834)

Alkali chlorides +  $\text{Aq}$  in presence of air decomp  $\text{Hg}$ , action is not increased by heat (Miahle)

Insol in alkali chlorides +  $\text{Aq}$  in neutral or

alkaline solution (Bhaduri, Z anorg 1897, 13 407)

Very sol in conc solution of I in KI+Aq (Varet, Bull Soc 1897, (3) 17 451)

Slowly sol in KCl or KI+Aq in presence of air (Palmaer, Z phys Ch 1907, 59 136)

Slowly sol in  $\text{Na}_2\text{S}$ +Aq in presence of air (Palmaer, Z phys Ch 1907, 59 137)

Hg is appreciably sol in the sulpho salts of Mo, W, V, As, Sb and Sn (Storch, B 1883, 16 2015)

Persulphates in alkali or neutral solution attack Hg ( $\text{NH}_4$ )<sub>2</sub>S<sub>2</sub>O<sub>8</sub> in  $\text{NH}_4\text{OH}$  solution has strongest action This dissolves Hg by repeated shaking at high temp (Tarugi, Gazz ch it 1903, 33, (1) 127)

Insol in KCN+Aq (Elmer, J pr 1888, (2) 37 442)

Slowly sol in KCN+Aq in presence of air (Palmaer, Z phys Ch 1907, 59 136)

Sol in considerable quantity in 6% KCN+Aq (Goyder, C N 1894, 69 268)

Most sol in  $\text{K}_4\text{Fe}(\text{CN})_6$ +Aq when KOH is present (Smith, J Am Chem Soc 1905, 27 544)

Hg dissolves in  $\text{Br}_2$  in the presence of KBr sl faster than in  $\text{I}_2$  but in  $\text{CuBr}_2$  much more slowly (Van Name and Edgar, Am J Sci 1910, (4) 29 255)

Not attacked by  $\text{PCl}_3$  even at  $350^\circ$  (Moissan, A ch 1885 (6) 6 457)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 829)

$\frac{1}{2}$  ccm oleic acid dissolves 0.0075 g Hg in 6 days (Gates, J phys Chem 1911, 15 143)

**Mercurous acetylde,  $\text{Hg}_2\text{C}_2+\text{H}_2\text{O}$**

(Burkard and Travers, Chem Soc 1902, 81 1271)

**Mercuric acetylde, basic,  $2\text{HgO}$ ,  $3\text{HgC}_2+2\text{H}_2\text{O}$**

(Burkard and Travers, Chem Soc 1902, 81 1272)

**Mercuric acetylde,  $\text{HgC}_2$**

Very sol in HCl with evolution of  $\text{H}_2\text{C}_2$  (Keiser, Am Ch J 1893, 15 535)

$+\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , alcohol and ether Sol in  $\text{NH}_4$  acetate+Aq, and in KCN+Aq Sl attacked by cold HCl, easily by hot Easily sol in  $\text{HNO}_3$  Dil  $\text{H}_2\text{SO}_4$  attacks slowly, conc causes explosion (Plimpton and Travers, Chem Soc 1894, 65 267)

**Mercuric acetylde chloride,  $\text{HgC}_2$ ,  $\text{HgCl}_2+\frac{1}{2}\text{H}_2\text{O}$**

Not acted upon by dil HCl Decomp by fuming  $\text{HNO}_3$  or aqua regia Insol in alcohol and ether (Keiser, Am Ch J 1893, 15 538)

**Mercuric acetylde mercuromercuric chloride,  $\text{HgC}_2$ ,  $\text{HgCl}_2$ ,  $\text{HgCl}_2+\text{H}_2\text{O}$**

Insol in all ordinary solvents (Biltz and Mumm, B 1904, 37 4420)

**Mercurous amidofluoride,  $\text{HgNH}_2\text{F}$**

Insol in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  Sol in dil HCl

Probably dimercuriammonium ammonium fluoride,  $\text{NH}_2\text{Hg}_2\text{F}$ ,  $\text{NH}_4\text{F}$  (Bohm, Z anorg 1904, 43 327)

**Mercury ammonium comps**

See—

**Mercurioammonium comps,  $\text{NH}_2\text{HgR}$**

**Dimercuroammonium comps,  $\text{NH}_2\text{Hg}_2\text{R}$**

**Mercurous chloramide,  $\text{Hg}(\text{NH}_2)\text{Cl}$**

**Dimercuriammonium comps,  $\text{NH}_2\text{GR}$**

**Mercuric chlor-, brom-, etc, amide,  $\text{Hg}(\text{NH}_2)\text{R}$**

**Mercuridiammonium comps,  $\text{Hg}(\text{NH}_2)_2\text{R}$**

**Mercuriammonium comps,  $\text{HgNH}_2\text{R}$**

**Dimercuridiammonium comps,  $\text{Hg}_2\text{N}_2\text{H}_4\text{R}$**

**Trimercuriammonium comps,  $\text{N}_2\text{H}_2\text{Hg}_3\text{R}$**

**Oxydimercuriammonium comps,  $(\text{NH}_2\text{Hg}_2\text{O})\text{R}$**

**Mercurous arsinchloride,  $\text{AsHgCl}$**

Decomp by  $\text{H}_2\text{O}$  (Capitaine, J Pharm 25 559)

**Mercurous arsinchloride chloride,  $\text{AsHg}_2\text{Cl}_2=2\text{AsHgCl}$ ,  $\text{Hg}_2\text{Cl}_2$  (?)**

Decomp by  $\text{H}_2\text{O}$  (Capitaine)

**Mercurous azoimide,  $\text{HgN}_3$**

Wholly insol in  $\text{H}_2\text{O}$  (Curtius, B 24 3324)

1 l  $\text{H}_2\text{O}$  dissolves 0.25 g (Wohler and Krupko, B 1913 46 2050)

**Mercuric azoimide,  $\text{HgN}_6$**

Sol in  $\text{H}_2\text{O}$  especially when hot (Berthelot and Vieille, Bull Soc 1894, (3) 11 747)

Moderately sol in  $\text{H}_2\text{O}$  (Wohler and Krupko, B 1913, 46 2050)

**Mercuric bromamide,  $\text{Hg}(\text{NH}_2)\text{Br}$**

Insol in  $\text{H}_2\text{O}$  and alcohol Sl sol in  $\text{NH}_4\text{OH}$ +Aq (Mitscherlich, J pr 19 455)

Correct composition is dimercuriammonium ammonium bromide,  $\text{Hg}_2\text{NBr}$ ,  $\text{NH}_4\text{Br}$ , which see (Pesci, Gazz ch it 19 511)

**Mercurous bromide,  $\text{Hg}_2\text{Br}_2$**

Solubility in  $\text{H}_2\text{O}=9.1\times 10^{-7}$  g equiv per l (Bodlander, Z phys Ch 1898, 27 61)

Solubility in  $\text{H}_2\text{O}=7\times 10^{-8}$  mols per liter at  $25^\circ$  (Sherrill, Z phys Ch 193, 430 735)

Solubility in  $H_2O$  at  $25^\circ = 1.4 \times 10^{-7}$  equivalents per l (Thompson, J Am Chem Soc 1906, 28 762)

Insol in  $H_2O$  and dil acids Decomp by  $HCl + Aq$  Sol in hot conc  $H_2SO_4$  with evolution of  $SO_2$  Sl sol in hot  $HNO_3 + Aq$  of 1.42 sp gr (Stromann, B 20 2818)

Decomp into Hg and  $HgBr_2$  by boiling with  $NH_4Br$ , or  $NH_4Cl + Aq$ , also by ammonium carbonate or succinate, but not by ammonium sulphate or nitrate (Wittstein)

Sol in  $Hg(NO_3)_2 + Aq$  (Wackenroder, A 41 317)

Partially decomp by alkali chlorides +  $Aq$ , when out of contact of air this decomp is slight and  $HgBr_2$  is formed, while in the air  $HgCl_2$  is the resulting product Much more rapidly decomp in hot than cold solutions (Miahle, A ch (3) 5 177)

A solution of  $HgBr$  in 0.1-N KBr contains about 1 mg Hg ions in 1300 l

Insol in alcohol

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Insol in acetone (Naumann, B 1904, 37 4329), (Eidmann, C C 1899, II 1014)

### Mercuric bromide, $HgBr_2$

Sol in 250 pts  $H_2O$  at ordinary temp and 20 pts boiling  $H_2O$  (Wittstein) Sol in 240 pts  $H_2O$  at  $18.75^\circ$  (Abt)

Sol in 94 pts  $H_2O$  at  $9^\circ$ , and in 4-5 pts at  $100^\circ$  (Lassaigne, J chim méd 12 177)

Solubility in g-equivalents per litre =  $2 \times 10^{-2}$  (Bodlander, Z phys Ch 1898, 27 61)

1 l  $H_2O$  dissolves about 4 g at ord temp (Morse, Z phys Ch 1902, 41 731)

1 l  $H_2O$  dissolves 0.017 mol at  $25^\circ$  (Jander, Dissert 1902)

Solubility in  $H_2O$  at  $25^\circ = 0.017$  mol liter (Sherrill, Z phys Ch 1903, 43 735)

Solubility at ord temp = 0.8%, at bpt = 8-9% (Larine, J Pharm 1904, (6) 20 450)

Solubility in cold  $H_2O = 4\%$ , but solution prepared by heating contains more Hg on account of decomp into HBr and oxybromide (Vicario, C C 1907, II 1224)

1 l  $H_2O$  dissolves about 5-6 g at ord temp (Gaudechon, A ch 1911, (8) 22 212)

1 l aqueous solution at  $25^\circ$  contains 0.017 mol (Herz and Paul Z anorg 1913, 83 431)

Decomp by warm  $HNO_3$ , or  $H_2SO_4 + Aq$  Sol in warm  $H_2SO_4$  (Ditte, A ch (5) 17 124)

1 mol is sol in 1 mol warm  $HI + Aq$  in 1 mol cold conc  $HCl$  and in  $\frac{1}{2}$  mol hot conc  $HCl$  (L6wig)

### Solubility of $HgBr_2$ in $KBr + Aq$ at $25^\circ$

Mols per liter	
KBr	HgBr
0	0 017
0 05	0 055
0 10	0 088
0 5	0 0359
0 866	0 611
2	1 407
3	2 096
4	2 339

(Sherrill, Z phys Ch 1903, 43 705)

### Solubility in various salts + $Aq$ at $25^\circ$

Salt	In 10 cc of the solution	
	Millimols Hg Br	Millimols salt
NaBr	0 17	0
	0 78	1 18
	2 85	5 96
	5 40	11 42
	12 76	24 48
	15 50	29 97
KBr	23 06	52 46
	0 17	0
	0 98	2 09
	4 72	7 70
	13 60	23 80
	19 30	34 70
CaBr	0 17	0
	1 17	0 72
	6 76	6 45
	13 58	18 92
	27 66	24 79
	36 66	37 54
SrBr <sub>2</sub>	0 17	0
	1 04	0 62
	4 71	3 28
	9 02	6 68
	17 70	14 01
	22 38	18 72
BaBr	0 17	0
	3 70	2 74
	5 40	3 96
	7 59	5 79
	14 78	10 96

(Herz and Paul, Z anorg 1913, 82 434)

Solubility in 0.1-N  $Hg(NO_3)_2 + Aq$  is about 20 g per liter (Morse, Z phys Ch 1902, 41 731)

Sol in KBr or  $NaBr + Aq$  (Jander, Dissert 1902)

Solubility in 10 cc  $Br_2 + Aq$  at  $25^\circ$

Millimol  $Br_2$  0 753 1 797 2 231  
 " Hg 0 1844 0 1947 0 2120

(Herz and Paul, Z anorg 1914, 85 215)

Sat solution in liquid  $\text{SO}_2$  contains about 1.5%  $\text{HgBr}_2$  at  $159.4^\circ$  (Niggl, Z anorg 1912, 75 182)

Moderately sol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 829)

Sol in  $\text{AlBr}_3$  (Isbekow, Z anorg 1913, 84 27)

1 ccm of sat solution in abs alcohol at ord temp contains 0.0958 g  $\text{HgBr}_2$ , at bpt contains 0.1262 g (Hamper, Ch Z 1887, 11 905)

#### Solubility of $\text{HgBr}_2$ in alcohols + Aq at $t^\circ$

Alcohol	$t^\circ$	G $\text{HgBr}_2$ per 100 g alcohol
Methyl alcohol	0	41 15
	10	49 5
	19	66 3
	22	60 9
	39	71 3
	65	90 8
	97	139 1
Ethyl alcohol	0	25 2
	10	26 3
	19	29 7
	39	31 9
	65	44 5
	89	66 9
alcohol	0	14 6
	10	15 6
	19	15 5
	39	20 8
	65	31 3
	86 5	42 7
Isobutyl alcohol	0	4 61
	10	5 63
	23	6 65
	39	9 58
	65	15 80

(Timofeev, Dissert 1894)

Much more sol than  $\text{HgI}_2$  in alcohol  
100 g of solution sat at  $0^\circ$  contain 13.33–13.05 g  $\text{HgBr}_2$ , 16.53 g at  $25^\circ$ , 22.63 g at  $50^\circ$  (Renders, Z phys Ch 1900, 32 522)

#### Solubility of $\text{HgBr}_2$ in methyl alcohol + Aq at $25^\circ$

P = g alcohol in 100 g alcohol + Aq  
 $\text{HgBr}_2$  = millimols  $\text{HgBr}_2$  in 10 cc of the solution

P	$\text{HgBr}_2$	Sp gr	P	$\text{HgBr}_2$	Sp gr
0	0 167	1 0022	47 06	0 700	0 9401
10 60	0 201	0 9857	64 00	1 90	0 9386
30 77	0 358	0 9588	78 05	4 07	0 9744
37 21	0 422	0 9508	100	13 96	1 2275

(Herz and Anders, Z anorg 1907, 52 165)

Solubility of  $\text{HgBr}_2$  in ethyl alcohol + Aq at  $25^\circ$   
P = g alcohol in 100 g alcohol + Aq  
 $\text{HgBr}_2$  = millimols  $\text{HgBr}_2$  in 10 cc of the solution

P	$\text{HgBr}_2$	Sp gr
0	0 167	1 0022
20 18	0 187	0 9717
40 69	0 440	0 9435
70 01	1 829	0 9214
100	6 337	0 9873

(Herz and Anders)

#### Solubility in mixtures of methyl and propyl alcohol at $25^\circ$

P = % propyl alcohol in the solvent  
G = g  $\text{HgBr}_2$  in 10 ccm of the solution  
S = Sp gr of the sat solution

P	G	S $25^\circ/4^\circ$
0	5 02	1 227
11 11	4 728	1 1954
23 8	4 153	1 1524
65 2	2 530	1 0257
91 8	1 635	0 9437
93 75	1 586	0 9368
96 6	1 466	0 9275
100	1 873	0 9213

(Herz and Kuhn, Z anorg 1908, 60 158)

#### Solubility in mixtures of ethyl and propyl alcohol at $25^\circ$

P = % propyl alcohol in the solvent  
G = g  $\text{HgBr}_2$  in 10 ccm of the solution  
S = Sp gr of the sat solution

P	G	S $25^\circ/4^\circ$
0	2 28	0 9873
8 1	2 225	0 9802
17 85	2 106	0 9740
56 6	1 763	0 9487
88 6	1 476	0 9269
91 2	1 464	0 9239
95 2	1 406	0 9227
100	1 378	0 9213

(Herz and Kuhn, Z anorg 1908, 60 161)

#### Solubility of $\text{HgBr}_2$ in mixtures of methyl and ethyl alcohol at $25^\circ$

P = % methyl alcohol in the mixtures  
 $\text{HgBr}_2$  = g  $\text{HgBr}_2$  in 10 ccm of the solution  
 $S_{25^\circ/4^\circ}$  = sp gr of the sat solution

P	$\text{HgBr}_2$	S $25^\circ/4^\circ$
0	2 28	0 9873
4 37	2 31	0 9932
10 4	2 54	1 009
41 02	3 33	1 080
80 69	4 57	1 185
84 77	4 68	1 193
91 25	4 86	1 211
100	5 02	1 227

(Herz and Kuhn, Z anorg 1908, 58 163)

Cold sat solution in anhydrous ether contains 0.00567 g in 1 cc, hot solution contains 0.032 g (Hampe, Ch Z 1887, 11 905)

Solubility in organic solvents at 18°-20°  
 100 g chloroform dissolve 0.126 g HgBr<sub>2</sub>  
 100 g tetrachlormethane dissolve 0.003 g HgBr<sub>2</sub>

100 g bromoform dissolve 0.679 g HgBr<sub>2</sub>  
 100 g ethyl bromide dissolve 2.310 g HgBr<sub>2</sub>

100 g ethylene dibromide dissolve 2.340 g HgBr<sub>2</sub>

(Sulc, Z anorg 1900, 25 401)

#### Solubility in CS<sub>2</sub> at t°

t°	100 pts sat solution contain pts HgBr <sub>2</sub>
-10	0.049
5	0.068
0	0.087
+ 5	0.105
10	0.122
15	0.140
20	0.187
25	0.232
30	0.274

(Aretowski, Z anorg 1894, 6 267)

100 g boiling methyl acetate (bpt 56.2-56.7°) dissolves 24 g HgBr<sub>2</sub> (Schroeder and Steiner, J pr 1909, (2) 79 49)

1 g HgBr<sub>2</sub> is sol in 4.56 g methyl acetate at 18° Sp gr 18°/4° of sat solution = 1.09 (Naumann, B 1909, 42 3795)

100 g anhydrous ethyl acetate or sat with H<sub>2</sub>O at 18° dissolve 130.5-135 g HgBr<sub>2</sub> (Hamers, Dissert 1906)

Solubility of HgBr<sub>2</sub> in ethyl acetate + Aq at 25°

P = g ethyl acetate in 100 g ethyl acetate + Aq  
 HgBr<sub>2</sub> = millimols HgBr<sub>2</sub> in 10 cc of the solution

P	HgBr <sub>2</sub>	Sp gr
0	0.167	1.0022
4.39	0.159	1.0018
96.76	7.42	1.1159
100	3.93	1.0113

(Herz and Anders, Z anorg 1907, 52 172)

1 pt HgBr<sub>2</sub> sol in 7.66 pts ethyl acetate at 18° (Naumann, B 1910, 43 315)

Easily sol in acetone (Oppenheim, B 2 572)

Sol in acetone (Eidmann, C C 1899, II 1014)

Acetone dissolves much more HgBr<sub>2</sub> than HgI<sub>2</sub>. 100 g sat solution at 25° contain 34.58 g HgBr<sub>2</sub> (Reinders, Z phys Ch 1900, 32 514)

Solubility in diethyl oxalate is much greater than that of HgI<sub>2</sub> and is equal to 12% at 100° (Reinders, Z phys Ch 1900, 32 507)

Solubility in benzene = 0.0194 mol per l at 25° (Sherrill, Z phys Ch 1903, 43 735)

Sol in allyl mustard oil (Mathews, J phys Chem 1905, 9 647)

Sol in benzonitrile (Naumann, B 1914, 47 1369)

#### Solubility in aniline

S = temp of solidification

Mols HgBr <sub>2</sub> per 100	S	Mols HgBr <sub>2</sub> per 100	S	Mols HgBr per 100	S
4.9	9°	25.4	115.5°	49.6	123
10	43.5	33.9	117	54.9	124
12.5	57	39.5	108	58.8	134
14.9	68	41.9	113	64.0	133
19.7	89	43.9	118		
23.4	106	46.2	121		

(Staronka, Anz Ak Wiss Krakau, 1910, 372)

#### Solubility of HgBr<sub>2</sub> in quinoline

S = temp of solidification

Mols HgBr <sub>2</sub> per 100	S	Mols HgBr <sub>2</sub> per 100	S	Mols HgBr <sub>2</sub> per 100	S
4.4	88°	8.9	111°	14.3	127°
				17.6	134°

(Staronka, Anz Wiss Krakau, 1910 372)

Mol weight determined in ethyl sulphide (Werner, Z anorg 1897, 15 30)  
 + 4H<sub>2</sub>O (Thomsen)

#### Mercuric perbromide, HgBr<sub>4</sub>

(Heiz and Paul, Z anorg 1914, 85 216)

#### Mercuric hydrogen bromide (Bromomercuric acid), HgBr<sub>2</sub>, HBr = HHgBr<sub>3</sub>

Decomp by H<sub>2</sub>O (Neumann, M 10 236)

#### Mercuric nickel bromide, basic, HgBr<sub>2</sub>, NiBr<sub>2</sub>, 6NiO + 20H<sub>2</sub>O

(Mailhe, A ch 1902, (7) 27 369)

#### Mercuric platinum bromide

See Bromoplatinate, mercuric

#### Mercuric potassium bromide, HgBr<sub>2</sub>, KBr

Sol in H<sub>2</sub>O, but decomp by a large amount, with separation of one half of the HgBr<sub>2</sub> (v Bonsdorff, Pogg 19 339)

2HgBr<sub>2</sub>, KBr + 2H<sub>2</sub>O Permanent Sol in H<sub>2</sub>O and alcohol (v Bonsdorff)

#### Mercuric sodium bromide, HgBr<sub>2</sub>, NaBr

Deliquescent (v Bonsdorff)

(Varet, C R 1890, 111, 527)

<p><b>HgBr<sub>2</sub>, 2NaBr</b> Very sol in H<sub>2</sub>O (Vicario, J Pharm 1907, (6) 26 145) 2HgBr<sub>2</sub>, NaBr + 3H<sub>2</sub>O Sol in H<sub>2</sub>O and alcohol (Berthelot)</p>	<p><b>Mercuric chloramide, Hg(NH<sub>2</sub>)Cl</b> Composition is <i>dimercuriammonium ammonium chloride</i>, Hg<sub>2</sub>NCl, NH<sub>4</sub>Cl, see</p>
<p><b>Mercuric strontium bromide, HgBr<sub>2</sub>, SrBr<sub>2</sub></b> Sol in all proportions of H<sub>2</sub>O (Lôwig, Mag Pharm 33 7) 2HgBr<sub>2</sub>, SrBr<sub>2</sub> Decomp by H<sub>2</sub>O into HgBr<sub>2</sub> and HgBr, SrBr<sub>2</sub> (Lôwig)</p>	<p><b>Mercuric chloramide oxymercuriammonium chloride, 4Hg(NH<sub>2</sub>)Cl, (NH<sub>2</sub>OH Cl (Milon)</b> Correct composition is <i>dimercuriammonium ammonium chloride</i>, NH<sub>2</sub>Cl, NH<sub>4</sub>Cl, see (Balestra, Gazz ch it 21 (2) 294) Hg(NH<sub>2</sub>)Cl, (NH<sub>2</sub>OH<sub>2</sub>)Cl (Milon) True composition is <i>dimercuriammonium mercuric chloride</i>, 2Hg<sub>2</sub>NCl, HgCl<sub>2</sub> + O, or <i>dimercuriammonium hydrogen chloride</i>, NH<sub>2</sub>Cl, HCl (Balestra)</p>
<p><b>Mercuric zinc bromide</b> Deliquescent in moist air (v Bonsdorff)</p>	<p><b>Mercuric chloramide chloride, Hg(NH<sub>2</sub>)Cl, HgCl<sub>2</sub></b> Properties as mercuric chloramide decomposed by cold HCl + Aq (Milon) True composition is <i>dimercuriammonium hydrogen chloride</i>, NH<sub>2</sub>Cl, 2HCl (Balestra, Gazz ch it 21 (2) 294)</p>
<p><b>Mercuric zinc bromide cyanide ammonia</b> See Cyanide zinc bromide ammonia, mercuric</p>	<p><b>Mercuric chloramide chromate,</b> 2Hg(NH<sub>2</sub>)Cl, HgCrO<sub>4</sub> Decomp by hot H<sub>2</sub>O Easily sol in H<sub>2</sub>O or HCl + Aq (Jugé and Kruss, B 22 203)</p>
<p><b>Mercuric bromide ammonia, HgBr<sub>2</sub>, 2NH<sub>3</sub></b> Decomp by boiling H<sub>2</sub>O Sol in min acids and acetic acid (Naumann, B 1910, 43 316)</p>	<p><b>Mercurous chloride, Hg<sub>2</sub>Cl</b> Almost absolutely insol in cold, but gradually decomposed by boiling H<sub>2</sub>O Calculated from electrical conductivity of Hg<sub>2</sub>Cl<sub>2</sub> + Aq, 1 l H<sub>2</sub>O dissolves 31 mg Hg<sub>2</sub>Cl<sub>2</sub> at 18° (Kohlrausch and Rose, Z phys 12 241)</p>
<p><b>Mercuric bromide cadmium oxide,</b> HgBr<sub>2</sub>, CdO + H<sub>2</sub>O (Mailhe, A ch 1902, (7) 27 371)</p>	<p>1 l H<sub>2</sub>O dissolves 2 mg Hg<sub>2</sub>Cl<sub>2</sub> at 18° (Kohlrausch, Z phys 1901 50 356) 1 l H<sub>2</sub>O dissolves 14 mg at 0.5, 21 mg at 18°, 28 mg at 21.6°, 7 mg at 15° (Kohlrausch, Z phys 1906 64 150) When finely divided is 10% more soluble when coarsely crystalline (Sauer, Z phys 1904 47 181)</p>
<p><b>Mercuric bromide cupric oxide,</b> HgBr<sub>2</sub>, CuO + 3H<sub>2</sub>O (Mailhe, Bull Soc 1901, (3) 25 791)</p>	<p>Solubility in H<sub>2</sub>O = 0.5 × 10<sup>-4</sup> g/mol (I, Z Elektrochem 1904, 10 301) Sol with decomp in boiling H<sub>2</sub>O from air, 20 cm H<sub>2</sub>O affording 0.002 g HgCl<sub>2</sub> after boiling 1 hour with Hg<sub>2</sub>Cl<sub>2</sub> (Mailhe, A ch (3) 5 176) H<sub>2</sub>(NO<sub>3</sub>) + Aq containing 1 pt H<sub>2</sub>(NO<sub>3</sub>) to 250, 10 pts H<sub>2</sub>O give ppt of Hg<sub>2</sub>Cl<sub>2</sub> with HCl + 1 pt Sol with decomp in conc HCl + Aq, 1 pt HNO<sub>3</sub> + Aq, equal parts, or Cl<sub>2</sub> + Aq (I, sensus) Insol in cold dil acids, but slowly sol on heating</p>
<p><b>Mercuric bromide potassium chloride,</b> HgBr<sub>2</sub>, 2KCl Decomp by H<sub>2</sub>O (Harth, Z anorg 1897, 14 345)</p>	<p>The solubility of Hg<sub>2</sub>Cl<sub>2</sub> in HCl + Aq increases slowly with time, and finally reaches a point where it increases very rapidly, which takes place sooner the more dil the acid. Presence of Hg<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> + Aq helps the solubility (Why not oxidation to HgCl<sub>2</sub>) (Varenne, C R 92 1161)</p>
<p><b>Mercuric bromide zinc oxide, HgBr<sub>2</sub>, ZnO + 8H<sub>2</sub>O</b> (Mailhe, C R 1901, 132, 1274)</p>	
<p><b>Mercuric bromoiodide, HgBrI</b> Sol in alcohol and ether Can be recrystallized from ether without decomp (Oppenheim, B 2 571)</p>	
<p><b>Mercurous chloramide, Hg<sub>2</sub>(NH<sub>2</sub>)Cl</b> Insol in boiling H<sub>2</sub>O or NH<sub>4</sub>OH + Aq (Kane, A ch (2) 72 215) Mixture of Hg and HgNH<sub>2</sub>Cl (Barfoed, J pr (2), 39 201)</p>	

Solubility of  $\text{Hg}_2\text{Cl}_2$  in  $\text{HCl} + \text{Aq}$  at  $25^\circ$ Solid phase =  $\text{Hg}_2\text{Cl}_2 + 0.1 \text{ g Hg}$ 

G per l		Sp gr of solutions
HCl	$\text{Hg}_2\text{Cl}_2$	
31.69	0.034	
36.46	0.048	
95.43	0.207	1.042
158.4	0.399	1.069
209.2	0.548	1.091
267.3	0.654	1.114
278.7	0.675	1.119
317.3	0.670	1.132
364.6	0.673	1.153

(Richards and Archibald, Z phys Ch 1902, 40 385)

Cold conc  $\text{H}_2\text{SO}_4$  does not dissolve or decomp. Boiling  $\text{H}_2\text{SO}_4$  dissolves with evolution of  $\text{SO}_2$  (Vogel)

Solubility of  $\text{Hg}_2\text{Cl}_2$  in chlorides + Aq at  $25^\circ$ Solid phase =  $\text{Hg}_2\text{Cl}_2 + 0.1 \text{ g Hg}$ 

Salt	G per liter		Sp gr of solutions
	NaCl	$\text{Hg}_2\text{Cl}_2$	
NaCl	5.85	0.0041	
	58.50	0.041	1.040
	119	0.129	1.078
	148.25	0.194	1.093
	222.3	0.380	1.142
	292.5	0.643	1.188
$\text{BaCl}_2$	104.15	0.044	1.088
	156.22	0.088	1.134
	208.30	0.107	1.174
	312.54	0.231	1.263
$\text{CaCl}_2$	39.96	0.022	
	55.5	0.033	
	111	0.081	1.064
	138.75	0.118	1.105
	195.36	0.231	1.151
	257.52	0.322	1.205
	324.67	0.430	1.243
	432.9	0.518	1.315
	499.5	0.510	1.358

(Richards and Archibald, Z phys Ch 1902, 40 385)

Sol in cold  $\text{HCN} + \text{Aq}$  with separation of Hg

Sol in alkali chlorides + Aq  $\text{NH}_4\text{Cl} + \text{Aq}$  dissolves out  $\text{Hg}_2\text{Cl}_2$  at ord temp, much more at  $40-50^\circ$ . Dil  $\text{NH}_4\text{Cl} + \text{Aq}$  decomposes more slowly than conc. Access of air hastens reaction (Miahle)

When heated several hours to  $40-50^\circ$ , 100 pts  $\text{NH}_4\text{Cl} + 833$  pts  $\text{H}_2\text{O}$  form 0.75 pt  $\text{Hg}_2\text{Cl}_2$  from 25 pts  $\text{Hg}_2\text{Cl}_2$ , 100 pts  $\text{NaCl} + 833$  pts  $\text{H}_2\text{O}$  form 0.33 pt  $\text{Hg}_2\text{Cl}_2$  from 25 pts  $\text{Hg}_2\text{Cl}_2$ , 100 pts  $\text{KCl} + 833$  pts  $\text{H}_2\text{O}$  form

0.25 pt  $\text{Hg}_2\text{Cl}_2$  from 25 pts  $\text{Hg}_2\text{Cl}_2$ , 100 pts  $\text{BaCl}_2 + 833$  pts  $\text{H}_2\text{O}$  form 0.33 pt  $\text{Hg}_2\text{Cl}_2$  from 25 pts  $\text{Hg}_2\text{Cl}_2$  (Miahle, J Pharm 26 108)

Other chlorides act as  $\text{NH}_4\text{Cl}$ , only less vigorously (Pettenkofer)

By boiling 1 pt  $\text{Hg}_2\text{Cl}_2$  10 times with a solution of 1 pt  $\text{NaCl}$  each time, the  $\text{Hg}_2\text{Cl}_2$  is finally completely decomp. (Henne)

Boiling  $\text{BaCl}_2 + \text{Aq}$  or  $\text{CaCl}_2 + \text{Aq}$  dissolve traces  $\text{K}_2\text{SO}_4 + \text{Aq}$ ,  $\text{KNO}_3 + \text{Aq}$ , or  $\text{KHC}_4\text{H}_4\text{O}_6 + \text{Aq}$  do not dissolve (Pettenkofer)

Sol in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  Insol in  $\text{NH}_4$  nitrate, or succinate + Aq (Wittstein)

Sol in hot  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$ , and still more in hot  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$ , on cooling it crystallises out completely 25 g  $\text{Hg}_2\text{Cl}_2$  dissolve in 15 l  $\text{H}_2\text{O}$  containing 50 g  $\text{Hg}(\text{NO}_3)_2$  (Debray, C R 70 995)

Sol in  $\text{PtCl}_2 + \text{Aq}$ Decomp by  $\text{NH}_4\text{OH} + \text{Aq}$ Decomp by  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ Sol in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Faktor, C C 1905, I 1524)Very sl sol in  $\text{NH}_4$  succinate (Wittstein)Insol in  $\text{SbCl}_3$  (Klemensiewicz, C C 1908, II 1850)Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Insol in alcohol or ether. More sol in  $\text{H}_2\text{O}$  containing pepsin and an acid than in  $\text{H}_2\text{O}$ , and is not converted thereby into  $\text{HgCl}_2$  (Torsellini, Ann Chim Ch farm (4) 4 105)

Small amts are sol with decomp in alcohol, ether and  $\text{CHCl}_3$ . 1 g  $\text{CHCl}_3$  dissolves 0.0046 g  $\text{Hg}_2\text{Cl}_2$  (MacLagan, Arch Pharm 1884, 222, 788)

Formic acid (95%) dissolves at  $16.5^\circ$ , 0.02%, at  $18^\circ$ , 0.0003% (Aschan, Ch Z 1913, 37 1117)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Hamers, Dissert 1906, Naumann, B 1904, 37 3602)

Somewhat sol in hydroxylamine hydrochloride (Adams, Am Ch J 1902, 28 1216)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Insol in acetone and in methylal (Eidmann, C C 1899, II 1014)

Solubility in organic solvents at  $18-20^\circ$ 100 g chloroform dissolve traces of  $\text{HgCl}_2$ 100 g bromoform dissolve 0.055 g  $\text{HgCl}_2$ 100 g ethyl bromide dissolve traces of  $\text{HgCl}_2$ 100 g ethylene dibromide dissolve traces of  $\text{HgCl}_2$  (Sulc Z anorg 1900, 25 401)Mercuric chloride,  $\text{HgCl}_2$ 

Permanent

Sol in 18.5 pts  $\text{H}_2\text{O}$  at  $13.8^\circ$  and 2-3 pts at 100 (J Davy 1822) Sol in 3 pts boiling  $\text{H}_2\text{O}$  (Wenzel) Sol in 18.23 pts  $\text{H}_2\text{O}$  at  $10^\circ$  and 3 pts at  $100^\circ$  (M R and P) Sol in 18.46 pts at  $18.75^\circ$  (Abt) Sol in 19 pts cold and 3 pts warm  $\text{H}_2\text{O}$  (Dumas)



100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{HgCl}_2$  at  $t^\circ$ 

$t^\circ$	Pts $\text{HgCl}_2$	$t^\circ$	Pts $\text{HgCl}_2$	$t^\circ$	Pts $\text{HgCl}_2$
0	5 73	40	9 62	80	24 30
10	6 57	50	11 34	90	37 05
20	7 39	60	13 86	100	53 96
30	8 43	70	17 29		

(Poggiale, A ch (3) 8 468)

Solubility of  $\text{HgCl}_2$  in  $\text{H}_2\text{O}$ 

$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$
+ 1	3 9	80	23 6
4 5	4 8	87	28 2
4 5	4 8	100	39 3
7 5	5 1	121	59 7
13 8	5 2	127	69 7
25 1	7 1	140	77 0
29 5	7 6	150	78 4
38 0	9 9	159	80 2
49	11 3	160	81 7
61	15 1	165	81 8

(Étard, A ch 1894, (7) 2 557)

71.17 g  $\text{HgCl}_2$  are sol in 1 l  $\text{H}_2\text{O}$  at  $25^\circ$  (Morse, Z phys Ch 1902, 41 726)Solubility at  $25^\circ = 0.267$  mol in 1 l  $\text{H}_2\text{O}$  (Jander, Z Elektrochem 1903, 8 688)Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 0.263$  mol liter (Sherrill, Z phys Ch 1903, 43 735)Sat  $\text{HgCl}_2 + \text{Aq}$  at  $25^\circ$  contains 6.9%  $\text{HgCl}_2$  (Foote, Am Ch J 1906, 35 238) $\text{HgCl}_2 + \text{Aq}$  contains 3.95 g  $\text{HgCl}_2$  in 100 g of solution at  $0^\circ$ , 7.67 g at  $30^\circ$  (Schreine makers, Ch Weekbl 1910, 7 202) $\text{HgCl}_2 + \text{Aq}$  sat at (?) contains 6.8%  $\text{HgCl}_2$  (Abe, J Tok Chem Soc 1912, 33 1087) $\text{HgCl}_2 + \text{Aq}$  sat at  $35^\circ$  contains 8.51%  $\text{HgCl}_2$  (Schreinemakers and Thonus, Ver K Akad Wet Amsterdam, 1912, 21 333)1 l aqueous solution sat at  $25^\circ$  contains 0.265 mol  $\text{HgCl}_2$  (Herz and Paul, Z anorg 1913, 82 431) $\text{H}_2\text{O}$  dissolves 7.39% at  $20^\circ$  (Aschan, Ch Z 1913, 37 1117) $\text{HgCl}_2 + \text{Aq}$  sat at  $8^\circ$  has 1.041 sp gr (Anthon 1837)Sp gr of  $\text{HgCl}_2 + \text{Aq}$  at  $20^\circ$ 

% $\text{HgCl}_2$	Sp gr	% $\text{HgCl}_2$	Sp gr
1	1 0072	4	1 0323
2	1 0148	5	1 0411
3	1 0236		

(Schroder, calculated by Gerlach, Z anal 27 306)

Sp gr of  $\text{HgCl}_2 + \text{Aq}$  at  $15^\circ$ 

% $\text{HgCl}_2$	Sp gr	% $\text{HgCl}_2$	Sp gr
8	1 071	11	1 1035
9	1 0815	12	1 115
10	1 095	13	1 127

(Mendelejeff, calculated by Gerlach, Z anal 27 306)

Sp gr of  $\text{HgCl}_2 + \text{Aq}$ 

% $\text{HgCl}_2$	Sp gr			
	at $0^\circ$	at $10^\circ$	at $20^\circ$	at $30^\circ$
4 72	1 04070	1 04033	1 03856	1 03566
3 57	1 03050	1 03022	1 02885	1 02577
2 42	1 02035	1 02018	1 01856	1 01585
1 22	1 01008	1 00990	1 00835	1 00575

(Schroder, B 19 161 R.)

Sp gr of  $\text{HgCl}_2 + \text{Aq}$  at room temp containing0.226 3.55%  $\text{HgCl}_2$   
1.0233 1.0328

(Wagner, W Ann 1883, 18 266)

Sp gr of  $\text{HgCl}_2 + \text{Aq}$  at  $25^\circ$ 

Concentration of $\text{HgCl}_2 + \text{Aq}$	Sp gr
$\frac{1}{4}$ -normal	1 0275
$\frac{1}{8}$ -normal	1 0138

(Wagner, Z phys Ch 1890, 5 39)

Sp gr at  $16\frac{1}{4}^\circ$  of  $\text{HgCl}_2 + \text{Aq}$  containing 4.5256%  $\text{HgCl}_2 = 1.03806$ Sp gr at  $16\frac{1}{4}^\circ$  of  $\text{HgCl}_2 + \text{Aq}$  containing 4.2224%  $\text{HgCl}_2 = 1.03491$  (Schonrock, Z phys Ch 1893, 11 768) $\text{HgCl}_2 + \text{Aq}$  containing 6.04%  $\text{HgCl}_2$  has sp gr  $20^\circ/20^\circ = 1.0523$  $\text{HgCl}_2 + \text{Aq}$  containing 6.08%  $\text{HgCl}_2$  has sp gr  $20^\circ/20^\circ = 1.0526$ 

(Le Blanc and Rohland, Z phys Ch 1890, 19 252)

Sat  $\text{HgCl}_2 + \text{Aq}$  boils at  $101.1^\circ$  (Cuthbert)B-pt of  $\text{HgCl}_2 + \text{Aq}$ 

% $\text{HgCl}_2$	B-pt	% $\text{H}_2\text{O}$	B-pt
4 8	100 $10^\circ$	11 04	100 $20^\circ$
9 0	100 $16^\circ$	15 2	100 $27\frac{1}{2}^\circ$

(Skinner, Chem Soc 61 340)

Solubility in  $\text{HCl} + \text{Aq}$  is greater than in  $\text{H}_2\text{O}$  (Dumas)Sol in 0.5 pt  $\text{HCl} + \text{Aq}$  of 1.158 sp gr at  $23^\circ$  forming a solution of 2.412 sp gr (Davy 1822)

Solubility of  $\text{HgCl}_2$  in  $\text{HCl} + \text{Aq}$ 

Pts HCl in 100 pts $\text{H}_2\text{O}$	Pts $\text{HgCl}_2$ dissolved by 100 pts liquid	Pts HCl in 100 pts $\text{H}_2\text{O}$	Pts $\text{HgCl}_2$ dissolved by 100 pts liquid
0 0	6 8	21 6	127 4
5 6	46 8	31 0	141 9
10 1	73 7	50 0	148 0
13 8	87 8	68 0	154 0

(Ditte, A ch (5) 22 551)

Solubility in  $\text{HCl} + \text{Aq}$  at  $0^\circ$   $\frac{\text{HgCl}_2}{2} = \frac{1}{2} \text{ mols}$ 

$\text{HgCl}_2$  (in mgs) in 10 ccm solution,  $\text{HCl}$   
= mols  $\text{HCl}$  ditto,  $\text{H}_2\text{O}$  = grms  $\text{H}_2\text{O}$   
present

$\frac{\text{HgCl}_2}{2}$	$\text{HCl}$	Sp gr	$\text{H}_2\text{O}$
9 7	4 3	1 117	9 704
19 8	9 9	1 238	9 340
35 5	17 8	1 427	9 816
55 6	26 9	1 665	8 135
68 9	32 25	1 811	7 714
72 37	34 25	1 874	7 679
85 5	41 5	2 023	7 131
88 65	48 1	2 066	6 893
95 675	70 875	2 198	6 431

(Engel, A ch (6) 17 362)

Not decomp by  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$ Sol in 630 pts  $\text{H}_2\text{SO}_4$  and in more than 500 pts hot  $\text{HNO}_3 + \text{Aq}$  of 1.41 sp gr without decomp (J Davy)Sol in  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{HIO}_3$ , or  $\text{H}_2\text{CrO}_4$  without decomp (Millon, A ch (3) 18 373)Very sl sol in  $\text{HNO}_3$ , but not decomp thereby (Wurtz)Solubility of  $\text{HgCl}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $30^\circ$ 

Composition of liquid phase			Solid phase
% $\text{HgCl}_2$	% $\text{NH}_4\text{Cl}$	% $\text{H}_2\text{O}$	
0	29 5	70 5	$\text{NH}_4\text{Cl}$
15 68	27 56	56 76	
22 80	26 91	50 29	
31 96	26 16	41 88	
42 45	25 05	32 50	
50 05	24 79	25 16	$\left\{ \begin{array}{l} \text{NH}_4\text{Cl} + \text{HgCl}_2 \quad 2\text{NH}_4\text{Cl} \\ \text{H}_2\text{O} \end{array} \right.$
50 60	24 31	25 09	$\text{HgCl}_2 \quad 2\text{NH}_4\text{Cl} \quad \text{H}_2\text{O}$
53 08	22 77	24 15	
55 97	21 42	22 61	
58 91	20 06	21 03	$\text{HgCl}_2 \quad 2\text{NH}_4\text{Cl} \quad \text{H}_2\text{O} +$
58 89	19 98	21 13	$\text{HgCl}_2 \quad \text{NH}_4\text{Cl} \quad \text{H}_2\text{O}$
56 83	18 86	24 61	$\text{HgCl}_2 \quad \text{NH}_4\text{Cl} \quad \text{H}_2\text{O}$
56 38	18 50	25 12	
55 83	17 70	26 47	
55 70	17 13	27 17	
55 58	16 82	27 60	

Solubility of  $\text{HgCl}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$   
at  $30^\circ$ —Continued

Composition of liquid phase			Solid phase
% $\text{HgCl}_2$	% $\text{NH}_4\text{Cl}$	% $\text{H}_2\text{O}$	
55 55	15 94	28 51	$\text{HgCl}_2 \quad \text{NH}_4\text{Cl} \quad \text{H}_2\text{O}$
55 85	15 35	28 80	
56 71	14 22	29 07	
57 04	14 10	28 86	$\text{HgCl}_2 \quad \text{NH}_4\text{Cl} \quad \text{H}_2\text{O} +$
56 98	14 14	28 88	$3\text{HgCl}_2 \quad 2\text{NH}_4\text{Cl} \quad \text{H}_2\text{O}$
56 83	13 90	29 27	$3\text{HgCl}_2 \quad 2\text{NH}_4\text{Cl} \quad \text{H}_2\text{O}$
56 26	13 04	30 70	
56 43	11 88	31 69	
56 70	11 05	32 23	
57 05	9 92	33 02	
58 55	9 23	32 22	
58 65	9 20	32 15	$\left\{ \begin{array}{l} 3\text{HgCl}_2 \quad 2\text{NH}_4\text{Cl} \quad \text{H}_2\text{O} + \\ 9\text{HgCl}_2 \quad 2\text{NH}_4\text{Cl} \\ 9\text{HgCl}_2 \quad 2\text{NH}_4\text{Cl} \end{array} \right.$
51 83	8 76	39 41	
46 00	7 52	46 48	
39 02	6 28	54 70	
35 60	5 26	59 14	
35 10	5 18	59 72	
32 90	5 06	62 04	
29 65	3 62	66 73	$9\text{HgCl}_2 \quad 2\text{NH}_4\text{Cl} + \text{HgCl}_2$
40 12	5 13	54 75	$\text{HgCl}_2$
21 00	2 29	76 71	
7 67	0	92 33	

(Meerburg, Z anorg 1908, 59 139)

1 pt sat  $\text{NaCl} + \text{Aq}$  dissolves 1.29 pts  $\text{HgCl}_2$  at  $14^\circ$  (Voit, A 104 354)Sat  $\text{NaCl} + \text{Aq}$  (20 grains  $\text{H}_2\text{O} + 7$  grains  $\text{NaCl}$ ) dissolves 32 grains  $\text{HgCl}_2$  at  $15.5^\circ$  and 3 grains more on warming. Sp gr of solution = 2.14 (Davy 1822)Sat  $\text{KCl} + \text{Aq}$  (21 grains  $\text{H}_2\text{O} + 7$  grains  $\text{KCl}$ ) dissolves 8 grains  $\text{HgCl}_2$  on being gently heated (Davy)Sat  $\text{BaCl}_2 + \text{Aq}$  (20 grains  $\text{H}_2\text{O} + 7$  grains  $\text{BaCl}_2 + 2\text{H}_2\text{O}$ ) dissolves 16 grains  $\text{HgCl}_2$  at  $15.5^\circ$  and 4 grains more on heating. Sp gr of solution = 1.9 (Davy) $\text{MgCl}_2 + \text{Aq}$  (31 grains  $\text{HCl} + \text{Aq}$  of 1.58 sp gr neutralised with  $\text{MgO}$ ) dissolves 40 grains  $\text{HgCl}_2$  and on gently heating Sp gr of solution = 2.1 (Davy)Sol in sat  $\text{KCl}$ ,  $\text{NaCl} + \text{Aq}$  and in  $\text{MnCl}_2$ ,  $7\text{NCl}_2$ ,  $\text{CoCl}_2$ ,  $\text{FeCl}_2$ ,  $\text{NiCl}_2$  and  $\text{CuCl}_2 + \text{Aq}$  (v Bonsdorff Pogg 17 123)

The solubility in  $\text{H}_2\text{O}$  is greatly increased by the addition of cupric chloride. 8.5%  $\text{HgCl}_2$  is sol in pure  $\text{H}_2\text{O}$  and 52.8%  $\text{HgCl}_2$  is sol in 18.06%  $\text{CuCl}_2 + \text{Aq}$  (Schreiner maktors, C C 1913, I 1858)

Solubility of  $\text{HgCl}_2 + \text{KCl}$  at 25°

Composition of solution		Composition of undissolved residue			Solid phase
% KCl	% $\text{HgCl}_2$	% KCl	% $\text{HgCl}_2$	% $\text{H}_2\text{O}$	
26 46	0	100	0		KCl
26 24	15 04		3 63		KCl+2KCl $\text{HgCl}_2$ $\text{H}_2\text{O}$
26 23	15 02		26 15		
26 33	15 02		52 01		
26 33	14 92		61 04		
23 74	18 91	34 61	61 66	3 73	2KCl $\text{HgCl}_2$ $\text{H}_2\text{O}$
22 36	21 39	34 77	62 02	3 21	
21 39	23 88	34 05	61 84	3 85	2KCl $\text{HgCl}_2$ $\text{H}_2\text{O} + \text{KCl}$ $\text{HgCl}_2$ $\text{H}_2\text{O}$
20 32	27 62		65 24		
20 26	27 38		73 98		KCl $\text{HgCl}_2$ $\text{H}_2\text{O}$
17 85	25 34	21 89	75 10	3 01	
9 26	18 95	21 02	73 36	5 62	
7 80	19 56	20 76	73 06	6 18	
6 84	22 81	20 75	74 54	4 71	
6 66	24 32	20 54	73 99	5 47	KCl $\text{HgCl}_2$ $\text{H}_2\text{O} + \text{KCl}$ 2 $\text{HgCl}_2$ 2 $\text{H}_2\text{O}$
6 52	25 13		76 46		
6 64	25 16		80 60		
6 27	25 11	12 09	83 20	4 71	2KCl 2 $\text{HgCl}_2$ $\text{H}_2\text{O}$
5 77	24 73	11 87	83 18	4 95	
4 68	24 75		84 46		KCl 2 $\text{HgCl}_2$ 2 $\text{H}_2\text{O} + \text{HgCl}_2$
4 66	25 17		93 58		
4 69	24 82		98 50		
0	6 90	0	100	0	$\text{HgCl}_2$

(Foote and Levy, Am Ch J 1906, 35 239)

Solubility of  $\text{HgCl}_2 + \text{KCl}$  at 20°

G per 100 g $\text{H}_2\text{O}$		Solid phase
KCl	$\text{HgCl}_2$	
0	7 39	$\text{HgCl}_2$
1 12	11 63	"
2 39	15 72	"
4 05	22 17	"
4 84	25 16	$\text{HgCl}_2 + 2\text{HgCl}_2$ , KCl
5 60	25 13	2 $\text{HgCl}_2$ , KCl
6 71	25 66	"
7 39	26 41	2 $\text{HgCl}_2$ , KCl + $\text{HgCl}_2$ , KCl
7 46	24 70	$\text{HgCl}_2$ , KCl
8 95	19 93	"
15	22 87	"
17 57	26 12	"
20 35	29	"
26 31	34 83	"
30 32	39 10	"
34 12	42 82	$\text{HgCl}_2$ , KCl + $\text{HgCl}_2$ , 2KCl
34 18	39 34	$\text{HgCl}_2$ , 2KCl
34 34	35 16	"
34 54	30 63	"
37 72	24 30	"
41 13	19 33	$\text{HgCl}_2$ , 2KCl + KCl
39 66	15 76	KCl
37 87	10 28	"
35 32	2 1	"

(Tichomiroff, J russ Phys Chem Soc 1907 39 731)

Solubility of  $\text{HgCl}_2 + \text{RbCl}$  in  $\text{H}_2\text{O}$  Solubility data are given showing double salts formed at 25° (Foote and Levy, l c)Solubility in  $\text{NaCl} + \text{Aq}$  100 pts  $\text{NaCl} + \text{Aq}$  containing given %  $\text{NaCl}$  dissolve g  $\text{HgCl}_2$ 

% NaCl	g $\text{HgCl}_2$ at 15	g $\text{HgCl}_2$ at 65°	g $\text{HgCl}_2$ at 100°
26	128	152	208
25	120	142	196
10	58	68	110
5	30	36	64
1	14	18	48
0 5	10	13	44

(Homeyer and Ratsert, Pharm Ztg 33 738)

Solubility of  $\text{HgCl}_2 + \text{NaCl}$  at 25°

Composition of solution		Composition of undissolved residue			Solid phase
% NaCl	% $\text{HgCl}_2$	% NaCl	% $\text{HgCl}_2$	% $\text{H}_2\text{O}$	
26 5	0	100	0	0	$\text{NaCl}$
18 66	51 35		16 39		$\text{NaCl} + \text{NaCl}$ $\text{HgCl}_2$ 2 $\text{H}_2\text{O}$
18 71	51 32		21 98		
18 64	51 42		65 45		
18 87	51 26		71 25		
14 97	57 74	16 38	74 18	9 44	$\text{NaCl}$ $\text{HgCl}_2$ 2 $\text{H}_2\text{O}$
14 03	59 69	16 36	74 21	9 43	
13 25	62 16	16 16	74 70	9 14	
13 17	62 59	15 96	74 76	9 28	
12 97	62 50		78 20		$\text{NaCl}$ $\text{HgCl}_2$ 2 $\text{H}_2\text{O} + \text{HgCl}_2$
13 14	62 48		88 64		
13 15	62 55		90 83		

(Foote and Levy, Am Ch J 1906, 35 239)

105.0 g  $\text{HgCl}_2$  are sol in 1 l of 0.1-N  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$  at 25° (Morse, Z phys Ch 1902, 4 726)Solubility in  $\text{MCl} + \text{Aq}$  at 25°

Salt	In 10 cc of the solution	
	Millimols $\text{H}_2\text{C}l$	Millimols salt
LiCl	2 65	0
	3 51	4 14
	6 66	8 35
	10 21	12 71
	16 78	17 38
	22 14	22 65
	28 96	30 91
	30 62	35 27
NaCl	2 65	0
	3 72	2 12
	5 08	4 16
	7 48	6 71
	11 92	11 53
	20 22	19 41
	27 54	27 83
	34 34	31 62

Solubility in  $\text{MCl} + \text{Aq}$  at  $25^\circ$  — *Continued*

Salt	In 10 ccm of the solution	
	Millimols $\text{HgCl}_2$	Millimols salt
$\text{KCl}$	2 65	0
	3 55	1 74
	3 81	2 21
	8 36	6 83
$\text{MgCl}_2$	2 65	0
	3 74	1 68
	7 19	4 15
	11 31	5 70
	18 64	9 97
	25 69	13 20
	32 06	17 28
$\text{CaCl}_2$	2 65	0
	3 64	1 90
	7 66	4 02
	11 08	6 56
	18 11	9 64
	26 45	14 29
	33 04	17 23
$\text{SrCl}_2$	2 65	0
	3 15	1 64
	5 63	3 11
	8 29	5 19
	13 42	7 24
	17 76	10 46
	22 93	13 86
$\text{BaCl}_2$	2 65	0
	6 97	3 85
	11 67	5 72
	16 20	7 76
	26 45	13 36
	53 48	30 30

(Herz and Paul, Z anorg 1913, 82 433)

Solubility in  $\text{H}_2\text{O}$  is increased by presence of  $\text{I}_2$  (Herz and Paul, Z anorg 1914, 85 214)

Solubility in  $\text{H}_2\text{O}$  is increased by presence of hydroxylamine hydrochloride (Adams, Am Ch J 1902, 28 213)

Moderately sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Insol in liquid  $\text{CO}_2$  (Buchner, Z phys Ch 1906, 54 674)

Abundantly sol in  $\text{H}_2\text{PtCl}_4 + \text{Aq}$  (Nilson, B 1876, 9 1146)

Sol in 2.5 pts cold alcohol (Richter) 3 pts (Karl) 2, pts alcohol of 0.833 sp gr at ordinary temp and 1.167 pts on boiling (Berzelius) 2 pts alcohol of 0.816 sp gr at  $15.5^\circ$  (sp gr of solution = 1.08) (J Davy Phil Trans 1822 358)

At  $10^\circ$  sol in 2.57 pts alcohol of  $39^\circ$  (Cartier) in 2.9 pts alcohol of 38 in 3.6 pts alcohol of 35 in 4.2 pts alcohol of  $30^\circ$  in 9.3 pts alcohol of 22 in 14.6 pts alcohol of  $14^\circ$  (N E Henry)

Sol in 25 mols methyl, 13.1 mols ethyl, and 20.3 mols propyl alcohol at  $8.5^\circ$ , in

16.2 mols methyl, 12.4 mols ethyl, and 18 mols propyl alcohol at  $20^\circ$ , in 6.8 mols methyl, 10.6 mols ethyl, and 14.6 mols propyl alcohol at  $38.2^\circ$  (Timofejew, C R, 112 1224)

100 pts absolute methyl alcohol dissolve 66.9 pts  $\text{HgCl}_2$  at  $25^\circ$ , 100 pts absolute ethyl alcohol dissolve 49.5 pts  $\text{HgCl}_2$  at  $25^\circ$  (de Bruyn, Z phys Ch 10 783)

At  $15^\circ$ , 1 pt by weight is sol in —

13.53 pts  $\text{H}_2\text{O}$

1.5 " methyl alcohol of sp gr 0.7990

2.5 " ethyl " " " 0.8100

6.3 " propyl " " " 0.8160

(Rohland, Z anorg 1899, 18 323)

100 g  $\text{HgCl}_2 + \text{CH}_3\text{OH}$  contain 1.2 g  $\text{HgCl}_2$  at the critical temp (Centnerszwer, Z phys Ch 1910, 72 437)

Solubility of  $\text{HgCl}_2$  in methyl alcohol + Aq at  $25^\circ$

$P = \text{g alcohol in 100 g alcohol} + \text{Aq}$

$\text{HgCl}_2 = \text{millimols HgCl}_2$  in 10 cc of the solution

P	$\text{HgCl}_2$	Sp gr
0	2 67	1 0565
10 60	2 92	1 0441
30 77	4 18	1 0420
37 21	4 96	1 0507
47 06	7 27	1 0809
64 00	14 19	1 2015
78 05	21 11	1 3314
100	17 95	1 2160

(Herz and Anders, Z anorg 1907, 52 165)

100 cc 90% ethyl alcohol dissolve 27.5 g  $\text{HgCl}_2$  at  $15.5^\circ$  Sp gr  $15^\circ$  of sat solution = 1.065 (Greenish and Smith, Pharm J 1903, 71 881)

100 g 99.2% ethyl alcohol dissolve 33.4 g  $\text{HgCl}_2$  at  $25^\circ$  (Osaka)

Solubility of  $\text{HgCl}_2$  in ethyl alcohol + Aq at  $25^\circ$

$P = \text{g alcohol in 100 g alcohol} + \text{Aq}$

$\text{HgCl}_2 = \text{millimols HgCl}_2$  in 10 cc of the solution

P	$\text{HgCl}_2$	Sp gr
0	2 67	1 0565
20 18	2 49	1 0214
40 69	3 94	1 0180
70 01	8 70	1 0616
100	13 61	1 1067

(Herz and Anders, Z anorg 1907, 52 170)

Solubility of  $\text{HgCl}_2$  in ethyl alcohol + Aq  
at  $25^\circ$ 

% $\text{C}_2\text{H}_5\text{OH}$	% $\text{HgCl}_2$	% $\text{C}_2\text{H}_5\text{OH}$	% $\text{HgCl}_2$
0	6 80	45 84	15 36
5 08	6 65	49 86	18 18
14 49	6 41	53 61	21 40
21	6 55	57 26	24 51
26 25	7 31	60 55	27 67
31 53	8 51	63 95	29 86
36 85	10 32	67 39	32 40
41 36	12 69		

(Abe, J Tok Chem Soc 1912, **33** 1087)

Solubility in alcohol is increased by presence of hydroxylamine hydrochloride (Adams, Am Ch J 1902, **28** 213)

Solubility of  $\text{HgCl}_2$  in a mixture of methyl and ethyl alcohol at  $25^\circ$ 

P = % methyl alcohol in the mixture  
G = g  $\text{HgCl}_2$  in 10 ccm of the solution  
S = sp gr of the sat solution

P	$\text{HgCl}_2$	S $25^\circ/4^\circ$
0	3 686	1 107
4 37	3 943	1 130
10 4	4 261	1 157
41 02	5 837	1 294
80 69	6 167	1 321
84 77	5 782	1 288
91 25	5 385	1 254
100	4 862	1 216

(Herz and Kuhn, Z anorg 1908, **58** 161)Solubility in mixtures of methyl and propyl alcohol at  $25^\circ$ 

P = % propyl alcohol in the solvent  
G = g  $\text{HgCl}_2$  in 10 ccm of the solution  
S = sp gr of the sat solution

P	G	S $25^\circ/4^\circ$
0	4 862	1 2160
11 11	5 034	1 2278
23 8	5 714	1 2848
65 2	4 228	1 1568
91 8	2 509	1 0090
93 75	2 323	1 0029
96 6	2 152	0 9851
100	2 003	0 9720

(Herz and Kuhn, Z anorg 1908, **60** 157)Solubility in mixtures of propyl and ethyl alcohol at  $25^\circ$ 

P = % propyl alcohol in the solvent  
G = g  $\text{HgCl}_2$  in 10 ccm of the solution  
S = sp gr of the sat solution

P	G	S $25^\circ/4^\circ$
0	3 686	1 1070
8 1	3 667	1 0988
17 85	3 406	1 0857
56 6	2 711	1 0272
88 6	2 166	0 9854
91 2	2 160	0 9824
95 2	2 087	0 9772
100	2 003	0 9720

(Herz and Kuhn, Z anorg 1908, **60** 160)Sp gr of  $\text{HgCl}_2$  + alcohol

% $\text{HgCl}_2$	Sp gr $25^\circ/20^\circ$
0	0 7948
5 44	0 8346
6 52	0 8431

(Le Blanc and Rohland, Z phys Ch 1896, **19** 283)Sp gr of alcoholic solution of  $\text{HgCl}_2$ 

% $\text{HgCl}_2$	Sp gr			
	at $0^\circ$	at $10^\circ$	at 20	at 30
0 00	0 83135	0 82286	0 81435	0 80594
1 22	0 8397	0 8312	0 8228	0 8141
2 38	0 8484	0 8399	0 8314	0 8227
4 42	0 8635	0 8549	0 8463	0 8375
8 56	0 8966	0 8877	0 8789	0 8659
12 43	0 9306	0 9213	0 9119	0 9024
15 91	0 9629	0 9523	0 9425	0 9329
19 32	0 9951	0 9852	0 9753	0 9652
22 46	1 0285	1 0184	1 0083	0 9982

(Schroder, B **19** 161 R)

Sp gr at  $16^\circ/4^\circ$  of  $\text{HgCl}_2$  + ethyl alcohol containing 23 5489%  $\text{HgCl}_2$  = 0 99855 (containing 11 8801%  $\text{HgCl}_2$ ) (Schonrock, Z phys Ch 1893, **11** 768)

Sp gr at  $16^\circ/4^\circ$  of  $\text{HgCl}_2$  + alcohol containing 10 9948%  $\text{HgCl}_2$  = 0 89550 (Schonrock, Z phys Ch 1893, **11** 769)

Sol in 4 pts ether (Karl), in 41 pts (Henry), in 286 pts (that of 0 745 sp gr (sp gr of solution = 1 08), the solvent power is not increased by elevating the temp, and b pt of ether is not raised (J Davy)

Ether extracts  $\text{HgCl}_2$  from  $\text{HgCl}_2$  + Aq (Orfila), very slightly if  $\text{HgCl}_2$  + Aq is dil (Lassaigne)

Very sl sol in pure ether (Polis, B **20** 717)

6 35 pts are sol in 100 pts ether at  $0^\circ$   
6 44 " " " " 100 " " " 18  
6 38 " " " " 100 " " " 35 5

(Laszczyński, B 1894, **27** 2286)

Sol in  $7\frac{1}{2}$ –8 pts ether (Madsen, Ch Z Rept 1897, 21 169)

Solubility in 100 cc ether at  $17^\circ = 4.1$ – $4.12$  g (Stromholm, J pr 1902, (2), 66 450)

The solubility of  $\text{HgCl}_2$  in  $\text{H}_2\text{O}$  is only sl affected by the presence of ether. An aqueous solution sat with ether and  $\text{HgCl}_2$  contains about 10% less  $\text{HgCl}_2$  than a pure sat aqueous solution. Partition coefficient for  $\text{HgCl}_2$   $\frac{\text{ether}}{\text{H}_2\text{O}} = 4.9$  at  $0^\circ$ , 3.02 at  $14.6^\circ$ , 2.80 at  $16.8^\circ$  (Stromholm, Z phys Ch 1903, 44 70)

#### Solubility of $\text{HgCl}_2$ in ether+Aq at $25^\circ$

% Ether	% $\text{H}_2\text{O}$	% $\text{HgCl}_2$
87 86	5 22	6 92
1 2	93 6	5 2
5 2	90 5	4 3
5 4	91 8	2 8
5 4	93 1	1 5

(Abe, J Tok Chem Soc 1912, 33 1087)

#### Solubility of $\text{HgCl}_2$ in ether+ethyl alcohol at $25^\circ$

% Alcohol	% $\text{HgCl}_2$	% Alcohol	% $\text{HgCl}_2$
67 57	32 43	27 16	36 29
53 59	32 50	22 48	34 08
51 02	37 39	15 20	28 55
44 79	37 96	8 97	20 67
38 69	38 24	0	5 49
32 84	37 75		

(Abe)

4 pts ether dissolve 1 pt  $\text{HgCl}_2$ , but 4 pts ether+1.33 pts camphor dissolve 1.33 pts  $\text{HgCl}_2$ . 4 pts ether+4 pts camphor dissolve 2 pts  $\text{HgCl}_2$ , 4 pts ether+8 pts camphor dissolve 1 pt  $\text{HgCl}_2$ , 4 pts ether+16 pts camphor dissolve 5 pts  $\text{HgCl}_2$  (Karls, Pogg, 10 608)

3 pts alcohol dissolve 1 pt  $\text{HgCl}_2$ , but 3 pts alcohol+1 pt camphor dissolve 2 pts  $\text{HgCl}_2$ , 3 pts alcohol+3 pts camphor dissolve 3 pts  $\text{HgCl}_2$ , 3 pts alcohol+6 pts camphor dissolve 6 pts  $\text{HgCl}_2$  (Karls, l c)

Solution can be obtained containing 25 pts camphor, 16 pts  $\text{HgCl}_2$ , and only 4 pts alcohol. Sp gr of solution = 1.326 (Simon, Pogg 37 553)

100 pts acetone dissolve 60 pts  $\text{HgCl}_2$  at  $25^\circ$  (Krug and M'Elroy, J Anal Appl Ch 184)

98.35 pts  $\text{HgCl}_2$  are sol in 100 pts acetone at  $0^\circ$

110.95 pts  $\text{HgCl}_2$  are sol in 100 pts acetone at  $10^\circ$

126.80 pts  $\text{HgCl}_2$  are sol in 100 pts acetone at  $18^\circ$  (Lasczynski, B 1894, 27 2287)

1 g  $\text{HgCl}_2$  is sol in 0.70 g acetone at  $18^\circ$ . Sp gr of sat solution  $18^\circ/4^\circ = 1.956$  (Naumann, B 1904, 37 4334)

Sat solution in acetone contains 57.74 g  $\text{HgCl}_2$  in 100 g solution at  $25^\circ$  (Foote and Haigh, J Am Chem Soc 1911, 33 461)

Sp gr at  $26.7^\circ/4^\circ$  of  $\text{HgCl}_2$ +acetone containing 36.25%  $\text{HgCl}_2 = 1.1585$  (Schonrock, Z phys Ch 1893, 11 769)

#### Sp gr of $\text{HgCl}_2$ +acetone

% $\text{HgCl}_2$	Sp gr $20^\circ/20^\circ$
0	0.8003
10 94	0.8847
21 05	0.9799

(Le Blanc and Rohland, Z phys Ch 1896, 19 283)

100 g methyl acetate dissolve 46 g at bpt ( $56.5^\circ$ ) (Schroeder and Steiner, J pr 1909, (2) 79 49)

1 g  $\text{HgCl}_2$  is sol in 2.35 g methyl acetate at  $18^\circ$ . Sp gr  $18^\circ/4^\circ$  of the sat solution = 1.251 (Naumann, B 1909, 42 3793)

#### Solubility in ethyl acetate

Pts sol in 100 pts ethyl acetate	
Pts $\text{HgCl}_2$	$t^\circ$
28 92	0
29 03	13
30 71	35
31 87	48
32 77	60
35 98	83

(Iaszczyński, B 1894, 27 2286)

Solubility in ethyl acetate = 1.3466 at  $18^\circ$  (Alexander, Dissert 1899)

#### Solubility of $\text{HgCl}_2$ in ethyl acetate

Temp	0	13	30	40	50
Mol $\text{HgCl}_2$ in 100 mols $\text{C}_4\text{H}_8\text{O}_2$	15.4	15.9	16.0	16.1	16.3

(Linebarger, Am Ch J 1894, 16 214)

1 g  $\text{HgCl}_2$  is sol in 3.5 g ethyl acetate at  $18^\circ$ . Sp gr of sat solution  $18^\circ/4^\circ = 1.110$  (Naumann, B 1904, 37 3602)

Solubility of  $\text{HgCl}_2$  in ethyl acetate and acetone at  $t^\circ$ 

$t^\circ$	Molecules $\text{HgCl}_2$ sol in 100 molecules of ethyl acetate	Molecules $\text{HgCl}_2$ sol in 100 molecules of acetone	Solid present in acetone
-15	9 10	14 5	$\text{HgCl}_2, \text{CH}_3\text{COCH}_3$
0	9 25	14 3	
+10		18 7	
10		23 5	$\text{HgCl}_2$
17		23 2	
25	9 15	22 8	

(Aten, Z phys Ch 1906, 54 121)

Solubility of  $\text{HgCl}_2$  in ethyl acetate+Aq at  $25^\circ$ 

P=g ethyl acetate in 100 g ethyl acetate +Aq

 $\text{HgCl}_2$ =millimols  $\text{HgCl}_2$  in 10 cc of the solution

P	$\text{HgCl}_2$	Sp gr
0	2 67	1 0565
4 39	2 72	1 0581
96 76	15 34	1 2371
100	9 75	1 1126

(Herz and Anders, Z anorg 1907, 52 172)

1 pt is sol in 2 05 pts ethyl acetate at  $18^\circ$  or 100 g ethyl acetate dissolve 48 7 g  $\text{HgCl}_2$  (Naumann, B 1910, 43 315)

Easily sol in glycerine, sol in 14 pts glycerine (Fairley, Monit Scient (3) 9 685)

100 g glycerine dissolve 80 g  $\text{HgCl}_2$  at  $25^\circ$  (Moles and Maquina, Ann Soc Eshan fis quim 1914, 12 383)

## Solubility in organic solvents

Solvent	$t^\circ$	Sat solution contains % $\text{HgCl}_2$
Methyl alcohol	-34	7 6
	-20	11 5
	-15	12 8
	-2	18 7
	+ 4	23 2
	12	27 6
	36	53 1
	51	61 0
	62	63 6
	64	63 7
	74	64 3
	100	68 7
	127	75 2

Solvent	$t^\circ$	Sat solution contains % $\text{HgCl}_2$
Ethyl alcohol	-60	3 0
	-55	7 8
	-43	8 8
	-40	9 8
	-30	14 3
	-23	18 6
	-21	19 1
	-20	21 9
	-17	22 1
	-11	24 7
	-9	27 0
	-5	29 7
	0	29 0
	+ 3	30 0
	7	30 9
	10	31 3
	14	31 3
	19	32 0
	31	34 2
	43	36 4
	51	38 9
	62	42 1
	63	42 5
	68	44 7
	75	45 2
	80	48 0
	92	51 0
	93	51 1
	100	53 6
	115	60 6
	127	65 3
	138	67 8
N-propyl alcohol	-32	14 7
	-22	15 1
	-14	15 6
	0	16 4
	0	16 5
	+ 16	18 2
	41	23 8
	53	27 9
	62	29 4
	67	32 7
	78	36 4
	100	43 8
	127	52 7
Allyl alcohol	21	20 6
	1	29 6
	+ 8	31 2
	22	48 7
Acetone	23	51 4
	18	52 9
	-15	56 6
	10	56 7
	8	58 4
	-4	59 1
	1	60 1
	+ 6	61 9
	12	61 4
	15	61 8
	27	62 0
	36	61 9
	54	62 1

Solubility in organic solvents—*Continued*

Solvent	t°	Sat solution contains % HgCl <sub>2</sub>
N-butyl alcohol	—21	12 4
	— 6	13 0
	+ 9	14 3
	21	15 9
	59	25 8
	82	33 1
Isobutyl alcohol	—11	5 5
	— 6	6 2
	0	6 7
	+11	7 5
	63	19 3
	98	32 1
	127	42 0
	145	47 2
	155	50 4
Amyl alcohol	—13	8 6
	+26	8 9
	50	14 0
	90	29 8
	106	35 1
Ether	—47	5 6
	—40	5 8
	—35	6 1
	—30	5 9
	—19	5 6
	0	5 8
	+13	5 8
	83	8 4
	100	8 7
	115	9 0
Ethyl formate	—20	29 6
	— 3	29 2
	+24	30 0
	+46	31 0
Ethyl acetate	50	39 6
	20	40 5
	—14	40 2
	6	40 0
	0	39 5
	+ 7	39 9
	19	40 2
	45	41 6
	66	44 0
	100	47 8
	131	50 1
Methyl acetate	150	57 0
	180	59 3
	—20	42 0
Amyl acetate	+24	40 3
	55	41 5
	+22	18 3
Ethyl butyrate	48	18 5
	+20	12 6
	55	13 5
	71	15 1

Solubility in organic solvents—*Continued*

Solvent	t°	Sat solution contains % HgCl <sub>2</sub>
Acetic acid	+21	2 7
	22	3 0
	33	5 0
	43	6 0
	50	6 7
	61	8 0
	87	11 0
	95	12 0
	95	12 5
	115	16 0
	116	17 0
	127	20 0
Formic acid	145	26 3
	182	44 8
	207	55 2
	21	2 0
	50	3 2
	90	7 3

Very sl sol in propionic and isobutyric acids

(Étard, A ch 1894, (7) 2 557 et seq.)

Solubility of HgCl<sub>2</sub> in organic solvents at t°

Solvent	t°	% HgCl <sub>2</sub>
CHCl <sub>3</sub>	—20 5	0 01
	+44 2	0 12
C <sub>6</sub> H <sub>6</sub>	+6 5	0 26
	18 0	0 53
	34 1	0 64
	54 1	1 02
	69 0	1 39
C H <sub>2</sub> Cl	0	1 33
	12 5	1 55
	20 8	1 68
	25 3	1 73
	30 2	1 92
	33 0	2 05
	45 9	2 42
CH <sub>3</sub> COOC <sub>2</sub> H <sub>5</sub>	0	22 8
	6 5	22 7
	26 1	22 8
	38 5	23 5
	45 3	26 4



Solubility of  $\text{HgCl}_2$  in mixed organic solvents  
at  $t^\circ$ 

Solvent	$t^\circ$	% $\text{HgCl}_2$
$\text{C}_6\text{H}_6 + \text{C}_2\text{H}_5\text{OH}$	-2 5	15 20
	0 0	15 40
	6 0	16 38
	20 5	18 40
	20 65	18 50
	24 5	19 33
	34 5	21 34
	54 4	24 84
	54 5	24 42
$\text{C}_6\text{H}_6 + 2\text{C}_6\text{H}_5\text{OH}$	-5 2	19 45
	0	20 13
	+9 1	21 65
	20 9	23 57
	24 4	24 19
	36 5	26 53
	53 7	31 27
	74 0	38 74
$\text{CHCl}_3 + \text{C}_2\text{H}_5\text{OH}$	-20 5	3 82
	-12 0	4 43
	0 0	4 89
	+8 0	5 37
	23 0	7 12
	38 5	8 51
	44 2	9 51
	45 6	9 98
$\text{CHCl}_3 + 2\text{C}_2\text{H}_5\text{OH}$	-20 5	6 60
	0 0	7 69
	+8 0	8 96
	23 0	10 66
	38 5	12 50
	44 2	14 40
$\text{CHCl}_3 + \text{CH}_3\text{OH}$	-12 0	1 73
	0 0	3 51
	+8 0	5 63
	23 0	10 15
	24 9	10 71
	30 6	11 40
	38 5	12 02
$\text{CHCl}_3 + 2\text{CH}_3\text{OH}$	-12 0	3 33
	0 0	6 73
	+8 0	8 21
	23 0	16 56
	24 9	18 45
	30 6	19 70
$\text{CCl}_4 + 2\text{CH}_3\text{OH}$	0 0	5 20
	7 7	6 69
	24 9	14 06
	30 6	19 40
	35 5	20 50
	36 1	21 80
	48 5	21 90

Solubility of  $\text{HgCl}_2$  in mixed organic solvents  
at  $t^\circ$ —Continued

Solvent	$t^\circ$	$\text{HgCl}_2$
$\text{C}_2\text{H}_4\text{Cl}_2 + \text{CH}_3\text{OH}$	0 0	13 33
	12 5	21 30
	20 8	29 23
	25 3	34 78
	30 2	36 87
	33 0	37 01
	37 4	37 95
	45 9	39 36
$\text{CH}_3\text{COOC}_2\text{H}_5 + \text{C}_6\text{H}_6$	0 0	9 62
	6 5	9 62
	25 7	9 78
	27 6	9 78
	35 5	10 81
$\text{CH}_3\text{COOC}_2\text{H}_5 + \text{CHCl}_3$	45 3	13 69
	0 0	3 34
	26 1	4 07
	36 1	4 78
	46 0	5 38
$2\text{CH}_3\text{COOC}_2\text{H}_5 + \text{CCl}_4$	48 5	5 10
	0 0	9 24
	10 3	9 05
	25 7	9 32
	27 6	9 50
	38 5	9 89
	45 3	11 70

(Dukelski, Z anorg 1907, 53 335)

Solubility in organic solvents at  $18^\circ/20^\circ$ 100 g chloroform dissolve 0.106 g  $\text{HgCl}_2$ 100 g tetrachloromethane dissolve 0.002 g  $\text{HgCl}_2$ 100 g bromoform dissolve 0.456 g  $\text{HgCl}_2$ 100 g ethyl bromide dissolve 2.010 g  $\text{HgCl}_2$ 100 g ethylene dibromide dissolve 1.530 g  $\text{HgCl}_2$ 

(Sulc Z anorg 1900, 25 401)

Solubility of  $\text{HgCl}_2$  in various organic  
solvents at  $25^\circ$ G = g  $\text{HgCl}_2$  dissolved in 1 mol of solvent

Solvent	( $\text{HgCl}_2$ )
Ethylene chloride	1.216
Tetrachlorethane	0.146
Chloroform	0.120
Dichlorethylene	0.110
Pentachlorethylene	0.039
Trichlorethylene	0.036
Perchlorethylene	0.012
Carbon tetrachloride	Trace

(Hofman, et al, B 1910, 43 188)

Very sl sol in nitromethane at ord temp  
Very sol on warming (Bruner, B 1903, 36  
3298)

Solubility in  $\text{CS}_2$  at  $t^\circ$ 

$t^\circ$	100 pts sat solution contain pts $\text{HgCl}_2$
-10	0 010
-5	0 014
0	0 018
+5	0 022
10	0 026
15	0 032
20	0 042
25	0 053
30	0 063

(Arctowski, Z anorg 1894, 6 267)

0 030 g is dissolved in 100 g sat solution in  $\text{CS}_2$  at  $8^\circ$  (Arctowski, Z anorg 1894, 6 256)

Formic acid (95%) dissolves 2 1% at  $19^\circ$  (Aschan, Ch Z 1913, 37 1117)

Sol in molten urethane (Castoro, Z anorg 1899, 20 61)

Sol in ethyl sulphocyanate (Kahlenberg, Z phys Ch 1903, 46 66)

Solubility of  $\text{HgCl}_2$  in benzene

100 pts  $\text{C}_6\text{H}_6$  dissolve at —

$15^\circ$   $41^\circ$   $55^\circ$   $84^\circ$   
0 54 0 62 0 85 1 80 pts  $\text{HgCl}_2$

(Iaszcynski, B 1594, 27 2287)

in  $\text{C}_2\text{H}_4$  = 0 0197 mol/l at  $25^\circ$   
(Z phys Ch 1903, 43 735)

Sol in  $\text{C}_2\text{H}_4$ , toluene, xylene, and other aromatic hydrocarbons. Insol or only sl sol in petroleum ether hexane decane and  $\text{CS}_2$  (Galkwitsch, B 1904 37 1563)

Sol in p toluidine (Werner)

Sol in quinoline (Beckmann and Gabel, Z anorg 1906, 51 236)

Solubility of  $\text{HgCl}$  in pyridine

$t$  = point of fusion

Solid Phase =  $\text{HgCl}$ ,  $2\text{C}_5\text{H}_5\text{N}$

$t$	$\text{HgCl}$	$t$	$\text{HgCl}$	$t$	$\text{HgCl}$
-32 8	2 76	40 90	29 29	78 0	49 72
-21 9	7 86	50 10	34 94	78 7	50 37
+ 0 02	13 14	60 03	40 36	80 2	51 52
12 58	17 34	70 15	46 44	82 5	52 40
18 78	19 78	70 8	45 77	89 0	56 45
23 60	21 59	74 6	48 00	90 5	57 01
27 23	22 65	75 2	48 38	94 1	60 09
31 05	24 46	76 4	49 15		

Solubility of  $\text{HgCl}_2$  in pyridine — Continued  
 $t$  = point of fusion

Solid Phase =  $\text{HgCl}_2$ ,  $\text{C}_5\text{H}_5\text{N}$

$t^\circ$	% $\text{HgCl}_2$	$t$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}$
74 7	48 38	90 61	53 50	104 1	60 09
83 5	50 53	75 0	56 45	104 2	60 72
86 5	52 37	99 5	56 07	104 7	58 97
87 3	52 02	99 5	57 01	107	63 06
		100 5	57 84		

Solid Phase =  $3\text{HgCl}_2$ ,  $\text{C}_5\text{H}_5\text{N}$

$t^\circ$	% $\text{HgCl}_2$	$t$	% $\text{HgCl}_2$	$t$	% $\text{HgCl}_2$
94 7	60 72	113 6	63 06	124 2	65 00
95 2	60 77	114 0	63 18	129 4	65 63
106 4	61 93	115 7	63 37	145 5	69 66
109 8	62 58	118 2	64 09		

(McBride, Z phys Ch 1910, 14 196)

## Solubility in pyridine

$S$  = temp of solidification

Mols per 100	$S$	Mols per 100	$S$	Mols per 100	$S$
5 8	19	27 0	87	38 5	130
5 9	18 5	28 6	(98)	41 0	137
10 2	39 5	30 3	91 5	43 2	142
14 1	52	31 2	92	44 0	143,5
21 4	74 5	33 1	108	47 5	159
25 0	83	35 1	115 5	52 8	173

(Staronka, Anz Ak Wiss Krakau, 1910 372)

Sp gr at  $16^\circ/4^\circ$  of  $\text{HgCl}_2$  + pyridine containing 17 53%  $\text{H}_2\text{O}$  - 1 1523, containing 6 57%  $\text{HgCl}$  = 1 1523 (Schonrock, Z phys Ch 1893, 11 768)

Mol weight determined in benzonitrile, methyl- and ethyl sulphide (Werner, Z anorg 1897, 15 31 26 und 30)

Sol in benzonitrile (Naumann, B 1914, 47 1369)

Easily sol in oil of turpentine and other essential oils, sl sol in cold benzene, but much more on heating, crystallising on cooling (Fruchimont, B 16 387)

Easily sol in boiling acetate

Insol in olive oil

Insol in oils and fats but sol when first dissolved in alcohol, free (ether or anhydrous ketones (Glock, Ch Z Repert 36 315)

Extracted from  $\text{HgCl}_2$  + Aq by volatile oils

**Mercuric hydrogen chloride (Chloromercuric acid),  $\text{HgCl}_2$ ,  $\text{HCl} = \text{IIIHgCl}$ ,**

Decomp by  $\text{H}_2\text{O}$  (Boullay, A ch 34 243)

Easily decomposed (Neumann, M 10 236)

$\text{HgCl}_2, 2\text{HCl} + 7\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$   
(Ditte, A ch (5) 22 551)  
 $3\text{HgCl}_2, 4\text{HCl} + 14\text{H}_2\text{O}$  As above  
 $2\text{HgCl}_2, \text{HCl} + 6\text{H}_2\text{O}$  As above  
 $4\text{HgCl}_2, 2\text{HCl} + 9\text{H}_2\text{O}$  As above  
 $3\text{HgCl}_2, \text{HCl} + 5\text{H}_2\text{O}$  As above

**Mercuric hydrazine chloride,  $\text{HgCl}_2,$   
 $2(\text{N}_2\text{H}_4, \text{HCl})$**

Very sol in  $\text{H}_2\text{O}$  More sol in hot alcohol  
than in cold, decomp by  $\text{HNO}_3$  (Curtius,  
J pr 1894, (2) 50 332)

**Mercuric nickel chloride, basic,  $\text{HgCl}_2,$   
 $6\text{NiO}, \text{NiCl}_2 + 20\text{H}_2\text{O}$ , and  $\text{HgCl}_2, 7\text{NiO},$   
 $\text{NiCl}_2$**

(Mailhe, A ch 1902, (7) 27 369)

**Mercuric nickel chloride**

Deliquescent (v Bonsdorff)

**Mercuric nitrosyl chloride,  $\text{HgCl}_2, \text{NOCl}$**

Sol in  $\text{H}_2\text{O}$  without effervescence (Sud-  
borough, Chem Soc 59 659)

**Mercuric phosphoric chloride,  $3\text{HgCl}_2, 2\text{PCl}_5$**

Decomp and dissolved by  $\text{H}_2\text{O}$  (Baudri-  
mont, A ch (4) 2 45)

**potassium chloride,  $2\text{HgCl}_2, \text{KCl} +$**

**asily sol in warm  $\text{H}_2\text{O}$  A clear  
at  $18^\circ$  is filled with crystals at  $15^\circ$   
1 alcohol (v Bonsdorff, Pogg 17**

$\text{HgCl}_2, \text{KCl} + \text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$ , sl  
sol in alcohol (v Bonsdorff, Pogg 19 336)

$\text{HgCl}_2, 2\text{KCl} + \text{H}_2\text{O}$  As above  
Solubility determinations show that the  
double salts formed by mercuric and potas-  
sium chlorides at  $25^\circ$  are

$2\text{KCl}, \text{HgCl}_2 + \text{H}_2\text{O}$   
 $\text{KCl}, \text{HgCl}_2 + \text{H}_2\text{O}$  Can be recryst with-  
out decomp

$\text{KCl}, 2\text{HgCl}_2 + 2\text{H}_2\text{O}$  Gives  $\text{HgCl}_2$  on  
recryst from  $\text{H}_2\text{O}$  (Foote and Levy, Am  
Ch J 1906, 35 237)

**Mercurous rhodium chloride**

See Chlororhodite, mercurous

**Mercuric rubidium chloride,  $\text{HgCl}_2, \text{RbCl}$**

Sol in  $\text{H}_2\text{O}$   
 $\text{HgCl}_2, 2\text{RbCl}$  Sol in  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Ag}$   
(Godeffroy, Arch Pharm (3) 12 47)  
 $+ 2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Godeffroy)  
 $2\text{HgCl}_2, \text{RbCl}$  Sol in  $\text{H}_2\text{O}$  (Godeffroy)

Solubility determinations show that at  $25^\circ$   
there exist five double mercuric rubidium  
chlorides with the following formulas

$\text{RbCl}, 5\text{HgCl}_2$  Gives  $\text{HgCl}_2$  on recryst  
from  $\text{H}_2\text{O}$

$3\text{RbCl}, 4\text{HgCl}_2 + \text{H}_2\text{O}$  Gives  $\text{RbCl},$   
 $5\text{HgCl}_2$  on recryst from  $\text{H}_2\text{O}$

$\text{RbCl}, \text{HgCl}_2 + \text{H}_2\text{O}$  Gives  $3\text{RbCl}, 4\text{HgCl}_2$   
on recryst from  $\text{H}_2\text{O}$

$3\text{RbCl}, 2\text{HgCl}_2 + 2\text{H}_2\text{O}$  Gives  $3\text{RbCl},$   
 $4\text{HgCl}_2$  on recryst from  $\text{H}_2\text{O}$   
 $2\text{RbCl}, \text{HgCl}_2 + \text{H}_2\text{O}$  Gives  $3\text{RbCl},$   
 $4\text{HgCl}_2$  on recryst from  $\text{H}_2\text{O}$   
(Foote and Levy, Am Ch J 1906, 35 241)

**Mercurous silver chloride,  $\text{HgCl}, \text{AgCl}$**

(Jones, J Soc Chem Ind 1893, 12 983)  
 $2\text{HgCl}, \text{AgCl}$  Min *Boradite* (Jones,  
J Soc Chem Ind 1893, 12 983)

$3\text{HgCl}, \text{AgCl}$  (Jones, Chem Soc 1910,  
97 338)

**Mercuric sodium chloride,  $\text{HgCl}_2, \text{NaCl}$**

Sp gr at  $16^\circ/4^\circ$  of aqueous solution con-  
taining 14.937% salt = 1.13310, containing  
11.0736% = 1.09528 (Schönrock, Z phys  
Ch 1893, 11 782)

$+ \text{H}_2\text{O}$  (Lanebarger, Am Ch J 1893, 15  
344)

$+ 1\frac{1}{2}\text{H}_2\text{O}$  Sol in 0.33 pt  $\text{H}_2\text{O}$  at  $15^\circ$   
(Schndler, Repert 36 240)

Extremely easily sol in alcohol (Vort)

Sol in 275 pts ether. Ether dissolves the  
undecomposed salt out of  $\text{H}_2\text{O}$  solution  
(Lassaigne, A ch 64 104)

$\text{HgCl}_2, 2\text{NaCl}$  Deliquescent Very sol  
in  $\text{H}_2\text{O}$  (Vort, A 104 351)

$2\text{HgCl}_2, \text{NaCl}$  Decomp by  $\text{H}_2\text{O}$  in dil  
solution Sol in acetone and acetic ether  
(Lanebarger, Am Ch J 1893, 15 344)

Solubility determinations show that the  
only double salt formed by mercuric and  
sodium chlorides between  $10^\circ$  and  $25^\circ$  is  
 $\text{NaCl}, \text{HgCl} + 2\text{H}_2\text{O}$  Can be recryst from  
 $\text{H}_2\text{O}$  (Foote and Levy, Am Ch J 1906, 35  
237)

**Mercuric strontium chloride, basic,  $\text{SrCl},$   
 $\text{HgO} + 6\text{H}_2\text{O}$**

Decomp by  $\text{H}_2\text{O}$  (Andr, C R 104 131)

**Mercuric strontium chloride,  $2\text{HgCl}, \text{SrCl}_2,$   
 $2\text{H}_2\text{O}$**

Easily sol in  $\text{H}_2\text{O}$  (v Bonsdorff)  
 $3\text{HgCl}, \text{SrCl}_2 + 5.6\text{H}_2\text{O}$  Very sol in  
 $\text{H}_2\text{O}$  (Swan, Am Ch J 1898, 20 6 2)

**Mercurous sulphur chloride**

See Mercurous sulphochloride

**Mercuric thallous chloride,  $\text{Hg}_2\text{Cl}, \text{HCl}$**

Easily sol in  $\text{H}_2\text{O}$  (Jorgensen, J pr 2)  
6 83)

**Mercurous stannous chloride,  $\text{Hg}_2\text{Cl}, \text{SnCl}_2$**

Decomp by  $\text{H}_2\text{O}$  (Capitane, J Pharm  
25 519)

**Mercuric yttrium chloride,  $3\text{HgCl}, \text{YCl}_3 +$   
 $9\text{H}_2\text{O}$**

Deliquescent Very sol in  $\text{H}_2\text{O}$  (Popp,  
A 131 179)

**Mercuric zinc chloride,  $\text{HgCl}_2$ ,  $\text{ZnCl}_2$** 

Very sol in  $\text{H}_2\text{O}$  (Harth, Z anorg 1897, 14 323)

$2\text{HgCl}_2$ ,  $\text{ZnCl}_2$  (Varet, C R 1896, 123 422)

**Mercuric zinc chloride ammonia,  $\text{HgCl}_2$ ,  $4\text{ZnCl}_2$ ,  $10\text{NH}_3+2\text{H}_2\text{O}$** 

Insol in boiling  $\text{H}_2\text{O}$ , but decomp thereby (André, C R 112 995)

$\text{HgCl}_2$ ,  $2\text{ZnCl}_2$ ,  $6\text{NH}_3+\frac{1}{2}\text{H}_2\text{O}$  As above (André)

**Mercuric chloride ammonia,  $\text{HgCl}_2$ ,  $12\text{NH}_3$** 

Sl sol in ammonia (Franklin, Am Ch J 1900, 23 300)

**Mercuric chloride cadmium oxide,  $\text{HgCl}_2$ ,  $(\text{CdO}+\text{H}_2\text{O})$** 

(Mailhe, A ch 1902, (7) 27 371)

**Mercuric chloride cobaltous oxide,  $\text{HgCl}_2$ ,  $3\text{CoO}+\frac{1}{2}\text{H}_2\text{O}$** 

(Mailhe, C R 1901, 132 1274)

**Mercuric chloride cupric oxide,  $\text{HgCl}_2$ ,  $3\text{CuO}+\text{H}_2\text{O}$** 

(Mailhe, Bull Soc 1901, (3) 25 791)

**Mercuric chloride hydrazine,  $\text{HgCl}_2$ ,  $\text{N}_2\text{H}_4$** 

Very unstable. Decomp by  $\text{H}_2\text{O}$ . Pptd from alcohol solution by  $\text{H}_2\text{O}$ , very sol in min acids with decomp.

Easily sol in  $\text{HCl}$  or  $\text{HNO}_3$ . Decomp by alkalis. Somewhat sol in acetic acid (Hofmann B 1897, 30 2020)

**Mercuric chloride hydroxylamine,  $\text{HgCl}_2$ ,  $2\text{NH}_2\text{OH}$** 

Completely sol in methyl and ethyl alcohol insol in ether, decomp by  $\text{H}_2\text{O}$  and  $\text{NaOH}+\text{Aq}$ . Sol in  $\text{NH}_4\text{OH}$ ,  $\text{HCl}+\text{Aq}$  (Adam, Am Ch J 1902 28 210)

**Mercuric chloride lead oxide,  $\text{HgCl}_2$ ,  $2\text{PbO}+2\text{H}_2\text{O}$** 

(Mailhe, A ch 1902 (7) 27 372)

**Mercuric chloride strontium chromate,  $2\text{HgCl}_2$ ,  $\text{HCl}$ ,  $\text{SrCrO}_4$** 

Sol in  $\text{H}_2\text{O}$  without decomp (Imbert, Bull Soc 1897 (2) 17 471)

**Mercuric chloriodide,  $2\text{HgCl}$ ,  $\text{HgI}$** 

Sol in  $\text{H}_2\text{O}$  (Liebig)

$\text{HgCl}$ ,  $\text{HgI}$ . Sl sol in hot  $\text{H}_2\text{O}$  with partial decomp. More easily sol in alcohol (Köhler B 12 1187)

**Mercurous fluoride,  $\text{Hg}_2\text{F}_2$** 

Decomp by  $\text{H}_2\text{O}$  with separation of  $\text{Hg}_2\text{O}$

**Mercuric fluoride,  $\text{HgF}_2$ ,  $+2\text{H}_2\text{O}$** 

Decomp by cold  $\text{H}_2\text{O}$ , with separation of  $\text{Hg}_2\text{O}$ . Sol in dil  $\text{HNO}_3+\text{Aq}$ , and  $\text{HF}+\text{Aq}$  (Finkener, Pogg 110 624)

**Mercurous hydrogen fluoride,  $\text{Hg}_2\text{F}_2$ ,  $4\text{HF}+4\text{H}_2\text{O}$** 

Deliquescent. Easily sol in  $\text{H}_2\text{O}$ . Sol in dil acids and dil  $\text{HF}$  (Bohm, Z anorg 1905, 43 327)

**Mercurous silicon fluoride**

See Fluosilicate, mercurous

**Mercurous fluoride ammonia,  $\text{Hg}_2\text{F}_2$ ,  $2\text{NH}_3$** 

Stable on air (Finkener, Pogg 110 142)

**Mercurous hydroxide,  $\text{Hg}_2\text{OH}$** 

Nearly insol in cold, sol in hot  $\text{H}_2\text{O}$ . Sol in  $\text{NaOH}+\text{Aq}$  (Bhaduri, Z anorg 1897, 13 410)

**Mercurous iodamide,  $\text{Hg}_2(\text{NH}_2)\text{I}$** 

(Rammelsberg, Pogg 48 184)

Is a mixture of  $\text{Hg}$  and  $\text{Hg}(\text{NH}_2)\text{I}$  (Barfoed)

**Mercurous iodide,  $\text{Hg}_2\text{I}_2$** 

Sol in over 2375 pts  $\text{H}_2\text{O}$  (Saladin, J chim méd 7 530)

Solubility in  $\text{H}_2\text{O}=2.6 \times 10^{-8}$  g-equiv per liter (calculated) (Bodlander, Z phys Ch 1898, 27 58)

Solubility in  $\text{H}_2\text{O}=3 \times 10^{-10}$  mols per litre at  $25^\circ$  (Sherrill, Z phys Ch 1903, 43 735)

Sol in  $\text{Hg}(\text{NO}_3)_2+\text{Aq}$  (Stromann, B 20 2315)

Sol in  $\text{KI}+\text{Aq}$ . Easily sol in  $\text{Hg}_2(\text{NO}_3)_2+\text{Aq}$ . Sl sol in  $\text{NH}_4\text{OH}+\text{Aq}$ . Sol in hot  $\text{NH}_4\text{Cl}+\text{Aq}$ , but less than  $\text{HgI}_2$ . Less sol in  $\text{NH}_4\text{NO}_3$  than in  $\text{NH}_4\text{Cl}+\text{Aq}$  (Brett)

Partially sol with separation of  $\text{Hg}$  and formation of  $\text{HgI}_2$  in cold  $\text{KI}+\text{Aq}$ , hot  $\text{NaI}$ ,  $\text{CuI}_2$ ,  $\text{SrI}_2$ ,  $\text{BaI}_2$ ,  $\text{MgI}_2$ ,  $\text{ZnI}_2$ , and  $\text{NH}_4\text{I}+\text{Aq}$ , in warm  $\text{NaCl}$ ,  $\text{KCl}$  and  $\text{NH}_4\text{Cl}+\text{Aq}$ , and slowly in hot  $\text{HCl}+\text{Aq}$  (Boullay, A ch (2) 34 358)

Decomp by alkali chlorides  $+\text{Aq}$  (Mailhe, A ch (3) 5 177)

Very easily sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898 20 829)

Not wholly insol in alcohol, ether, or chloroform (M - Icp anal Ch 1884 375)

Decomp in alcohol, 1000 g boiling alcohol decomp about 3.15 g  $\text{HgI}_2$  (François, C R 1896, 121 890)

Boiling alcohol decomp  $\text{HgI}_2$  to  $\text{Hg}$  and  $\text{HgI}_2$  which dissolves until 0.220 g  $\text{HgI}_2$  are contained in 100 g alcohol (François, C R 1896, 121 889)

Insol in cold ether (François, J Pharm 1897, (6), 6 445)

Insol in methylene iodide (Rutgers, Z anorg 3 345)

Difficultly sol in methyl acetate (Naumann, B 1909, 42 3790)

Phenol at  $180^\circ$  decomp it into  $\text{Hg}$  and  $\text{HgI}_2$  until a state of equilibrium is reached with

275 g  $\text{HgI}_2$  to 100 g phenol, above which point  $\text{HgI}_2$  is sl sol (0.05 g in 100 g) in phenol- $\text{HgI}_2$  mixture. Decomp by cold aniline more rapidly than by hot. Equilibrium is reached when 26.35 g  $\text{HgI}_2$  are present to 100 g aniline at bpt of aniline. Aniline containing more than 26 g  $\text{HgI}_2$  to 100 g dissolves  $\text{HgI}_2$  in considerable quantity (François, C C 1896, I, 470).

Sl sol in benzonitrile (Naumann, B 1914, 47 1369).

Sl sol in allyl mustard oil (Mathews, J phys Chem 1905, 9 647).

### Mercuric iodide, $\text{HgI}_2$

Sol in 150 (?) pts  $\text{H}_2\text{O}$  (Würtlz)

1 l  $\text{H}_2\text{O}$  at 17.5° dissolves 0.0403 g  $\text{HgI}_2$  (Bourgoin, A ch (6) 3 429).

Sol in about 6500 pts  $\text{H}_2\text{O}$  (Hager)

According to calculation from electrical conductivity of  $\text{HgI}_2 + \text{Aq}$ ,  $\text{HgI}_2$  is much less sol, 1 l  $\text{H}_2\text{O}$  dissolving only 0.5 mg  $\text{HgI}_2$  at 18° (Kohlrausch and Rose, Z phys Ch 12 241).

1 l  $\text{H}_2\text{O}$  dissolves 0.054 g  $\text{HgI}_2$  at 22° (Rohland, Z anorg 1898, 15 412).

1 l  $\text{H}_2\text{O}$  at 25° dissolves about 0.06 g (Morse, Z phys Ch 1902, 41 731).

1 l  $\text{H}_2\text{O}$  at 18° dissolves  $4 \times 10^{-6}$  mol (Abegg, Z Elektrochem 1903, 9 553).

Solubility in  $\text{H}_2\text{O}$  at 25° = 0.00013 mol liter (Sherrill, Z phys Ch 1903, 43 735).

) dissolves 0.4 mg  $\text{HgI}_2$  at 18° h, Z phys Ch 1904, 50 356).

) at 18° dissolves 0.2 to 0.4 mg (Kohlrausch, Z phys Ch 1908, 64 168).

The yellow modification is always deposited from solution even in the presence of an excess of the red form (Gernez, C R 1903, 136 1323).

Sol in many acids, especially in  $\text{HCl}$ , and  $\text{HI} + \text{Aq}$ . Insol in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  (Berthelot). Scarcely sol in dil  $\text{HNO}_3 + \text{Aq}$ .

Not attacked by cold  $\text{H}_2\text{SO}_4$  decomp by hot (Ditte, A ch 1879, (5) 17 124).

Sat solution in  $\text{H}_2\text{SO}_4 + \text{Aq}$  contains at critical temp (158.2°), 0.7%  $\text{HgI}_2$  (Nakagishi, Z anorg 1912, 75 152).

Sol in hot  $(\text{NH}_4)_2\text{CO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , cold  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_4\text{NO}_3$ , or ammonium succinate +  $\text{Aq}$  (Wittstein).

Sol in  $\text{HgCl}_2$ ,  $\text{Hg}(\text{NO}_3)_2$  or  $\text{Hg}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . Easily sol in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . Easily sol in soluble iodides +  $\text{Aq}$ . More sol in hot than in cold  $\text{NaI}$  or  $\text{KI} + \text{Aq}$ . When conc 1 mol  $\text{KI}$  in hot solution dissolves 3 mols  $\text{HgI}_2$ , but a portion separates on cooling.  $\text{BaI}_2$ ,  $\text{SrI}_2$ ,  $\text{MgI}_2$ , and  $\text{CaI}_2$  act in the same way. Easily sol in cold, more sol in hot  $\text{ZnI}_2 + \text{Aq}$ , 2 mols  $\text{HgI}_2$  being dissolved to 1 mol  $\text{ZnI}_2$ . In  $\text{NH}_4\text{I} + \text{Aq}$ , 3 mols  $\text{HgI}_2$  are dissolved to 2 mols  $\text{NH}_4\text{I}$ . Abundantly sol in hot  $\text{KCl}$ ,  $\text{NaCl}$ ,  $\text{NH}_4\text{Cl} + \text{Aq}$ , but separates out on cooling, and the trace remaining may be pptd by  $\text{H}_2\text{O}$ , 2 g  $\text{KCl}$  in solution dissolves 1.66 g  $\text{HgI}_2$ . Sol in  $\text{HgCl}_2 + \text{Aq}$ , and very easily sol in

alcoholic solution of  $\text{HgCl}_2$  (Boullay, A ch (2) 34 346).

### Solubility in $\text{MI} + \text{Aq}$ at 25°

Salt	In 10 cc of the solution	
	Millimols $\text{HgI}_2$	Millimols salt
$\text{NaI}$	4 12	7 94
	6 22	13 85
	9 45	22 25
$\text{KI}$	1 27	3 03
	1 80	3 90
	5 10	10 34
	7 00	15 54
$\text{CaI}_2$	12 24	25 19
	0 50	0 53
	2 61	2 52
	4 40	1 68
$\text{SrI}_2$	4 58	4 84
	17 06	17 99
$\text{BaI}_2$	2 12	2 51
	3 20	3 55
	5 82	5 39
$\text{BaI}$	6 94	6 08
	0 59	0 99
	7 42	7 18
$\text{BaI}$	8 98	9 78
	14 62	15 08

(Herz and Paul, Z anorg 1913, 82 131)

### Solubility of $\text{HgI}_2 + \text{KI}$ in $\text{H}_2\text{O}$

Temp 0		
% $\text{KI}$	$\text{HgI}_2$	Solubility
50 9	19 3	$\text{KI}$
44 4	32 4	
39	48	
37 4	53 6	$\text{KI} + \text{KHgI}_2$
37 8	52 6	$\text{KHgI}_2$
35 1	52 2	
35 5	51 2	$\text{KHgI}_2 + \text{H}_2\text{O}$
26 7	50 3	$\text{KHgI}_2 + \text{HgI}_2$
26 6	49 4	$\text{HgI}_2$
23 7	40 2	
14 9	22 5	
Temp 50		
60 6		$\text{KI}$
40	53	$\text{KI} + \text{KHgI}_2$
39 6	52 7	$\text{KHgI}_2$
40	52 2	
40 2	51 2	
39 3	50 3	
33 7	49 8	
33	52	
31 4	51 7	$\text{KHgI}_2 + \text{H}_2\text{O}$
29 1	52 2	

(Dunningham, Chem Soc 1914, 105 368)

Very sol in KSCN + Aq (Philipp, Pogg 1867, **131** 93)

Sol in 109 pts cryst  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Eder and Ulm, M 1882, **3** 197)

Very sol in hot  $\text{CaCl}_2 + \text{Aq}$ , less sol in  $\text{BaCl}_2$ ,  $\text{KCl}$  and  $\text{NaCl} + \text{Aq}$  (Lea, Z anorg 1896, **12** 341)

Solubility in normal  $\text{Hg}(\text{NO}_3)_2 + \text{Aq} = 48.0 \text{ g per litre}$  (Morse, Z phys Ch 1902, **41** 731)

Extremely sol in cold conc  $\text{NH}_4\text{Br} + \text{Aq}$  (Grossmann, B 1903, **36** 1602)

Sol in alkali sulphates + Aq (Barth, Z phys Ch 1892, **9** 215)

Sol in  $\text{Ca}(\text{OCl})_2 + \text{Aq}$ , sol in  $\text{KOH} + \text{Aq}$  (Melsens, A ch (3) **26** 222)

Sol in liquid  $\text{SO}_2$  (Walden and Centnerszwa, C C **1902**, I 344)

Very easily sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, **20** 829)

Sol in  $\text{SOCl}_2$ ,  $\text{S}_2\text{Cl}_2$ ,  $\text{SO}_2\text{Cl}_2$ , warm  $\text{AsCl}_3$ ,  $\text{PBr}_3$ , warm  $\text{POCl}_3$  (Walden, Z anorg 1900, **25** 212)

Easily sol in  $\text{AsBr}_3$  (Walden, Z anorg 1902, **29** 371)

Insol in liquid  $\text{CO}_2$  (Buchner, Z phys Ch 1906, **54** 674)

More sol in alcohol than in  $\text{H}_2\text{O}$  1 l  $\text{H}_2\text{O}$  containing 10% of 90% alcohol dissolves 0.08 g  $\text{HgI}_2$  1 l of alcohol of 90° B dissolves 2.571 g  $\text{HgI}_2$ , 1 l absolute alcohol dissolves 11.86 g  $\text{HgI}_2$  (Boungoin, A ch (6) **3** 429)

Sol in 130 pts cold, and 15 pts hot 90% alcohol ( $\text{HgI}_2$ )

100 pts absolute methyl alcohol dissolve 3.16 pts at 19° 100 pts absolute ethyl alcohol dissolve 2.09 pts at 19° (de Bruyn Z phys Ch **10** 783)

0.00842 pt is sol in 1 pt alcohol at 15° (Gautier and Charpy C R 1890, **111** 647)

100 g methyl alcohol dissolve 3.7 g  $\text{HgI}_2$  at 19° ethyl alcohol 1.86 g propyl alcohol, 1.2 g isobutyl alcohol, at 22.5°, 0.51 g (Lumoforew Dissert **1894**)

At 15° 20 100 g methyl alcohol dissolve 3.24 g  $\text{HgI}_2$  ethyl alcohol 1.42 g, propyl alcohol 0.826 g (Kohland, Z anorg 1898, **15** 412)

Solubility of  $\text{HgI}_2$  in ethyl alcohol + Aq at 25°

A g alcohol in 100 g alcohol + Aq  
 $\text{HgI}_2$  millimols  $\text{HgI}_2$  in 100 cc of the solution

A	$\text{HgI}_2$	Sp gr
100	3.86	0.80325
95.82	2.36	0.80950
92.44	1.92	0.81536
86.74	1.38	0.82996
78.75	0.935	0.84651
67.63	0.45	0.87214

(Herz and Knoch, Z anorg 1905, **45** 266)

Solubility of  $\text{HgI}_2$  in methyl alcohol + Aq at 25°

P = g alcohol in 100 g alcohol + Aq  
 $\text{HgI}_2$  = millimols  $\text{HgI}_2$  in 10 cc of the solution

P	$\text{HgI}_2$	Sp gr
0	0.0013	
47.06	0.0098	0.9187
64.00	0.0347	0.8834
78.05	0.0981	0.8519
100	0.571	0.8155

(Herz and Anders, Z anorg 1907, **52** 165)

Solubility of  $\text{HgI}_2$  in ethyl alcohol + Aq at 25°

P = g alcohol in 100 g alcohol + Aq  
 $\text{HgI}_2$  = millimols  $\text{HgI}_2$  in 10 cc of the solution

P	$\text{HgI}_2$	Sp gr
70.01	0.061	0.8636
100	0.386	0.8032

(Herz and Anders, Z anorg 1907, **52** 170)

At 15°, 1 pt by weight is sol in —  
24813 pts  $\text{H}_2\text{O}$

30.8 pts methyl alcohol of sp gr at 0.7990  
70.3 " ethyl " " " " 0.8100  
121.0 " propyl " " " " 0.8160

(Rohland, Z anorg 1899, **18** 328)

Solubility of  $\text{HgI}_2$  in mixtures of methyl and ethyl alcohol at 25°

P = % methyl alcohol in the mixtures  
 $\text{HgI}_2$  = g  $\text{HgI}_2$  in 10 cc of the solution  
S 25°/1° = Sp gr of the sat solution

P	$\text{HgI}_2$	S 25°/1°
0	0.180	0.8038
4.37	0.193	0.8039
10.4	0.208	0.8046
11.02	0.232	0.8077
80.69	0.289	0.8131
84.77	0.296	0.8140
91.25	0.298	0.8146
100	0.316	0.8156

(Herz and Kuhn, Z anorg 1908, **58** 164)

## Solubility in mixtures of methyl and propyl alcohol at 25°

P = % propyl alcohol in the solvent  
 G = g HgI<sub>2</sub> in 10 ccm of the solution  
 S = Sp gr of the sat solution

P	G	S 25°/4°
0	0 316	0 8156
23 8	0 304	0 8155
91 8	0 169	0 8101
93 75	0 167	0 8110
96 6	0 153	0 8108
100	0 142	0 8116

(Herz and Kuhn, Z anorg 1908, 60 158)

## Solubility in mixtures of propyl and ethyl alcohol at 25°

P = % propyl alcohol in the solvent  
 G = g HgI<sub>2</sub> in 10 ccm of the solution  
 S = Sp gr of the sat solution

P	G	S 25°/4°
0	0 180	0 8038
8 1	0 173	0 8036(?)
17 85	0 165	0 8043
56 6	0 155	0 8075
91 2	0 152	0 8099
95 2	0 144	0 8108
100	0 142	0 8116

(Herz and Kuhn, Z anorg 1908, 60 161)

## Solubility in 100 pts amyl alcohol equals

0 66 pts at 13°  
 3 66 " " 71°  
 5 30 " " 100°  
 9 57 " " 133 5°

(Laszcynski, B 1894, 27 2287)

Sp gr at 16°/4° of HgI<sub>2</sub>+alcohol containing 1 8358% HgI = 0 80718, containing 1 7119% = 0 80597 (Schonrock, Z phys Ch 1893, 11 770)

Somewhat sol in ether Sol in 77 pts ether (Saladin) Sol in 60 pts ether (Hager)

Sol in cold ether (François, J Pharm 1897, (6) 6 445)

Very sl sol in anhydrous ether (Hampe)

0 62 pt is sol in 100 pts ether at 0°

0 97 pt is sol in 100 pts ether at 36°

(Laszcynski, B 1894, 27 2286)

Solubility in ether = 0 3% at ord temp (Marsh, Chem Soc 1910, 97 2299)

Nearly insol in ether (Dunningham, Chem Soc 1914, 105 368)

Data are given on the system HgI<sub>2</sub>+KI+ether (Dunningham)

Solubility at 23° in chloroform = 0 071%, in ether = 0 551%, in acetone = 2 005% in ethyl alcohol = 2%, in methyl alcohol = 3 975%, in benzene = 0 247% (Beckmann and Stock, Z phys Ch 1895, 17 130)

## Solubility in organic solvents at t°

Solvent	t°	100 g of the solvent dissolve g HgI <sub>2</sub>
Chloroform	61	0 163
Tetrachlormethane	75	0 094
Ethylene dichloride	85 5	1 200
Isobutyl chloride	69	0 328
Ethyl bromide	38	0 773
Methyl alcohol	66	6 512
Ethyl alcohol	78	4 325
Isopropyl alcohol	81	2 266
Isobutyl alcohol	ca 100	2 433
Methyl formate	36-38	1 166
Ethyl formate	52-55	2 150
Methyl acetate	56-59	2 500
Ether	35	0 470
Acetone	56	3 249
Acetal	ca 100	2 000
Chloral	96	
Epichlorhydrin	ca 100	6 113
Hexane	67	0 072
Benzene	80	0 825
Ethyl acetate	74-78	4 200

(Sulc, Z anorg 1900, 25 402)

## Solubility in organic solvents at 18-20°

100 g chloroform dissolve 0 040 g HgI<sub>2</sub>

100 g tetrachlormethane dissolve 0 006 g HgI<sub>2</sub>

100 g bromoform dissolve 0 486 g HgI<sub>2</sub>

100 g ethyl bromide dissolve 0 643 g HgI<sub>2</sub>

100 g ethyl iodide dissolve 2 041 g HgI<sub>2</sub>

100 g ethylene dibromide dissolve 0 748 g HgI<sub>2</sub>

(Sulc, Z anorg 1900, 25 401)

1 pt ethylene bromide dissolves 0 00553 pts HgI<sub>2</sub> at 15° (Gautier and Charpy, C R 1890, 111 647)

100 pts methylene iodide CH<sub>2</sub>I<sub>2</sub> dissolve 2 5 pts HgI<sub>2</sub> at 15°, 16 6 pts at 100°, and 58 pts at 180° (Retgers, Z anorg 3 252)

1 l sat solution in CCl<sub>4</sub> at 15° contains 0 170 g HgI<sub>2</sub> (Dawson, Chem Soc 1909, 95 874)

Sol in 340 pts glycerine (Furley, Monit Scient (3) 9 685)

100 pts acetone dissolve 2 09 pts HgI<sub>2</sub> at 25° (Krug and M'Elroy, J Anal Ch 6 84)

Sol in acetone and in methyl al (Fidmann, C C 1899, II, 1014)

## Solubility in 100 pts acetone equals

2 83 pts HgI<sub>2</sub> at — 1°  
 3 36 " " " 15°  
 4 73 " " " 40°  
 6 07 " " " 55°

(Laszcynski, B 1894, 27 2287)

100 g methyl acetate solution, sat at 18°, contain 1 10 g HgI<sub>2</sub> (Bezold, Dissert 1906)

100 g boiling methyl acetate slowly dissolve 2.3 g  $\text{HgI}_2$  (Schroeder and Steiner, J pr 1909, (2) 79 49)

Solubility in ethyl acetate at  $t^\circ$ 

Pts sol in 100 pts ethyl acetate	$t^\circ$
1 49	- 2
1 56	+17 5
1 64	21
2 53	40
3 19	55
4 31	76

(Laszczyński, B 1894, 27 2286)

100 g ethyl acetate anhydrous, or sat with  $\text{H}_2\text{O}$  at  $18^\circ$ , dissolve at  $18^\circ$ , 14.70 g  $\text{HgI}_2$ . Solubility increases somewhat with temp (Hamers, Dissert 1906)

Solubility of  $\text{HgI}_2$  in ethyl acetate + Aq at  $25^\circ$ 

P = g ethyl acetate in 100 g ethyl acetate + Aq  
 $\text{HgI}_2$  = millimols  $\text{HgI}_2$  in 10 cc of the solution

l	$\text{HgI}_2$	$\zeta$ p gr
4 39	0 0028	0 9973
96 76	0 412	0 9063
100	0 241	0 9011

(Herz and Anders, Z anorg 1907, 52 172)

1 pt is sol in 68.03 pts ethyl acetate at  $18^\circ$  (Nununn, B 1910, 43 316)

Solubility in diethyl oxalate is 12.5% at bpt and 2.5% at  $100^\circ$  (Reinders, Z phys Ch 1900, 32 507)

Solubility in  $\text{CS}_2$  at  $t^\circ$ 

t	100 pts sat solution contain pts $\text{HgI}_2$
-10	0 107
- 5	0 141
0	0 173
+ 5	0 207
10	0 239
15	0 271
20	0 320
25	0 382
30	0 445

(Arctowski, Z anorg 1894, 6 267)

Solubility in  $\text{CS}_2$ 

100 g of the sat solution contain at  
 $-86.5^\circ$   $-93^\circ$   $-116^\circ$   
 0.024 0.023 0.017 g  $\text{HgI}_2$   
 (Arctowski, Z anorg 1896, 11 274)

0.0028 pt is sol in 1 pt  $\text{CS}_2$  at  $15^\circ$  (Gautier and Charpy, C R 1890, 111 647)

1 l sat solution in  $\text{CS}_2$  at  $15^\circ$  contains 3.127 g  $\text{HgI}_2$  (Dawson, Chem Soc 1909, 95 874)

Very sol in liquid methylamine (Gibbs, J Am Chem Soc 1906, 28 1419)

Abundantly sol in methylamine (Fitzgerald, J phys Chem 1912, 16 633)

Somewhat sol in allyl mustard oil (Mathews, J phys Chem 1905 9 647)

Sol in  $\text{Sb}(\text{CH}_3)_3 + \text{Aq}$

Very sl sol in Na citrate + Aq (Spiller)

1 pt  $\text{C}_6\text{H}_6$  dissolves 0.00217 pts  $\text{HgI}_2$  at  $15^\circ$  (Gautier and Charpy, C R 1890, 111 647)

## Solubility in 100 pts benzene equals

0.22 pts at  $15^\circ$   
 0.88 " "  $60^\circ$   
 0.95 " "  $65^\circ$   
 1.24 " "  $84^\circ$

(Laszczyński, B 1894, 27 2284)

1 l  $\text{C}_6\text{H}_6$  dissolves 0.00493 mol  $\text{HgI}_2$  at  $25^\circ$  (Sherrill, Z phys Ch 1903, 43 735)

100 g boiling phenol dissolve 10 g  $\text{HgI}_2$  (François, C R 1895, 121 769)

Sl sol in phenol with 20%  $\text{H}_2\text{O}$ . Not very sol in acetic acid at  $119^\circ$ , in amyl acetate at  $133^\circ$ , in amyl bromide at  $119^\circ$ . Rather sol in diethyl oxalate at  $186^\circ$ , in ethylene bromide at  $131^\circ$ , in amyl alcohol at  $137^\circ$ , in amyl iodide at  $150^\circ$ , in  $\text{CHBr}_3$  at  $151^\circ$ , in iodo-benzol at  $190^\circ$ , in oil of turpentine at  $160^\circ$ . Very sol in benzaldehyde at  $179^\circ$ , in methylene iodide at  $182^\circ$  (Reinders, Z phys Ch 1900, 32 506)

1000 pts oil of bitter almonds dissolve 4 pts  $\text{HgI}_2$  at ord temp, 1000 pts olive oil, 4 pts, 1000 pts poppy oil, 10 pts, 1000 pts nut oil, 15 pts, 1000 pts castor oil, 20 pts, 1000 pts lard oil, 4 5 pts, 1000 pts vaseline, 2 5 pts, 1000 pts benzene, 4 pts. Sol in phenol (Mehn, Pharm J 3 327, B 19 8 R)

## Solubility in aniline

S = Temp of solidification

Mols per 100	S	Mols per 100	S	Mols per 100	S
5 9	$12^\circ$	19 9	$48.5^\circ$	33 0	$128^\circ$
8 2	$22.5$	25 8	$53.5$	35 6	140
10 3	29	29 3	105	37 5	147
14 9	$41.5$	31 7	122	39 2	156
16 6	45	32 4	(55)		

(Staronka, Anz Ak Wiss Krakau, 1910 372)



Solubility of  $\text{HgI}_2$  in aniline at  $t^\circ$ 

$t^\circ$	g $\text{HgI}_2$ per 100 g aniline	Solid phase
-6 5	23 35	$\text{HgI}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$
+0 4	28 69	"
17 8	42 85	"
21 1	47 55	"
26 9	55 47	"
30 1	62 05	"
36 2	75 80	"
42 9	96 49	"
46 8*		" + $\text{HgI}_2(\text{red})$
48 8	128 1	$\text{HgI}_2(\text{red})$
63 6	163 8	"
70 82	184 1	"
76 2	201 6	"
95 9	246 7	"
108 *		$\text{HgI}_2(\text{red}) + \text{HgI}_2(\text{yellow})$
115 7	281 8	$\text{HgI}_2(\text{yellow})$
137 2	285 2	"
181 1	279	"
199 1	863 2	"

\* Transition point

(Pearce and Fry, J phys Ch 1914, 18 667)

Very sol in boiling alcoholic solution of aniline (Vohl, Dissert 1871)

Abundantly sol in hot benzonitrile and other aromatic nitriles (Werner, Z anorg 1897, 15 7)

Sol in benzonitrile (0.98 g in 100 g at  $18^\circ$ ) 20 times more sol by addition of 5 g KI to 100 cc benzonitrile (Naumann, B 1914, 47 1375)

Sol in pyridine (Naumann, B 1904, 37 4609)

Solubility of  $\text{HgI}_2$  in pyridine

S = temp of solidification

Mols per 100	S	Mols per 100	S	Mols per 100	S
5	$10^\circ$	34 6	$107^\circ$	51 3	93 5°
9 8	42 5	38 0	103	51 6	96
15 14	66 5	43 0	97	52 7	108
19 3	83	46 7	88 5	53 2	109
26 3	102 5	48 5	89	55 4	122
29 6	107	50 6	89	57 9	135

(Staronka, Anz Ak Wiss Krakau, 1910 372)

Sp gr at  $16^\circ/4^\circ$  of  $\text{HgI}_2$  + pyridine containing 10.43%  $\text{HgI}_2 = 1.1482$ , containing 7.99% = 1.1053 (Schonrock, Z phys Ch 1893, 11 770)Solubility of  $\text{HgI}_2$  in quinoline

S = temp of solidification

Mols per 100	S	Mols per 100	S	Mols per 100	S
4 7	$100^\circ$	29 8	$151^\circ$	43 0	$165^\circ$
9 1	115 5	31 4	153	46 1	167
13 2	133 5	35 4	156	48 8	170
23 1	138	37 7	160	49 5	169 5
26 7	145	41 6	165	54 4	166 5

(Staronka, Anz Ak Wiss Krakau, 1910 372)

Mol weight determined in pyridine, methyl- and ethyl-sulphide (Werner, Z anorg 1897, 15 20)

More or less sol at high temp in petroleum (bpt  $160-230^\circ$ ), bromnaphthalene, pyridine, toluene and amyl alcohol (Reinders, Z phys Ch 1900, 32 503)

## Yellow modification

100 g of sat solution in acetone at  $25^\circ$  contain 3.0 g  $\text{HgI}_2$  (Reinders, Z phys Ch 1900, 32 514)

## Red modification

Solubility in alcohol equals

0.717-0.724 g in 100 g solution at  $0^\circ$ 1.044-1.084 g " "  $25^\circ$ 2.10-2.20 g " "  $50^\circ$ 

(Reinders, Z phys Ch 1900, 32 522)

100 g of sat solution in acetone at  $25^\circ$  contain 1.95 g  $\text{HgI}_2$  (Reinders, Z phys Ch 1900, 32 514) $\text{HgI}_2$  is moderately sol in abs alcohol at its b-pt. The solution has a decided yellow color. On cooling, yellow crystals separate out. They soon change to the red modification.

Readily sol in hot amyl alcohol. Yellow crystals separate from the solution when cooled.

Readily sol in allyl alcohol, forming a yellow solution, from which yellow crystals separate on cooling.

Sl sol in acetone, giving a yellow solution. On cooling yellow plates separate from the solution and rapidly turn red.

Sol in phenol at  $150^\circ \text{C}$ . Solution has yellow color and yellow crystals separate out on cooling.

Readily sol in boiling benzene. Saturated solution is yellow. The yellow iodide separates out on cooling, and changes rapidly to the red.

Sol in toluene giving yellow solution, from which yellow crystals separate on cooling. They rapidly change to red.

Readily sol in naphthalene at temperatures above its transition point. Solution is yellow and on cooling yellow crystals separate out.

Readily sol in hot pseudo-cumene giving a yellow solution. On cooling gives yellow crystals.

Readily sol in ethyl iodide giving very

yellow solution, from which yellow crystals separate on cooling, which change to red rapidly

Only sl sol in ethyl bromide, giving yellow solution from which yellow crystals separate on cooling, which change rather slowly to the red

Sparingly sol in isopropyl bromide

Moderately sol in isobutyl bromide, giving a pink solution from which yellow crystals separate on cooling, which change slowly to red

Sl sol in ethylidene chloride On sudden cooling at 18° the iodide crystallizes out in yellow plates, which quickly change to red

Sparingly sol in propyl chloride, giving a pink solution, from which yellow crystals separate on cooling

Readily sol in ethyl cyanide, giving a yellow solution On cooling yellow crystals separate and rapidly change to red

Moderately sol in benzene cyanide, giving a deep yellow solution On sudden cooling the solution deposits yellow crystals, which rapidly turn red

Rapidly sol in benzoic acid at high temperatures

Sparingly sol in ethyl acetate, giving yellow solution

Sol in ethyl propionate

Very sol in ethyl butyrate, giving a yellow solution On cooling the iodide crystallized from the solution

Sl sol in ethyl isobutyrate

Readily sol in methyl salicylate, giving a yellow solution

Sparingly sol in phenyl salicylate, giving yellow solution On cooling yellow crystals separate out, which gradually change to red (Kastle, Am Ch J 1999, 22 474)

**Mercuriomercuric iodide**,  $\text{Hg}_2\text{I}_2 = \text{Hg I}_2$ ,  $2\text{HIgI}_2$

Insol in  $\text{H}_2\text{O}$  or alcohol Partially sol in  $\text{KI} + \text{Aq}$ , in hot  $\text{NaCl}$ , and  $\text{NH}_4\text{Cl} + \text{Aq}$ , and in hot  $\text{HCl} + \text{Aq}$ , though very slowly (Boullay, A ch (2) 34 345)

**Mercury periodide**,  $\text{HgI}_6$

Sol in  $\text{KI} + \text{Aq}$  Decomp by cold  $\text{H}_2\text{O}$  or alcohol (Joergensen, J pt (2) 2 347)

**Mercuric hydrogen iodide** (Iodomeric acid),  $\text{HI}$ ,  $\text{IIgI}_2 = \text{HHgI}_3$

Crystallizes from  $\text{HI} + \text{Aq}$  (Boullay)

Easily decomp (Neumann, M 10 236)

$3\text{HIgI}_2$ ,  $2\text{HI} + \text{II}_2\text{O}$  (François, Dissert 1901)

**Mercuric nickel iodide**,  $\text{HgI}_2$ ,  $\text{NiI}_2 + 6\text{H}_2\text{O}$

Sol in alcohol, ether, and acetone, not decomp by  $\text{H}_2\text{O}$  (Dobroserdoff, C C 1901, II 332)

$2\text{HgI}_2$ ,  $\text{NiI}_2 + 6\text{H}_2\text{O}$  Hydrosopic, decomp by  $\text{H}_2\text{O}$ , sol in acetone and ether (Dobroserdoff, C C 1901, II 332)

**Mercuric potassium iodide**,  $\text{HgI}_2$ ,  $\text{KI} + \frac{1}{2}\text{H}_2\text{O}$

Deliquescent (v Bonsdorff) Permanent, decomp by  $\text{H}_2\text{O}$  into  $2\text{KI}$ ,  $\text{HgI}_2$ , and  $\text{HgI}_2$  (Boullay), sol in alcohol, ether, and conc  $\text{HC}_2\text{H}_3\text{O}_3$ , but decomp by other acids (Berthelot, J Pharm 14 186) Sp gr of sat solution in  $\text{H}_2\text{O} = 2.4$  to  $3.1$

$+ \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with decomp Can be cryst from alcohol Very sl sol in dry ether Very sol in wet ether (Marsh, Chem Soc 1910, 97 2297)

$\text{HgI}_2$ ,  $2\text{KI}$  Sol in  $\text{H}_2\text{O}$  (Thomsen and Bloxam, Chem Soc 41 379)

Sat solution of  $\text{KI} + \text{HgI}_2$  in  $\text{H}_2\text{O}$  at 22° contains 8.66% K, 22.49% Hg and 52.48% I, corresponding to 0.22 mol K, 0.11 mol Hg and 0.45 mol I (Dubois, C R 1905, 141 385)

Sp gr at  $16\frac{1}{4}^\circ$  of aqueous solution containing 12.2875% salt = 1.10148, containing 12.2371% = 1.1038, containing 7.9843% = 1.06491 (Schonrock, Z phys Ch 1893, 11 782)

Sol in methyl acetate (Bezold, Dissert 1906)

Sol in ethyl acetate (Alexander, Dissert 1899, Hamers, Dissert 1906)

Sol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4328)

Sol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3601)

$+ 2\text{H}_2\text{O}$  Sol in alcohol, ether and acetone, decomp by  $\text{H}_2\text{O}$  (Pawlow, C C 1901, I 363)

Solubility determinations show that  $\text{KHgI}_3$  and  $\text{KHgI}_2 + \text{H}_2\text{O}$  are the only double salts formed at 20°–30° See  $\text{HgI}_2 + \text{KI}$  under  $\text{HgI}_2$  (Dunningham, Chem Soc 1914, 105 368)

**Mercuric rubidium iodide**,  $\text{HgI}_2$ ,  $\text{RbI}$

Sol in alcohol, decomp by  $\text{H}_2\text{O}$

$\text{HgI}_2$ ,  $2\text{RbI}$  Very easily sol in  $\text{H}_2\text{O}$  (Grossmann, B 1904, 37 1258)

Very sol in acetic acid and alcohol, decomp by  $\text{H}_2\text{O}$  Stable in aq solution in the presence of an excess of  $\text{RbI}$  (Erdmann, Arch Pharm 1894, 232 30)

**Mercuric silver iodide**,  $\text{HgI}_2$ ,  $2\text{AgI}$

(Wegehus and Kilpi, Z anorg 1909, 61 416)

**Mercuric sodium iodide**,  $\text{HgI}_2$ ,  $\text{NaI}$

Deliquescent, and decomp by much  $\text{H}_2\text{O}$  (v Bonsdorff, Pogg 17 266)

Sol in alcohol, decomp by  $\text{H}_2\text{O}$

$\text{HgI}_2$ ,  $2\text{NaI}$  Deliquescent, sol in  $\text{H}_2\text{O}$  and alcohol (Boullay)

Sat solution of  $\text{NaI} + \text{HgI}_2$  in  $\text{H}_2\text{O}$  at 24.75° contains 4.59% Na, 25% Hg, and 58.25% I, corresponding to 0.20 mol Na,

0.12 mol Hg, and 0.45 mol I (Duboin, C R 1905, **141** 385)  
 +4H<sub>2</sub>O Extremely deliquescent (Duboin, C R 1906, **143** 314)

**Mercuric strontium iodide, HgI<sub>2</sub>, SrI<sub>2</sub> (?)**

Sol in H<sub>2</sub>O without decomp (Boullay)  
 +8H<sub>2</sub>O As Ca salt (Duboin, C R 1906, **142** 573)  
 2HgI<sub>2</sub>, SrI<sub>2</sub> (?) Decomp by much H<sub>2</sub>O into sol HgI<sub>2</sub>, SrI<sub>2</sub> and insol HgI<sub>2</sub> (Boullay)

**Mercuric thorium iodide, 5HgI<sub>2</sub>, ThI<sub>4</sub>+18H<sub>2</sub>O**

Very deliquescent Easily decomp by H<sub>2</sub>O (Duboin, A ch 1909, (8) **16** 282)  
 5HgI<sub>2</sub>, 2ThI<sub>4</sub>+21H<sub>2</sub>O (Duboin)  
 2HgI<sub>2</sub>, ThI<sub>4</sub>+12H<sub>2</sub>O (Duboin)

**Mercuric zinc iodide**

Deliquescent Decomp by H<sub>2</sub>O (v Bonsdorff)

**Mercuric iodide ammonia, HgI<sub>2</sub>, 2NH<sub>3</sub>**

Decomp by NH<sub>3</sub> giving NH<sub>4</sub>I and NH<sub>4</sub>I (François, C R 1900, **130** 333)  
 Stable only in the presence of excess of ammonia Gives off NH<sub>3</sub> in the air (François J Pharm 1897, (6) **5** 388, C C **1897**,

**Mercuric iodide hydrazine, HgI<sub>2</sub>, N<sub>2</sub>H<sub>4</sub>**

Decomp by H<sub>2</sub>O (Hofmann and Marburg, A 1899, **305** 215)

**Mercuric iodide rubidium bromide,**

HgI<sub>2</sub>, 2RbBr  
 Decomp by H<sub>2</sub>O  
 Sol in alcohol without decomp (Grossmann, B 1903, **36** 1603)

**Mercuric iodide silver chloride, HgI<sub>2</sub>, 2AgCl**

Insol in H<sub>2</sub>O (Lea, Sil Am J (3) **7** 34)

**Mercury iodoantimonide, Hg<sub>3</sub>Sb<sub>2</sub>2HgI<sub>2</sub>**

Sol in HNO<sub>3</sub> aqua regia and hot H<sub>2</sub>SO<sub>4</sub>, insol in HCl (Granger, C R 1901, **132** 1116)

**Mercury nitride, Hg<sub>3</sub>N<sub>2</sub>**

Gradually decomp by H<sub>2</sub>O Decomp by conc HNO<sub>3</sub>, or HCl+aq (Hirzel, J B **1852** 419)

Not attacked by cold, but decomp by hot dil H<sub>2</sub>SO<sub>4</sub>

Sol in acids+aq  
 Sol in ammoniacal solutions of ammonium salts

Insol in excess of KNH<sub>3</sub> (Franklin, Z anorg 1905, **46** 18)

Sol in ammonia solutions of ammonium salts and in aq acid solutions

Very explosive (Franklin, J Am Chem Soc 1905, **27** 835)

HgN<sub>8</sub>

See Mercurous azoimide

HgN<sub>6</sub>

See Mercuric azoimide

**Mercurous oxide, Hg<sub>2</sub>O**

Insol in H<sub>2</sub>O Insol in dil HCl or HNO<sub>3</sub>+aq Sol in warm conc HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+aq Sol in 150,000 pts H<sub>2</sub>O (Bhaduri Z anorg 1897, **13** 410)

Decomp by H<sub>2</sub>O or weak bases (Rose), (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+aq (Wittstein), KNO<sub>3</sub>+aq (Rose), KI+aq (Berthelot), or conc NH<sub>4</sub>Cl+aq (Pagenstecher) into HgO and Hg, or HgCl<sub>2</sub>, etc

SI decomp by alkali chlorides+aq with formation of HgCl<sub>2</sub>, which dissolves (Miahle)

SI sol in alkali cyanides+aq (Jahn)

Insol in KOH, and NaOH+aq

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, **20** 829)

Insol in alcohol and ether

**Mercuric oxide, HgO**

Sol in 20,000 to 30,000 pts H<sub>2</sub>O (Bineau, C R **41** 509)

Sol in 200,000 pts H<sub>2</sub>O (Wallace, Ch Gaz **1858** 345)

Ordinary coarse HgO is sol in H<sub>2</sub>O to the extent of 50 mg per l at 25°, but when finely powdered the solubility increases to 150 mg per l (Hulett, Z phys Ch 1901, **37** 406)

Red modification is —

Sol in 19,500 pts H<sub>2</sub>O at 25°, in 2,600 pts H<sub>2</sub>O at 100° (Schick, Z phys Ch 1903, **42** 172)

1 l H<sub>2</sub>O dissolves 50 mg red modification of HgO at 25° (Hulett, Z phys Ch 1901, **37** 406)

Yellow modification is —

Sol in 19,300 pts H<sub>2</sub>O at 25° in 2,400 pts at 100° (Schick, Z phys Ch 1903, **42** 172)

Sol in acids Insol in H<sub>3</sub>PO<sub>4</sub> or H<sub>2</sub>AsO<sub>4</sub>+aq (Haack, A **262** 190)

Scarcely attacked by HClO<sub>4</sub>+aq (Millon, A ch (3) **18** 352)

Solubility of HgO in H<sub>2</sub>O at 25°

Hg=g-atoms Hg in 1 l of the solution

Hg normal	H <sub>2</sub>
0.12	0.01258
0.24	0.0247
0.57	0.0629
1.11	0.1168
2.17	0.2586

(Jaeger, Z anorg 1901, **27** 26)

Solubility of  $\text{HgO}$  in  $\text{HF}$  is decreased by the addition of  $\text{KF}$ , which proves the non-existence of complex fluorides (Jaeger)

Insol in  $\text{H}_3\text{AsO}_4$ ,  $\text{H}_3\text{PO}_4$  and in primary and secondary alkali salts of these acids (Haack, in *Hot* 1891, 262 190)

Sol in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ , less in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett)

Insol in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$

Decomp by alkali chlorides  $+ \text{Aq}$  into  $\text{HgCl}_2$ , which dissolves (Miahle, *A ch* (3) 5 177)

Sol in  $\text{Fe}(\text{NO}_3)_3$ , and  $\text{Bi}(\text{NO}_3)_3 + \text{Aq}$  with pptn of oxides Sol in  $\text{KI} + \text{Aq}$  (Persoz)

Very sol in acid sulphites  $+ \text{Aq}$  (Barth, *Z phys Ch* 1892, 9 192)

Completely sol in conc  $\text{CaCl}_2$ ,  $\text{BaCl}_2$ ,  $\text{MgCl}_2$ , and  $\text{SrCl}_2 + \text{Aq}$  (André, *C R* 1887, 104 431)

Solubility in  $\text{Ag}$  salts  $+ \text{Aq}$  100 g  $\text{Ag}_2\text{SO}_4$  in aqueous solution dissolve 13 g  $\text{HgO}$  Solubility in  $\text{AgNO}_3 + \text{Aq}$  is 15 6 100, in  $\text{Ag}$  acetate  $+ \text{Aq}$  is 1 137 100 (Finci, *Gazz ch* it 1911, 41 (2) 545)

Much less sol in  $\text{KCl}$  and  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Schoch)

Sol in  $\text{U}(\text{NO}_3)_3$ ,  $\text{Al}(\text{NO}_3)_3$  and  $\text{Fe}(\text{NO}_3)_3 + \text{Aq}$  (Mailhe, *A ch* 1902, (7) 27 373)

Very sl sol in cold  $\text{Hg}(\text{CN})_2 + \text{Aq}$ , abundantly sol at  $75^\circ$  with evolution of  $\text{HCN}$  (Barthe, *J Pharm* 1896, (6) 3 183)

Sol in cold or hot alcoholic  $\text{NH}_4\text{SCN}$  in large amounts (Fleischer, *A* 1875, 179 225)

Completely sol in  $\text{KI} + \text{Aq}$  (Jehn, *Arch Pharm* 1873, 201 97)

Solubility of red or yellow modification in  $\text{N}/50 \text{ KCl} + \text{Aq}$  is about 25% greater than in pure  $\text{H}_2\text{O}$  (Schick, *Z phys Ch* 1903, 42 168)

Insol in liquid  $\text{HF}$  (Franklin, *Z anorg* 1905, 46 2)

Insol in liquid  $\text{NH}_3$  (Gore, *Am Ch J* 1898, 20 829)

Insol in liquid  $\text{NH}_3$  (Franklin, *Am Ch J* 1898, 20 829)

Sol in alcoholic solution of hydroxylamine hydrobromide below  $0^\circ$  (Adams, *Am Ch J* 1902, 28 216)

Insol in alcohol

Sol in trichloroacetic acid  $+ \text{Aq}$  (Brand, *J pr* 1913, (2) 88 342)

Insol in acetone and in methylal (Eidmann, *C C* 1899, II 1014)

Insol in acetone (Naumann, *B* 1904, 37 4329)

When freshly pptd, is insol in acetone  $+ \text{Aq}$  even on warming, but easily sol if liquid is made alkaline by  $\text{NaOH}$  Insol in acetophenone even after long warming at  $100^\circ$  Sol in acetaldehyde and much  $\text{H}_2\text{O}$  and a little  $\text{NaOH}$  (Auld and Hantzsch, *B* 1905, 38 2680)

Sol in formamide (Fischer, *Arch Pharm* 1894, 232 329)

Very sol in ethylene diamine For 1 mol

$\text{HgO}$ , 7-10 mols ethylene diamine are necessary (Traube and Lowe, *B* 1914, 47 1910)

Easily sol in benzamide (Dessaignes, *A ch* 1852, (3) 34 146)

When freshly pptd, is sol in picric acid  $+ \text{Aq}$  (Varet, *C R* 1894, 119 560)

Sol in alkaline solution of phenol disulphonic acid (Lumiére and Chevroter, *C R* 1901, 132 145)

Sol in nucleic acid  $+ \text{Aq}$  when freshly pptd (Schweckerath, *Pat* 1899)

Sol in gum arabic  $+ \text{Aq}$  (Peschier, *J Pharm* 1896, (6) 3 509)

### Mercuric oxybromide, $\text{HgBr}_2$ , $\text{HgO}$

(André, *A ch* (6) 3 123)

$\text{HgBr}_2$ ,  $2\text{HgO}$  (André)

$\text{HgBr}_2$ ,  $3\text{HgO}$  (a) Yellow Insol in cold, sl sol in hot  $\text{H}_2\text{O}$  Easily sol in alcohol (Lowig)

(b) Brown Insol in alcohol (Rammelsberg, *Pogg* 55 248)

$\text{HgBr}_2$ ,  $4\text{HgO}$  (André)

Insol in ord solvents Decomp by alkalis and acids (Fischer and von Wartenburg, *Ch Z* 1902, 26 894)

$2\text{HgBr}_2$ ,  $7\text{HgO}$  Readily decomp by acids and alkalis (Fischer and von Wartenburg)

### Mercurous oxychloride, $\text{Hg}_2\text{O}$ , $2\text{HgCl}$

Min *Eglestonite*

Decomp by hot  $\text{HCl}$  and by  $\text{HNO}_3$  (Moses, *Am J Sci*, 1903, (4) 16 253)

### Mercuric oxychloride,

$\text{HgO}$ ,  $\text{HgCl}_2$  Less sol than  $\text{HgCl}_2$ , but not isolated (Thummel) Decomp by cold  $\text{H}_2\text{O}$  (André, *A ch* (6) 3 118)

$\text{HgO}$ ,  $2\text{HgCl}_2$  Decomp by warm  $\text{H}_2\text{O}$  or cold alcohol into  $2\text{HgO}$ ,  $\text{HgCl}_2$  (Thummel, *Arch Pharm* (3) 27 589)

Decomp by  $\text{H}_2\text{O}$  Not decomp by alcohol (Arotowski, *Z anorg* 1895, 9 178)

$2\text{HgO}$ ,  $\text{HgCl}_2$  Two modifications

A Red Insol in  $\text{H}_2\text{O}$ , decomp by alkali carbonates, or chlorides  $+ \text{Aq}$  into  $4\text{HgO}$ ,  $\text{HgCl}_2$

Acted upon by cold alkali carbonates and alkali chlorides  $+ \text{Aq}$  (Schoch, *Am Ch J* 1903, 29 335)

Not decomp by  $\text{H}_2\text{O}$  at ord temp (Thummel)

Very sl sol in cold, completely sol in hot  $\text{H}_2\text{O}$  (Haack, *A* 1891, 262 189)

A small amt of  $\text{HNO}_3$  converts it into a white powder, more  $\text{HNO}_3$  dissolves it (Haack, *A* 1891, 262 189)

B Black Not decomp by alkali chlorides, or carbonates  $+ \text{Aq}$  (Thummel)

Not affected by boiling alkali carbonates or alkali chlorides  $+ \text{Aq}$  (Schoch, *Am Ch J* 1901, 29 335)

Insol in cold and hot  $\text{H}_2\text{O}$  and alcohol

Sol in acid (Van Nest, *Dissert* 1909)

Not changed by  $\text{H}_2\text{O}$  (Blaas, *Miner Mitt* (2) 2 177)

Sol in  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$  (Blaas)  
 Not changed by alcohol (Blaas)  
 $+\frac{1}{2}\text{H}_2\text{O}$  (Ray, A 1901, 316 255)  
 $3\text{HgO}$ ,  $\text{HgCl}_2$  Decomp by warm  $\text{H}_2\text{O}$   
 (Thummel)

Not attacked by cold  $\text{H}_2\text{O}$  (André)  
 Ppt (Tarugi, Gazz ch it 1901, 31 313)  
 Decomp by  $\text{H}_2\text{O}$  Not decomp by al-  
 coh (Arctowski, Z anorg 1895, 9 178)

#### Three modifications

a Prisms Decomp by boiling  $\text{H}_2\text{O}$

b Brick-red, amorphous

c Yellow plates

(Schoch, Am Ch J 1903, 29 337)

#### Yellow plates

Decomp by hot  $\text{H}_2\text{O}$ ,  $\text{Na}_2\text{CO}_3$  or  $\text{NaOH} +$   
 $\text{Aq}$  Sol in  $\text{KHCO}_3 + \text{Aq}$  Insol in cold dil  
 $\text{HNO}_3$  (Tarugi)

$4\text{HgO}$ ,  $\text{HgCl}_2$  Decomp by  $\text{H}_2\text{O}$  Not  
 decomp by alcohol (Arctowski, Z anorg  
 1895, 9 178)

#### Two modifications

A Yellow plates

Easily sol in acids Insol in alcohol and  
 ether Decomp by  $\text{KOH}$  (Dukelski, Z  
 anorg 1906, 49 336)

B Brown, amorphous

Easily sol in acids Decomp by  $\text{KOH}$   
 Insol in alcohol and ether (Dukelski,  
 Z anorg 1906, 49 336)

$5\text{HgO}$ ,  $\text{HgCl}_2$  (Millon)

1st (Thummel)

2 Does not exist (T)

3 Insol in cold  $\text{H}_2\text{O}$  (Roucher, A  
 353)

Does not exist (T)

$7\text{HgO}$ ,  $4\text{HgCl}_2$  (Roucher)

Does not exist (T)

### Mercuromercuric oxychloride, $\text{Hg}_2\text{OCl}$

Min *Terlinguante*

Decomp by  $\text{HCl}$  and  $\text{HNO}_3$

Slowly decomp by cold acetic acid when  
 powdered (Hillebrand and Schaller, J  
 Am Chem Soc 1907, 29 1190)

### Mercuric strontium oxychloride, $\text{HgO}$ , $\text{SrCl}_2$ $+ \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (André, C R 104 431)

### Mercuric oxyfluoride, $\text{HgO}$ , $\text{HgF}_2 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  Sol in dil  $\text{HNO}_3 + \text{Aq}$   
 (Finkener)

### Mercuric oxyiodide, $3\text{HgO}$ , $\text{HgI}_2$

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{HI} + \text{Aq}$  (Weyl,  
 Pogg 131 524)

### Mercuric oxyphosphide, $\text{Hg}_3\text{P}_2\text{O}_4$

Decomp by  $\text{H}_2\text{O}$  (Parthell and van  
 Haaren, Arch Pharm 1900, 238 35)

### Mercuric oxyselenide, $2\text{HgSe}$ , $\text{HgO}$

Easily sol in aqua regia (Uelsmann, A  
 116 122)

### Mercury phosphide, $\text{Hg}_3\text{P}_2$

Insol in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$  Easily  
 sol in aqua regia (Granger, C R 115 229)  
 $\text{Hg}_3\text{P}_4$  (Granger, C N 1898, 77 229)

### Mercury phosphochloride, $\text{P}_2\text{Hg}_3$ , $3\text{HgCl}$ , $+ \text{H}_2\text{O}$

See *Dimercuriphosphonium mercuric chloride*

### Mercury phosphosulphide, $2\text{HgS}$ , $\text{P}_2\text{S}$

$\text{HgS}$ ,  $\text{P}_2\text{S}$

$2\text{HgS}$ ,  $\text{P}_2\text{S}_3$  (Berzelius)

$3\text{HgS}$ ,  $\text{P}_2\text{S}_3$  (Baudrimont, C R 55 323)

$2\text{HgS}$ ,  $\text{P}_2\text{S}_5$  (Berzelius, A 47 256)

### Mercuric selenide, $\text{HgSe}$

Sol in cold aqua regia when crystalline  
 When precipitated shows the same properties  
 towards solvents as mercuric sulphide (Reeb  
 J Pharm (4) 9 173)

Min *Tilmannite* Sol only in aqua regia

### Mercuric selenochloride, $2\text{HgSe}$ , $\text{HgCl}_2$

Insol in boiling  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 +$   
 $\text{Aq}$  Easily sol in aqua regia and a mixture  
 of  $\text{H}_2\text{SO}_4$  and conc  $\text{HNO}_3 + \text{Aq}$  (Uelsmann,  
 J B 1860 92)

### Mercurous sulphide, $\text{Hg}_2\text{S}$

Insol in  $\text{H}_2\text{O}$ , dil  $\text{HNO}_3$ , hot  $\text{NH}_4\text{OH}$ , or  
 $(\text{NH}_4)_2\text{S} + \text{Aq}$  Sol in  $\text{KOH} + \text{Aq}$  with separa-  
 tion of  $\text{Hg}$  (Rose)

Does not exist, only mixtures of  $\text{Hg}$  and  
 $\text{HgS}$  are formed (Barfoed, J pr 93 230)

See also Baskerville, J Am Chem Soc  
 1903, 25 799)

Not attacked by  $\text{HNO}_3$  below  $0^\circ$ , but at-  
 tacked by dil  $\text{HNO}_3$  and  $\text{HCl} + \text{Aq}$  when  
 temp is increased Sol in  $\text{Na}_2\text{S}$  or  $\text{K}_2\text{S}$  but  
 $\text{Hg}$  soon ppts (Antony and Sestini, Gazz  
 ch it 1894, 24, (1) 194)

### Mercuric sulphide, $\text{HgS}$

Insol in  $\text{H}_2\text{O}$

Pptd as a brown coloration in presence of  
 20,000 pts  $\text{H}_2\text{O}$ , and as a green coloration in  
 presence of 40,000 pts  $\text{H}_2\text{O}$  (I asugne)

Much less sol in  $\text{H}_2\text{O}$  than  $\text{Ag}_2\text{S}$  or  $\text{CuS}$   
 (Bodlander, Z phys Ch 1898, 27 64)

1 l  $\text{H}_2\text{O}$  dissolves  $0.05 \times 10^{-6}$  mols  $\text{HgS}$  at  
 $18^\circ$  (Weigel, Z phys Ch 1907 58 294)

Sol in cold conc., and in hot dil  $\text{HCl} + \text{Aq}$  or  
 $\text{HBr} + \text{Aq}$  (Kekule, A Suppl 2 101) Very  
 sl decomp by hot conc  $\text{HCl} + \text{Aq}$  Not at-  
 tacked by hot  $\text{HNO}_3 + \text{Aq}$  Sol in cold aqua  
 regia

Not attacked by 4-N  $\text{HNO}_3$  or 4-N  $\text{HNO}_3$   
 $+ 4\text{-N H}_2\text{SO}_4$  at ord temp even after many  
 days By action of a mixture of equal volumes  
 of 4-N  $\text{HNO}_3$  and conc  $\text{H}_2\text{SO}_4$ , there was  
 slight action on pptd  $\text{HgS}$  after 14, more  
 action after 62 days If  $\text{HgS}$  is boiled with  
 the 4-N acids, oxidation takes place most  
 rapidly with 4-N  $\text{HNO}_3$ , then the mixture  
 $66.7\%$  4-N  $\text{H}_2\text{SO}_4 + 33.3\%$  4-N  $\text{HNO}_3$ , then

33 3% 4-N  $\text{H}_2\text{SO}_4$  + 66 7% 4-N  $\text{HNO}_3$ , and lastly 4-N  $\text{H}_2\text{SO}_4$  alone (Moore, J Am Chem Soc 1911, **33** 1094)

Cold conc  $\text{H}_2\text{SO}_4$  does not attack red or black  $\text{HgS}$ , but they are attacked by hot acid (Berthelot, A ch 1898, (7) **14** 198)

Freshly pptd  $\text{HgS}$  is insol in dil  $\text{KCN}$  +  $\text{Aq}$  (Berthelot)

Sol in  $\text{K}_2\text{S}$  +  $\text{Aq}$ , but readily only in presence of free alkali (Brunner, Pogg **15** 596)

Insol in boiling  $\text{KOH}$  +  $\text{Aq}$

Sol in  $\text{KSH}$  or  $\text{NaSH}$  +  $\text{Aq}$  Very sl sol in cold yellow  $(\text{NH}_4)_2\text{S}$  +  $\text{Aq}$  Insol in  $\text{KCN}$  or  $\text{Na}_2\text{S}_2\text{O}_3$  +  $\text{Aq}$  (Fresenius)

Easily sol in conc  $\text{Na}_2\text{S}$  or  $\text{K}_2\text{S}$  +  $\text{Aq}$ , even in absence of  $\text{KOH}$  or  $\text{NaOH}$  Insol in  $(\text{NH}_4)_2\text{S}$  +  $\text{Aq}$  Sol in  $\text{CaS}$ ,  $\text{BaS}$ , or  $\text{SrS}$  +  $\text{Aq}$  Insol in  $\text{NaSH}$  or  $\text{KSH}$  +  $\text{Aq}$  (de Koninck, Z angew Ch **1891** 51)

Solubility in  $\text{NaSH}$  is very small in comparison with that in  $\text{Na}_2\text{S}$  +  $\text{Aq}$  (Knox, Trans Faraday Soc 1908, **4** 30)

Solubility in  $\text{BaS}$  is practically equal to that in  $\text{Na}_2\text{S}$  (Knox)

All cryst modifications are sol in conc  $\text{K}_2\text{S}$  and in conc  $\text{Na}_2\text{S}$  +  $\text{Aq}$  (Allen and Crenshaw, Am J Sci 1912, (4) **34** 368)

Sol in potassium thiocarbonate +  $\text{Aq}$  (Rosenblatt, Z anal **26** 15)

Sol in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, and -stannates (Storch, B **16** 2015)

1 l  $\text{BaS}_2\text{H}_2$  +  $\text{Aq}$  containing 50 g  $\text{Ba}$  dissolves no  $\text{HgS}$  in the cold, but 50-60 g at 40-50°

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J **1898**, **20** 829)

Insol in acetone (Eidmann, C C **1899**, **II** 1014)

Insol in pyridine (Schroeder, Dissert **1901**)

Insol in ethyl acetate (Naumann, B **1910**, **43** 314)

Exists in a colloidal state, sol in  $\text{H}_2\text{O}$  (Winnsinger, Bull Soc (2) **49** 452)

Min *Cinnabar* Insol in  $\text{H}_2\text{O}$ , alcohol, dil acids or alkaline solutions

Decomp by hot dil  $\text{HNO}_3$  +  $\text{Aq}$  Not decomp by  $\text{HCl}$  +  $\text{Aq}$ , but easily by hot  $\text{H}_2\text{SO}_4$  or aqua regia Easily sol in  $\text{CuCl}_2$  +  $\text{Aq}$  (Kersten)

Sol in a mixture of  $\text{Na}_2\text{S}$  and  $\text{NaOH}$  when present in the proportion of  $\text{HgS}$   $2\text{Na}_2\text{S}$

Sol in pure  $\text{Na}_2\text{S}$  +  $\text{Aq}$  or in mixtures of  $\text{Na}_2\text{S}$  and  $\text{NaSH}$  +  $\text{Aq}$  Insol in cold  $\text{NaSH}$  +  $\text{Aq}$ , but sol on warming with evolution of  $\text{H}_2\text{S}$  (Becker, Sill Am J (3) **33** 199)

Insol in acetone (Krug and M'Elroy)

Cinnabar is easily sol in 20%  $\text{HBr}$  +  $\text{Aq}$  (Rising and Lenher, J Am Chem Soc **1896**, **18** 96)

Sol in  $\text{S}_2\text{Cl}_2$  (Smith, J Am Chem Soc **1898**, **20** 291)

### Mercuric platinum sulphide

See Sulphoplatinate, mercuric

### Mercuric potassium sulphide, $\text{K}_2\text{S}$ , $2\text{HgS}$

Decomp into its constituents by  $\text{H}_2\text{O}$ , decomp by  $\text{HCl}$ , and  $\text{HNO}_3$  +  $\text{Aq}$ , and by hot  $\text{KOH}$ , and  $\text{NH}_4\text{OH}$  +  $\text{Aq}$  (Schneider, Pogg **127** 488)

$\text{K}_2\text{S}$ ,  $\text{HgS}$  +  $5\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  or alkalies (Weber, Pogg **97** 76)

+  $\text{H}_2\text{O}$  (Ditte)

+  $7\text{H}_2\text{O}$  Sol in  $\text{K}_2\text{S}$  +  $\text{Aq}$  (Ditte, C R **98** 1271)

$\text{K}_2\text{S}$ ,  $5\text{HgS}$  +  $5\text{H}_2\text{O}$  Easily decomp by  $\text{H}_2\text{O}$  (Ditte)

### Mercuric sodium sulphide, $\text{HgS}$ , $\text{Na}_2\text{S}$ + $8\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  or alkalies

$5\text{HgS}$ ,  $2\text{Na}_2\text{S}$  +  $3\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Knox, Trans Faraday Soc 1908, **4** 36)

### Mercuric sulphobromide, $2\text{HgS}$ , $\text{HgBr}_2$

Insol in  $\text{H}_2\text{O}$  Not attacked by boiling  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$  (Rose)

### Mercuric sulphochloride, $2\text{HgS}$ , $\text{HgCl}_2$

Insol in  $\text{H}_2\text{O}$ , cold or hot, dil or conc  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HCl}$  +  $\text{Aq}$  (Rose, Pogg **13** 59)

Decomp by hot aqua regia

By boiling with dil  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HCl}$ ,  $\text{Hg}$  and  $\text{Cl}$  go into solution (Hamers, Dissert **1906**)

Insol in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$  Partly sol in  $\text{HCl}$  and  $\text{HNO}_3$ , easily sol in aqua regia (Alexander, Dissert **1899**)

Sol in aqua regia (Deniges, Bull Soc **1915**, (4) **17** 356)

$3\text{HgS}$ ,  $\text{HgCl}_2$  Properties as the above comp (Poleck and Goerck, B **21** 2415)

$4\text{HgS}$ ,  $\text{HgCl}_2$  As above (P and G)

$5\text{HgS}$ ,  $\text{HgCl}_2$  As above (P and G)

Insol in alkali sulphides and in fuming  $\text{HNO}_3$ , decomp by  $\text{NaOBr}$  +  $\text{Aq}$  and by  $\text{KOH}$  (Bodroux, C R **1900**, **130** 1399)

Sl sol in solutions of alkali sulphides unless heated (Berzelius)

Easily sol in alkali sulphides +  $\text{Aq}$ , slowly sol in alkalies or alkali hydrosulphides +  $\text{Aq}$  (Atterberg, J B **1873** 258)

### Mercurous sulphotetrachloride, $\text{Hg}_2\text{SCl}_4$

Decomp by  $\text{H}_2\text{O}$  with separation of  $\text{S}$ ,  $\text{HgCl}_2$  going into solution (Capitane, J Pharm **25** 525)

### Mercuric sulphofluoride, $2\text{HgS}$ , $\text{HgF}_2$

Decomp by boiling  $\text{H}_2\text{O}$  Not decomp by hot  $\text{HCl}$  or  $\text{HNO}_3$  +  $\text{Aq}$ , but gives  $\text{HF}$  with hot  $\text{H}_2\text{SO}_4$  +  $\text{Aq}$  (Rose, Pogg **13** 66)

### Mercury sulphonamide, $\text{HgN}_2\text{S}$ , $\text{NH}_3$

Ppt (Ruff, B **1904**, **37** 1585)

### Mercuric sulphiodide, $\text{HgS}$ , $\text{HgI}_2$

Ppt (Rammelsberg, Pogg **48** 175)

$2\text{HgS}$ ,  $\text{HgI}_2$  (Palm, C C **1863** 121)

Insol in min acids with exception of aqua regia (Hamers, Dissert 1906)

**Mercuric sulphoiodide ammonia**,  $2\text{HgS}$ ,  $\text{HgI}_2$ ,  $\text{NH}_3$   
(Foerster, Ch Z 1895, 19 1895)

**Mercuric telluride**,  $\text{HgTe}$

Min *Coloradoute* Sol in boiling  $\text{HNO}_3$ +Aq with separation of  $\text{H}_2\text{TeO}_3$

**Metastannic acid**

See Stannic acid.

**Molybdatoiodic acid**

See Molybdoiodic acid

**Molybdenum**, Mo

Not attacked by  $\text{HCl}$ ,  $\text{HF}$ , or dil  $\text{H}_2\text{SO}_4$ +Aq Sol in conc  $\text{H}_2\text{SO}_4$  Very easily sol in aqua regia Oxidised by  $\text{HNO}_3$ +Aq either to molybdenum oxide, which dissolves in  $\text{HNO}_3$ , or, if  $\text{HNO}_3$  is in excess, to molybdic acid, which remains undissolved

Attacked by  $\text{HNO}_3$ +Aq containing 3-70%  $\text{HNO}_3$ , but only slowly by 70% acid, with formation of insol white powder, much more vigorously by 50% acid, in which case a clear solution is formed (Montemartini, Gazz ch 22 384)

Not attacked by alkalis+Aq (Bucholz, Scher J 9 485)

With a sp gr 9.01, the metal is malleable and sol in a mixture of  $\text{HF}$  and  $\text{HNO}_3$ , sol in fused  $\text{KClO}_3$  (Moissan, Bull Soc 1895, (3) 13 966)

Ductile Mo is moderately quickly attacked by  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$  (Fink, Met Chem Eng 1910, 8 341)

Not immediately attacked by cold dil  $\text{HNO}_3$  Not attacked by dil and conc  $\text{H}_2\text{SO}_4$  Boiling dil  $\text{HCl}$ +Aq does not attack, conc dissolves traces by long heating Sol in aqua regia (Lederer, Dissert 1911)

Dil  $\text{HCl}$  dissolves 20.3% Mo at  $110^\circ$  in 18 hrs More slowly sol in  $\text{HCl}$  (sp gr 1.15)

Insol in dil  $\text{H}_2\text{SO}_4$  at  $110^\circ$  Slowly sol in conc  $\text{H}_2\text{SO}_4$  (sp gr 1.82) at  $110^\circ$ , rapidly sol at  $200^\circ$ - $250^\circ$

Slowly sol in conc  $\text{HNO}_3$  (sp gr 1.40), rapidly sol in dil  $\text{HNO}_3$  (sp gr 1.15)

Rapidly sol in hot aqua regia Insol in hot or cold  $\text{HF}$  (Ruder, J Am Chem Soc 1912, 34 388)

Insol in  $\text{KOH}$ +Aq Sol in fused  $\text{KOH}$  (Ruder, J Am Chem Soc 1912, 34 389)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

**Molybdenum acichloride**

See Molybdenyl chloride

**Molybdenum amide**,  $\text{OH MoO}_2 \text{NH}_2$

Very unstable Insol in abs alcohol (Fleck, Z anorg 1894, 7 353)

**Molybdenum amide nitride**,  $\text{Mo}_5\text{N}_{19}\text{H}_4 = 4\text{MoN}_2, \text{Mo}(\text{NH}_2)_2$

Not attacked by  $\text{HCl}$ , or dil  $\text{HNO}_3$ +Aq (Uhrlaub)

**Molybdenum amidochloride**,  $\text{Mo}_2(\text{NH}_2)_3\text{Cl}_3$

Insol in  $\text{H}_2\text{O}$  and dil acids (Rosenheim, Z anorg 1905, 46 317)

**Molybdenum amidochloride ammonia**,  $\text{Mo}_2(\text{NH}_2)_3\text{Cl}_3, 10\text{NH}_3$

Unstable in the air (Rosenheim, Z anorg 1905, 46 319)

**Molybdenum boride**,  $\text{Mo}_3\text{B}_4$

Moderately attacked by hot conc acids and vigorously by hot aqua regia (Tucker and Moody, Chem Soc 1902, 81 17)

**Molybdenum dibromide**,  $\text{MoBr}_2 = \text{Mo}_3\text{Br}_4\text{Br}$

See Bromomolybdenum bromide

**Molybdenum tribromide**,  $\text{MoBr}_3$

Not decomp by  $\text{H}_2\text{O}$  Boiling conc  $\text{HCl}$ , and cold dil  $\text{HNO}_3$ +Aq do not attack appreciably Dil alkalis act slowly, but decomp with separation of  $\text{Mo}_2\text{O}_3$  on boiling (Blomstrand, J pr 82 435)

**Molybdenum tetrabromide**,  $\text{MoBr}_4$

Rapidly deliquescent, and easily sol in  $\text{H}_2\text{O}$  (Blomstrand, J pr 82 433)

**Molybdenum bromochloride**, etc

See Bromomolybdenum chloride, etc

**Molybdenum bronze**

See Molybdate molybdenum oxide, sodium

**Molybdenum carbide**,  $\text{Mo}_2\text{C}$

Insol in  $\text{HNO}_3$  (Moissan, Bull Soc 1895, (3) 13 967)

$\text{Mo}_2\text{C}$  Does not decomp  $\text{H}_2\text{O}$  even at  $500$ - $600^\circ$  Slowly attacked by hot  $\text{HCl}$ ,  $\text{HF}$  and hot conc  $\text{H}_2\text{SO}_4$  Easily decomp by  $\text{HNO}_3$  Not attacked by  $\text{NaOH}$ +Aq or  $\text{KOH}$ +Aq (Moissan and Hoffmann, C R 1904, 138 1559)

**Molybdenum carbonyl**,  $\text{Mo}(\text{CO})_6$

Quickly attacked by bromine Sol in ether or benzene (Mond, Hirtz and Cowap, Chem Soc 1910, 97 808)

**Molybdenum dichloride**,  $\text{MoCl}_2 = \text{Mo}_3\text{Cl}_4\text{Cl}_2$

See Chloromolybdenum chloride

**Molybdenum trichloride,  $\text{MoCl}_3$** 

Insol in  $\text{H}_2\text{O}$  or boiling conc  $\text{HCl} + \text{Aq}$   
Easily sol, especially when heated, in  $\text{HNO}_3 + \text{Aq}$  Sol in  $\text{H}_2\text{SO}_4$  Decomp by  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$

Sl sol in alcohol (Leicht and Kempe)  
Practically insol in alcohol and ether (Hampe, Ch Z 1888, 12 5)

**Molybdenum tetrachloride,  $\text{MoCl}_4$** 

Deliquescent Hisses with little  $\text{H}_2\text{O}$ , but only partly sol in more  $\text{H}_2\text{O}$  Only sl sol in conc  $\text{HCl} + \text{Aq}$  Sol in  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$  Partly sol in alcohol and ether (Liechti and Kempe)

**Molybdenum pentachloride,  $\text{MoCl}_5$** 

Very deliquescent Sol in  $\text{H}_2\text{O}$  with extreme evolution of heat Sol in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$

When freshly prepared, is incompletely sol in  $\text{H}_2\text{O}$ , but after standing is easily sol with hissing (Kalischer, Dissert 1902)

Sol in a small amt of conc  $\text{HCl}$  (Hampe, Ch Z 1888, 12 5)

Sol in absolute alcohol or ether (Liechti and Kempe)

Sol in  $\text{CHCl}_3$  and in  $\text{CCl}_4$  Sol with hissing in many organic solvents (ethers, alcohols, ketones, aldehydes, acids, acid esters, acid anhydrides, amines) Sol in cinnamic aldehyde (Kalischer, Dissert 1902)

**Molybdenum hydroxyl chloride,  $\text{Mo}(\text{OH})_2\text{Cl}_2$** 

Easily sol in  $\text{H}_2\text{O}$  (Debray, C R 46 1101)

**Molybdenum tetrachloride phosphorus pentachloride,  $\text{MoCl}_4, \text{PCl}_5$** 

Sol in  $\text{H}_2\text{O}$   
 $\text{MoCl}_4, 2\text{PCl}_5$  Sol in  $\text{H}_2\text{O}$  (Cronander, Bull Soc (2) 19 500)

**Molybdenum phosphorus pentachloride,  $\text{MoCl}_5, \text{PCl}_5$** 

Easily decomp (Smith and Sargent, Z anorg 1894, 6 385)

**Molybdenum phosphoryl chloride,  $\text{MoCl}_5, \text{POCl}_3$** 

Decomp by  $\text{H}_2\text{O}$ , insol in  $\text{CS}_2$ , sol in  $\text{C}_6\text{H}_6$  and  $\text{CHCl}_3$

**Molybdenum trichloride potassium chloride**

Efflorescent Decomp with  $\text{H}_2\text{O}$  (Berzelius)

$\text{MoCl}_3, 3\text{KCl}$  Very sol in  $\text{H}_2\text{O}$  Nearly insol in alcohol and ether (Chilesotti, C C 1903, II 652)

$+2\text{H}_2\text{O}$  Fairly easily sol in cold  $\text{H}_2\text{O}$  without any apparent decomp Decomp in aqueous solution, slowly in the cold but rapidly on boiling This decomp is prevented by the presence of  $\text{HCl}$

Sl sol in conc  $\text{HCl}$  (Henderson, Proc Chem Soc 1903, 19 245)

**Molybdenum rubidium chloride,  $\text{Rb}_2\text{MoCl}_6 + \text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  Nearly insol in alcohol and ether (Chilesotti, C C 1903, II 652)

**Molybdenum pentachloride nitrogen sulphide,  $\text{MoCl}_5, \text{N}_4\text{S}_4$** 

Decomp in moist air (Davis, Chem Soc 1906, 89, (2) 1575)

**Molybdenum hexafluoride,  $\text{MoF}_6$** 

Decomp by a little  $\text{H}_2\text{O}$  with separation of blue oxide Sol in large amount of  $\text{H}_2\text{O}$  forming a colorless solution

Absorbed by alkalis and  $\text{NH}_4\text{OH} + \text{Aq}$  (Ruff, B 1907, 40 2930)

**Molybdenum fluoride with MF**

See Fluomolybdate, M

**Molybdenum potassium trifluoride (?)**

Precipitate Sol in  $\text{HCl} + \text{Aq}$

**Molybdenum potassium tetrafluoride (?)**

Sl sol in  $\text{H}_2\text{O}$  (Berzelius)

**Molybdenum sesquihydroxide,  $\text{Mo}_2\text{O}_5\text{H}_6$** 

Difficultly sol in acids Insol in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ , or  $\text{K}_2\text{CO}_3 + \text{Aq}$  Somewhat sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , but pptd on boiling (Berzelius)

**Molybdenum hydroxide,  $\text{Mo}_2\text{O}_5, 5\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  Insol in  $\text{CaCl}_2$ ,  $\text{NH}_4\text{Cl}$ , or  $\text{NaCl} + \text{Aq}$  Sl sol in alcohol (Berzelius)

**Molybdenum dihydroxide,  $\text{MoO}_2, x\text{H}_2\text{O}$** 

Slowly and not abundantly sol in  $\text{H}_2\text{O}$ , from which it is precipitated by  $\text{NH}_4\text{Cl}$  and other salts Gelatinises by standing in closed vessels or by evaporating on the air Sol in the ordinary acids Insol in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  Sol in alkali carbonates  $+ \text{Aq}$

**Molybdenum dioxide,  $\text{MoO}_2$** 

Insol in  $\text{H}_2\text{O}$  and alcohol Sl attacked by cold  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$  (Guichard, A ch 1901, (7) 23 567)

Sl decomp  $\text{H}_2\text{O}$  at ordinary temp Slowly sol in  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  (Guichard, C R 1896, 123 822)

**Molybdenum tetraoxide (?)**

Completely sol in water (Berzelius)

**Molybdenum nitride,  $\text{Mo}_5\text{N}_3$ , and  $\text{Mo}_5\text{N}_4$** 

(Uhrlaub)

See Molybdenum amide

$\text{Mo}_5\text{N}_2$  (Rosenheim, Z anorg 1905, 46 317)



**Molybdenum monoxide, MoO**

Known only as hydroxide (Blomstrand, J pr 77 90)

**Molybdenum sesquioxide, Mo<sub>2</sub>O<sub>3</sub>**

Insol in acids or alkalies

See **Molybdenum sesquihydroxide**

**Molybdenum dioxide, MoO<sub>2</sub>**

Insol in HCl or HF + Aq Sl sol in conc H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub> oxidises to MoO<sub>3</sub>. Not attacked by KOH + Aq (Ulhk, A 144 227)  
Sl sol in KHC<sub>4</sub>H<sub>4</sub>O<sub>6</sub> + Aq

**Molybdenum trioxide, MoO<sub>3</sub>**

Sol in 500 pts cold, and much less hot H<sub>2</sub>O (Bucholz)

Sol in 960 pts hot H<sub>2</sub>O (Hatchett)

Sol in 570 pts cold, and much less hot H<sub>2</sub>O (Dumas)

Sol in acids before ignition Insol in acids, but sl sol in acid potassium tartrate + Aq after ignition Sol in alkalies or alkali carbonates + Aq

Sol in NH<sub>4</sub>OH + Aq

See also **Molybdic acid**

Min *Molybdite* Sol in HCl + Aq

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<sup>e</sup>, Mo<sub>2</sub>O<sub>3</sub>

and HCl, only sl sol in B 1901, 34 151)

sol in H<sub>2</sub>O (2 g in 1 l)

H<sub>4</sub>Cl + Aq Insol in caustic alkalis, somewhat sol in NH<sub>4</sub>OH Much more sol in M<sub>2</sub>CO<sub>3</sub> + Aq and in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq (Klason, B 1901, 34 150)

Mo<sub>2</sub>O<sub>3</sub> + 3H<sub>2</sub>O (Smith and Oberholtzer, Z anorg 1893, 4 243)

Mo<sub>2</sub>O<sub>3</sub> + 6H<sub>2</sub>O Sol in H<sub>2</sub>O (Bailhache, C R 1901, 133 1212)

Mo<sub>2</sub>O<sub>3</sub> + 6H<sub>2</sub>O Very sol in H<sub>2</sub>O (Guichard, C R 1900, 131 419)

Mo<sub>2</sub>O<sub>3</sub> Sol in H<sub>2</sub>O (Junius, Z anorg 1905, 46 447)

Mo<sub>2</sub>O<sub>3</sub> + 21H<sub>2</sub>O = Mo<sub>2</sub>O<sub>5</sub>, 18MoO<sub>2</sub> + 21H<sub>2</sub>O Easily sol in H<sub>2</sub>O Insol in NH<sub>4</sub>Cl + Aq (Klason, B 1901, 34 160)

Mo<sub>2</sub>O<sub>3</sub> + 24H<sub>2</sub>O = Mo<sub>2</sub>O<sub>5</sub>, 24MoO<sub>2</sub> + 24H<sub>2</sub>O (Klason, B 1901, 34 159)

3Mo<sub>2</sub>O<sub>3</sub>, 2Mo<sub>7</sub>O<sub>24</sub> + 18H<sub>2</sub>O Sol in H<sub>2</sub>O (B)

It is probable that the five blue oxides of molybdenum described by Klason (B 34, 148 158) and Bailhache are either the blue oxide Mo<sub>5</sub>O<sub>14</sub> prepared by the author or mixtures of this compd with molybdenum trioxide (Guichard, C R 1902, 134 173)

Mo<sub>5</sub>O<sub>12</sub> Not attacked by ammonia, easily oxidised by HNO<sub>3</sub> + Aq Not attacked by HCl or H<sub>2</sub>SO<sub>4</sub> + Aq (Wohler, A 110 275)  
Formula is Mo<sub>5</sub>O<sub>8</sub>, according to Wohler, but Muthmann (A 238 108) has shown that correct formula is Mo<sub>5</sub>O<sub>12</sub>

Not attacked by boiling alkalies, HCl, or dil H<sub>2</sub>SO<sub>4</sub> + Aq Sol in conc H<sub>2</sub>SO<sub>4</sub>, with

subsequent decomp Sol in aqua regia, and Cl<sub>2</sub> + Aq (Muthmann)

Mo<sub>5</sub>O<sub>8</sub> Sol in H<sub>2</sub>O (Muthmann, A 238 108)

Min *Ilsemaninite* (?)

+ 5H<sub>2</sub>O Moderately sol in H<sub>2</sub>O (Marchetti, Z anorg 1899, 19 393)

Mo<sub>5</sub>O<sub>7</sub> (v d Pfordten, B 15 1925)

**Molybdenum trioxide ammonia, MoO<sub>3</sub>, 3NH<sub>3</sub>**

Unstable in air Very sol in H<sub>2</sub>O with evolution of ammonia (Rosenheim, Z anorg 1906, 50 303)

3MoO<sub>3</sub>, NH<sub>3</sub> + ½H<sub>2</sub>O True composition of commercial molybdic acid (Klason, B 1901, 34 156)

NH<sub>4</sub>H<sub>2</sub>Mo<sub>5</sub>O<sub>12</sub> Very sl sol in cold, easily sol in hot H<sub>2</sub>O with partial decomp (Klason, B 1901, 34 156)

3MoO<sub>3</sub>, 3NH<sub>3</sub> + 7H<sub>2</sub>O = (NH<sub>4</sub>)<sub>3</sub>Mo<sub>3</sub>O<sub>12</sub> + 4H<sub>2</sub>O True composition of Rammelsberg's 3(NH<sub>4</sub>)<sub>2</sub>O, 7MoO<sub>3</sub> + 12H<sub>2</sub>O (Klason, B 1901, 34 155)

4MoO<sub>3</sub>, NH<sub>3</sub> + 6H<sub>2</sub>O Very sl sol in cold, very easily sol in hot H<sub>2</sub>O An insol modification with less H<sub>2</sub>O gradually cryst out (Mylus, B 1903, 36 639)

4MoO<sub>3</sub>, 2NH<sub>3</sub> + 3H<sub>2</sub>O (Klason, B 1901, 34 156)

6MoO<sub>3</sub>, 3NH<sub>3</sub> + 5H<sub>2</sub>O Very sl sol in cold, more easily sol in hot H<sub>2</sub>O, with partial decomp (Klason, B 1901, 34 156)

12MoO<sub>3</sub>, 3NH<sub>3</sub> + 12H<sub>2</sub>O (Klason, B 1901, 34 158)

12MoO<sub>3</sub>, 3NH<sub>3</sub>, 12H<sub>2</sub>O + 3MoO<sub>3</sub>, 8H<sub>2</sub>O Moderately sol in boiling H<sub>2</sub>O (Klason)

15MoO<sub>3</sub>, 3NH<sub>3</sub> + 6H<sub>2</sub>O Insol in H<sub>2</sub>O (Klason)

4MoO<sub>3</sub>, MoO<sub>2</sub>, 2NH<sub>3</sub> + 7H<sub>2</sub>O Slowly sol in H<sub>2</sub>O, fairly stable, gradually decomp by dil acids (Hofmann, Z anorg 1890, 12 280)

**Molybdenum trioxide ammonia hydrogen peroxide, 18MoO<sub>3</sub>, 14NH<sub>3</sub>, 3H<sub>2</sub>O<sub>2</sub> + 18H<sub>2</sub>O**

Sol in H<sub>2</sub>O Sp gr of sat solution = 1.486 at 17.4° (Bacrwald, B 1884, 17 1206)

**Molybdenum oxybromide**

See **Molybdenyl bromide**

**Molybdenum oxychloride**

See **Molybdenyl chloride**

**Molybdenum oxyfluoride**

See **Molybdenyl fluoride**

**Molybdenum oxyfluoride with MF**

See **Fluoxymolybdate, M, and Fluoxyhypomolybdate, M**

**Molybdenum phosphide, Mo<sub>2</sub>P<sub>2</sub>**

Gradually sol in hot HNO<sub>3</sub> + Aq (Wohler and Rautenberg, A 109 374)

**Molybdenum selenide,  $\text{MoSe}_2$**

Not obtained pure (Uelsmann, A 116 125)

**Molybdenum silicide**

Sol in HF, only very sl sol in other acids (Warren, C N 1898, 78 319)

$\text{MoSi}_2$  Insol in all min acids, sol in a warm mixture of HF+ $\text{HNO}_3$  (Defacqz, C R 1907, 144 1425)

Insol in min acids, sol in HF+ $\text{HNO}_3$ . Unattacked by 10-20% KOH+Aq. Decomposed by fused NaOH (Honigschmid, M 1907, 28 1020)

Not attacked by boiling  $\text{HNO}_3$ , aqua regia or HF (Watts, Trans Am Electrochem Soc 1906, 9 106)

$\text{Mo}_2\text{Si}_3$  (Vigouroux, C R 129 1238)

**Molybdenum disulphide,  $\text{MoS}_2$**

Insol in  $\text{H}_2\text{O}$ . Easily sol in aqua regia. Easily oxidised by  $\text{HNO}_3$ . Sol in boiling  $\text{H}_2\text{SO}_4$ . Sl attacked by KOH+Aq (Berzelius)

Min *Molybdenite*. Sol in  $\text{HNO}_3$ +Aq, with separation of  $\text{MoO}_3$ , sol in aqua regia, very sl sol in  $\text{H}_2\text{SO}_4$

**Molybdenum trisulphide,  $\text{MoS}_3$**

Somewhat sol in  $\text{H}_2\text{O}$ , especially if hot, but pptd by an acid. Difficultly sol except when boiled with KOH+Aq. Sl sol in solutions of alkali sulphides unless heated (Berzelius)

Easily sol in alkali sulphides+Aq, slowly sol in alkalis or alkali hydrosulphides+Aq (Atterberg, J B 1873 258)

**Molybdenum tetrakisulphide,  $\text{MoS}_4$**

Not decomposed by hot H O or acids. Sl sol in cold alkali sulphides+Aq, but easily by boiling (Berzelius)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 828)

**Molybdenum sesquisulphide,  $\text{Mo}_2\text{S}_3$**

Insol in HCl and  $\text{H}_2\text{SO}_4$ , sol in hot conc  $\text{HNO}_3$  and aqua regia (Guichard, C R 1900, 130 138)

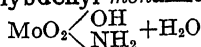
**Molybdenum sulphide with MS**

*Sr* Sulphomolybdate, M

**Molybdenum sulphochloride,  $\text{Mo}_2\text{S}_2\text{Cl}_2$**

Insol in  $\text{H}_2\text{O}$  and alkalis. Slowly sol in conc  $\text{HNO}_3$  (Smith and Oberholtzer, Z anorg 1894, 5 67)

**Molybdenyl monamide,  $\text{NH}_4\text{MoO}_4$  or**



(Rosenheim, Z anorg 1905, 46 318)

**Molybdenyl bromide,  $\text{MoO}_2\text{Br}_2$**

Deliquescent, and sol in  $\text{H}_2\text{O}$  with slight evolution of heat

$\text{Mo}_2\text{O}_3\text{Br}_4$  Unstable in air (Smith and Oberholtzer, Z anorg 4 236)

**Molybdenyl potassium bromide,  $\text{MoOBr}_3$ , 2KBr**

(Weinland, Z anorg 1905, 44 109)

$\text{MoOBr}_3 \cdot \text{KBr} + 2\text{H}_2\text{O}$  (Weinland, Z anorg 1905, 44 110)

**Molybdenyl rubidium bromide,  $\text{MoOBr}_3$ , 2RbBr**

(Weinland, Z anorg 1905, 44 108)

**Molybdenyl chloride,  $\text{MoO}_2\text{Cl}_2$**

Sol in  $\text{H}_2\text{O}$  and alcohol

Abundantly sol in abs alcohol. Not very sol in abs ether (Hampe, Ch Z 1888, 12 23)

+ $\text{H}_2\text{O}$  Composition settled by mol wt determinations. Dissociates in alcohol and in  $\text{H}_2\text{O}$  (Vaudenberghe, Z anorg 1895, 10 52)

Very hygroscopic. Sol in acetone, ether and alcohol (Vaudenberghe, l c)

$\text{MoOCl}_4$  Deliquescent. Sol in little  $\text{H}_2\text{O}$  with violent action. More  $\text{H}_2\text{O}$  decomposes (Puttbach, A 201 123)

Formula is  $\text{Mo}_2\text{O}_3\text{Cl}_2$ , according to Blomstrand (J pr 71 460)

$\text{Mo}_2\text{O}_3\text{Cl}_4$  (Puttbach, l c)

$\text{Mo}_2\text{O}_3\text{Cl}_5$  Deliquescent. Sol in  $\text{H}_2\text{O}$  with very slight evolution of heat and subsequent formation of precipitate (Blomstrand)

Sol in acids (Puttbach, A 201 129)

$\text{Mo}_2\text{O}_3\text{Cl}_5$  Deliquescent, and sol in H O (Blomstrand)

$\text{Mo}_2\text{O}_3\text{Cl}_5$  Insol in HCl and cold  $\text{H}_2\text{SO}_4$ . Sol in hot  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  (Puttbach, A 201 123)

$\text{Mo}_2\text{O}_3\text{Cl}_7$  Difficultly sol in HCl. Easily sol in  $\text{HNO}_3$ , and alkalis+Aq (Puttbach)

**Molybdenyl potassium chloride,  $\text{MoO}_2\text{Cl}_2$ , KCl+H O**

(Weinland, Z anorg 1905, 44 97)

+ $2\text{H}_2\text{O}$  (Weinland, Z anorg 1905, 44 96)

$6\text{MoO}_2\text{Cl}_2, 2\text{KCl} + 6\text{H}_2\text{O}$  (Weinland, Z anorg 1905, 44 97)

$\text{MoOCl}_3, 2\text{KCl} + 2\text{H O}$  Sol in H O (Nordenskjöld, B 1901, 34 1573)

Ppt (Henderson, Proc Chem Soc 1903, 19 245)

**Molybdenyl rubidium chloride,  $\text{MoO}_2\text{Cl}_2$ , RbCl+ $\text{H}_2\text{O}$**

$\text{MoO}_2\text{Cl}_2, 2\text{RbCl}$  (Weinland, Z anorg 1905, 44 95)

$\text{MoOCl}_3, 2\text{RbCl}$  Sl sol in  $\text{H}_2\text{O}$ . Less sol than K salt (Nordenskjöld, B 1901, 34 1573)

**Molybdenyl fluoride,  $\text{MoO}_2\text{F}_2$** 

Decomp rapidly in moist air (Schulze, J pr (2) 21 442)

Very hygroscopic Sol in a little  $\text{H}_2\text{O}$  giving a blue solution, in more  $\text{H}_2\text{O}$  giving a colorless solution

Sol in  $\text{AsCl}_3$ ,  $\text{SiCl}_4$ ,  $\text{SO}_2\text{Cl}_2$  and  $\text{PCl}_3$  On warming these solutions, gas is evolved

Insol in toluene Nearly insol in ether,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , and  $\text{CS}_2$  Sol in warm pyridine and in ethyl and methyl alcohol (Ruff, B 1907, 40 2934)

$\text{MoOF}_4$  Very hygroscopic Decomp by  $\text{H}_2\text{O}$  and conc  $\text{H}_2\text{SO}_4$  Decomp by alcohol Sol in ether and  $\text{CHCl}_3$  with evolution of gas Insol in toluene Very sl sol in benzene and  $\text{CS}_2$  (Ruff, B 1907, 40 2932)

$\text{Mo}_2\text{O}_3\text{F}_4$  Deliquescent Easily sol in  $\text{HF}$  + Aq, not in  $\text{H}_2\text{O}$  (Smith and Oberholtzer)

**Molybdenyl fluoride with MF**

See Fluoxymolybdate, M, and Fluoxyhypomolybdate, M

**Molybdenyl hydroxide,  $\text{MoO}(\text{OH})_3$** 

2 g are sol in 1000 cc  $\text{H}_2\text{O}$ , insol in  $\text{H}_2\text{O}$  +  $\text{NH}_4\text{Cl}$ , only sl sol in  $\text{NH}_4\text{OH}$  and alkali carbonates + Aq (Klason, B 1901, 34 151)

**Molybdic acid,  $\text{H}_2\text{MoO}_4$** 

144 217)

insol in  $\text{H}_2\text{O}$  (Vivier, C R 106

very sparingly sol in cold  $\text{H}_2\text{O}$ , more sol in hot  $\text{H}_2\text{O}$  (Rosenheim and Berthelm, Z anorg 1903, 34 435)

 **$\alpha$ -modification**

Solubility of  $\text{MoO}_3$ ,  $\text{H}_2\text{O}$  ( $\alpha$ -modification) in  $\text{H}_2\text{O}$  at  $t^\circ$

1000 g  $\text{H}_2\text{O}$  dissolve g  $\text{MoO}_3$

$t^\circ$	G $\text{MoO}_3$	$t^\circ$	G $\text{MoO}_3$
14 8	2 117	42 0	3 446
15 2	2 131	45 0	3 661
24 6	2 619	52 0	4 184
25 6	2 689	60 0	4 685
30 3	2 973	70 0	4 231
36 0	3 085	80 0	5 212
36 8	3 295		

(Rosenheim and Davidsohn, Z anorg 1903, 37 318)

( $\beta$  modification),  $\text{MoO}_3$ ,  $\text{H}_2\text{O}$  From  $\text{MoO}_3$ ,  $2\text{H}_2\text{O}$  at  $60^\circ$ – $70^\circ$  (Rosenheim and Davidsohn)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Easily sol in  $\text{H}_2\text{SO}_4$  (Ruegenberg and Smith, J Am Chem Soc 1900, 22 772)

$\text{H}_2\text{MoO}_5$  Sol in  $\text{H}_2\text{O}$  and acids (Milngk)

Very sol in  $\text{H}_2\text{O}$  (Mylius, B 1903, 36, 638)

Solubility of  $\text{MoO}_3$ ,  $2\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$   
1000 g  $\text{H}_2\text{O}$  dissolve g  $\text{MoO}_3$  at  $t^\circ$

$t^\circ$	G $\text{MoO}_3$	$t^\circ$	G $\text{MoO}_3$
18	1 066	59	11 258
23	1 856	60	12 057
30	2 638	66	17 274
40	4 761	70	20 550
48	6 360	74 4	20 904
50 2	6 873	75	20 920
54	7 855	79	21 064

(Rosenheim and Berthelm, Z anorg 1903, 34 430)

Solubility of  $\text{MoO}_3$ ,  $2\text{H}_2\text{O}$  in ammonium salts + Aq at  $t^\circ$

1000 g of the solvent dissolve g  $\text{MoO}_3$

Solvent	$t^\circ$	G $\text{MoO}_3$
10% $(\text{NH}_4)_2\text{SO}_4$	29 6	19 27
10% $\text{NH}_4\text{HSO}_4$	31 5	27 53
"	41 8	34 36
"	49 7	37 69

(Rosenheim and Davidsohn, Z anorg 1903, 37 315)

$\text{H}_2\text{MoO}_6$  (?) Known only in solution

$\text{H}_2\text{MoO}_7$  Easily sol in  $\text{H}_2\text{O}$  (Ullik)

$\text{H}_2\text{MoO}_{13}$  Easily sol in  $\text{H}_2\text{O}$  (U)

$\text{H}_2\text{MoO}_{25}$  Easily sol in  $\text{H}_2\text{O}$  (U)

Molybdic acid also exists in a colloidal modification, sol in  $\text{H}_2\text{O}$  (Graham, C R 59 174)

**Molybdates**

The normal molybdates of the alkali metals are easily sol in  $\text{H}_2\text{O}$ , while the others are sl sol or insol therein

The trimolybdates are sl sol in cold, but very easily sol in hot  $\text{H}_2\text{O}$

The tetramolybdates are easily sol in  $\text{H}_2\text{O}$

**Aluminum molybdate,  $\text{Al}_6\text{MoO}_4$** 

Precipitate (Gentile, J pr 81 414)

Contains aluminum hydroxide and sulphate (Struve, J pr 61 441)

**Aluminum ammonium molybdate**

See Aluminicomolybdate, ammonium

**Aluminum barium molybdate**

See Aluminicomolybdate, barium

**Ammonium molybdate,  $(\text{NH}_4)_2\text{MoO}_4$** 

Efflorescent through loss of  $\text{NH}_3$ , decomp by  $\text{H}_2\text{O}$  into acid salt (Svanberg and Struve)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 826)

$(\text{NH}_4)_2\text{Mo}_2\text{O}_7$  Sol in  $\text{H}_2\text{O}$   
 $+\text{H}_2\text{O}=\text{NH}_4\text{HMoO}_4$  Sol in  $\text{H}_2\text{O}$  Sol  
 in 2-3 pts  $\text{H}_2\text{O}$  (Brandes, Mauro, Gazz  
 ch it 18 120)

$(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}+4\text{H}_2\text{O}$  (Commercial am-  
 monium molybdate)

Not efflorescent Sol in  $\text{H}_2\text{O}$  (Delafor-  
 taine, N Arch Sc ph nat 23 17)

According to Struve and Berlin=

$(\text{NH}_4)_4\text{Mo}_5\text{O}_{17}+3\text{H}_2\text{O}$

According to Marignac and Delffs=  
 $(\text{NH}_4)_4\text{HMoO}_4$  The true composition of

commercial ammonium molybdate is  
 $(\text{NH}_4)_{10}\text{Mo}_{12}\text{O}_{41}$  (Junius, Z anorg 1905,  
 46 428)

$+12\text{H}_2\text{O}$  More sol than the above  
 (Rammelsberg, Pogg 127 298)

Insol in acetone (Krug and M'Elroy, J  
 Anal Appl Ch 6 184)

$(\text{NH}_4)_{10}\text{Mo}_{12}\text{O}_{41}$  True formula for com-  
 mercial ammonium molybdate (Sand and  
 Eisenlohr, Z anorg 1907, 52 68)

$+7\text{H}_2\text{O}$  (Junius, Z anorg 1905, 46 428)

$(\text{NH}_4)_4\text{Mo}_5\text{O}_{17}+\text{H}_2\text{O}$  (Jean, C R 78  
 436)

$(\text{NH}_4)_2\text{Mo}_2\text{O}_7+\text{H}_2\text{O}$  Very difficultly sol  
 in cold, easily sol in hot  $\text{H}_2\text{O}$  (Berlin, J pr  
 49 445)

Easily sol in  $\text{NH}_4\text{OH}+\text{Aq}$  (Kammerer,  
 J pr (2) 6 358)

$(\text{NH}_4)_2\text{O}$ ,  $4\text{MoO}_3$  Practically insol in  
 cold, sl sol in hot  $\text{H}_2\text{O}$  (Westphal, Dissert  
 1995)

$+2\text{H}_2\text{O}$  Very difficultly sol in cold,  
 rather easily sol in hot  $\text{H}_2\text{O}$  (Berlin)

100 cc  $\text{H}_2\text{O}$  dissolve 3 5200 g at  $15^\circ$ , sp  
 gr = 1 03, 3 6711 g at  $18^\circ$ , sp gr = 1 04,  
 4 5961 g at  $32^\circ$ , sp gr = 1 05 (Wempe, Z  
 anorg 1912, 78 255)

$+2\frac{1}{2}\text{H}_2\text{O}$  (Junius, Z anorg 1905, 46  
 440)

$(\text{NH}_4)_2\text{O}$ ,  $8\text{MoO}_3+13\text{H}_2\text{O}$  (Rosenheim,  
 Z anorg 1897, 15 188)

$(\text{NH}_4)_4\text{O}$ ,  $9\text{MoO}_3+17\text{H}_2\text{O}$  (Westphal,  
 Dissert 1895)

See also Molybdenum trioxide ammonia

**Ammonium barium molybdate,**

$3(\text{NH}_4)_2\text{O}$ ,  $3\text{BaO}$ ,  $14\text{MoO}_3+12\text{H}_2\text{O}$   
 (Westphal, Dissert 1895)

**Ammonium bismuth molybdate,**

$\text{NH}_4\text{Bi}(\text{MoO}_4)_2$   
 (Rudert, J Am Chem Soc 1903, 25  
 914)

**Ammonium cadmium molybdate ammonia,**

$(\text{NH}_4)_2\text{Cd}(\text{MoO}_4)_2$ ,  $2\text{NH}_3$   
 Decomp by  $\text{H}_2\text{O}$   
 Sol in dil  $\text{NH}_4\text{OH}+\text{Aq}$  (Briggs, Chem  
 Soc 1904, 85 674)

**Ammonium cerium molybdate,**

$(\text{NH}_4)_6\text{CeMo}_{14}\text{O}_{48}+24\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Barbieri, C A 1909 293)

**Ammonium chromic molybdate**

See Chromicomolybdate, ammonium

**Ammonium cobaltous molybdate,**

$3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3$ ,  $3\text{CoO}$ ,  $7\text{MoO}_3+x\text{H}_2\text{O}$   
 $5[3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3]$ ,  $7[3\text{CoO}$ ,  $7\text{MoO}_3]+$   
 $x\text{H}_2\text{O}$

$2[3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3]$ ,  $3[3\text{CoO}$ ,  $7\text{MoO}_3]$   
 $+x\text{H}_2\text{O}$

$3[3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3]$ ,  $5[3\text{CoO}$ ,  $7\text{MoO}_3]$   
 $+x\text{H}_2\text{O}$

$3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3$ ,  $5[3\text{CoO}$ ,  $7\text{MoO}_3]+$   
 $x\text{H}_2\text{O}$

$9[2(\text{NH}_4)_2\text{O}$ ,  $5\text{MoO}_3]$ ,  $5[2\text{CoO}$ ,  $5\text{MoO}_3]+$   
 $118\text{H}_2\text{O}$

$4(\text{NH}_4)_2\text{O}$ ,  $2\text{CoO}$ ,  $15\text{MoO}_3+20\text{H}_2\text{O}$   
 (Marckwald, Dissert 1895)

**Ammonium cobaltous molybdate ammonia,**

$(\text{NH}_4)_2\text{Co}(\text{MoO}_4)_2$ ,  $2\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$

Sol in dil  $\text{NH}_4\text{OH}+\text{Aq}$  (Briggs, Chem  
 Soc 1904, 85 674)

**Ammonium cobaltic molybdate**

See Cobaltmolybdate, ammonium

**Ammonium cupric molybdate,**  $(\text{NH}_4)_2\text{O}$ ,  $\text{CuO}$ ,  
 $5\text{MoO}_3+9\text{H}_2\text{O}$

Sl sol in cold, sol in boiling  $\text{H}_2\text{O}$  without  
 decomp (Struve)

**Ammonium cupric molybdate ammonia,**

$(\text{NH}_4)_2\text{Cu}(\text{MoO}_4)_2$ ,  $2\text{NH}_3$

Sol in dil  $\text{NH}_4\text{OH}+\text{Aq}$

Decomp by  $\text{H}_2\text{O}$  (Briggs, Chem Soc  
 1904, 85 673)

**Ammonium ferric molybdate,**  $3(\text{NH}_4)_2\text{Mo}_2\text{O}_7$ ,  
 $\text{Fe}_2(\text{MoO}_4)_3+20\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Struve)

See also Ferricomolybdate, ammonium

**Ammonium lanthanum molybdate,**

$(\text{NH}_4)_6\text{La}_2\text{Mo}_{14}\text{O}_{48}+24\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Barbieri, C A 1909 293)

**Ammonium lithium molybdate,**  $\text{NH}_4\text{LiMoO}_4$   
 $+\text{H}_2\text{O}$

(Traube, N Jahrb Miner 1894, I 194)

**Ammonium magnesium molybdate,**  $(\text{NH}_4)_2\text{O}$ ,  
 $\text{MgO}$ ,  $2\text{MoO}_3+2\text{H}_2\text{O}=(\text{NH}_4)_2\text{MoO}_4$ ,

$\text{MgMoO}_4+2\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Ullik, A 144 344)

**Ammonium manganous molybdate,**

$2(\text{NH}_4)_2\text{O}$ ,  $\text{MnO}$ ,  $3\text{MoO}_3+5\text{H}_2\text{O}$

Decomp by boiling  $\text{H}_2\text{O}$  (Marckwald,  
 Dissert 1895)

$(\text{NH}_4)_2\text{O}$ ,  $2\text{MnO}$ ,  $6\text{MoO}_3+16\text{H}_2\text{O}$  De-  
 comp by boiling  $\text{H}_2\text{O}$  (Marckwald, Dissert  
 1895)

$(\text{NH}_4)_2\text{O}$ ,  $3\text{MnO}$ ,  $6\text{MoO}_3 + 16\text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}$  (Marckwald, Dissert 1895)  
 $3(\text{NH}_4)_2\text{O}$ ,  $2\text{MnO}$ ,  $12\text{MoO}_3 + 22\text{H}_2\text{O}$  (Marckwald, Dissert 1895)

#### Ammonium manganic molybdate

See Permanganomolybdate ammonium.

#### Ammonium mercuric molybdate

Sol in  $\text{HCl} + \text{Aq}$  Sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ , separating out on cooling Sol in hot  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (Hirzel)

#### Ammonium molybdenum molybdate,

$(\text{NH}_4)_2\text{O}$ ,  $2\text{MoO}_2$ ,  $4\text{MoO}_3 + 9\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$ , but the solution soon becomes cloudy (Rammelsberg, Pogg 127 291)

#### Ammonium neodymium molybdate,

$(\text{NH}_4)_3\text{NdMoO}_{24} + 12\text{H}_2\text{O}$

Ppt (Barbieri, C C 1911, I 1043)

#### Ammonium nickel molybdate,

$(\text{NH}_4)_2\text{O}$ ,  $3\text{NiO}$ ,  $9\text{MoO}_3 + 25\text{H}_2\text{O}$

Very sl sol in cold, sol in hot  $\text{H}_2\text{O}$  without decomp (Marckwald, Dissert 1895)

$3(\text{NH}_4)_2\text{O}$ ,  $2\text{NiO}$ ,  $10\text{MoO}_3 + 14\text{H}_2\text{O}$  Very sl sol in cold, sol in hot  $\text{H}_2\text{O}$  without decomp (Marckwald, Dissert 1895)

$5(\text{NH}_4)_2\text{O}$ ,  $3\text{NiO}$ ,  $16\text{MoO}_3 + 16\text{H}_2\text{O}$  (Hall, J Am Chem Soc 1907, 29, 702)

$6(\text{NH}_4)_2\text{O}$ ,  $3\text{NiO}$ ,  $16\text{MoO}_3 + 29\text{H}_2\text{O}$  Very sl sol in cold, sol in hot  $\text{H}_2\text{O}$  without decomp (Marckwald, Dissert 1895)

$8(\text{NH}_4)_2\text{O}$ ,  $6\text{NiO}$ ,  $31\text{MoO}_3 + 63\text{H}_2\text{O}$  Very sl sol in cold, sol in hot  $\text{H}_2\text{O}$  without decomp (Marckwald, Dissert 1895)

$3(\text{NH}_4)_2\text{O}$ ,  $9\text{NiO}$ ,  $34\text{MoO}_3 + 120\text{H}_2\text{O}$  Very sl sol in cold, easily sol in hot  $\text{H}_2\text{O}$  without decomp (Marckwald, Dissert 1895)

#### Ammonium nickelic molybdate

See Nickelomolybdate, ammonium

#### Ammonium nickel hydrogen molybdate,

$(\text{NH}_4)_2\text{H}_6[\text{Ni}(\text{MoO}_4)_6] + 5\text{H}_2\text{O}$

See Nickelomolybdate, ammonium hydrogen

#### Ammonium praseodymium molybdate,

$(\text{NH}_4)_3\text{PrMoO}_{24} + 12\text{H}_2\text{O}$

Ppt (Barbieri, C A 1911 1884)

#### Ammonium samarium molybdate,

$(\text{NH}_4)_3\text{SmMoO}_{24} + 12\text{H}_2\text{O}$

Ppt (Barbieri, C A 1911 1884)

#### Ammonium sodium molybdate,

$7(\text{NH}_4)_2\text{O}$ ,  $2\text{Na}_2\text{O}$ ,  $21\text{MoO}_3 + 15\text{H}_2\text{O}$  (?)

Easily sol in  $\text{H}_2\text{O}$  (Delafontaine, J pr 95 136)

$7(\text{NH}_4)_2\text{O}$ ,  $3\text{Na}_2\text{O}$ ,  $25\text{MoO}_3 + 30\text{H}_2\text{O}$  (?) (Delafontaine)

$(\text{NH}_4, \text{Na})_2\text{O}$ ,  $3\text{MoO}_3 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Mauro, Gazz ch it 11 214)

#### Ammonium thorium molybdate

See Thoromolybdate, ammonium

#### Ammonium titanium molybdate

See Titanomolybdate, ammonium

#### Ammonium vanadium molybdate

See Vanadiomolybdate, ammonium

#### Ammonium zinc molybdate

Sol in  $\text{H}_2\text{O}$  (Berzelius)

#### Ammonium zirconium molybdate

See Zirconomolybdate, ammonium

#### Ammonium molybdate hydrogen dioxide,

$18\text{MoO}_3$ ,  $7(\text{NH}_4)_2\text{O}$ ,  $3\text{H}_2\text{O}_2 + 11\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Barwald, B 17 1206)

#### Barium molybdate, basic,

$2\text{BaO}$ ,  $\text{MoO}_3 + \text{H}_2\text{O}$  (?)

Insol in  $\text{H}_2\text{O}$  Sol in dil  $\text{HCl} + \text{Aq}$  or  $\text{HNO}_3 + \text{Aq}$  (Heine, J pr 9 204)

#### Barium molybdate, $\text{BaMoO}_4$

Difficultly sol in  $\text{H}_2\text{O}$ , sol in dil  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$  (Svanberg and Struve)

Sol in 17,200 pts  $\text{H}_2\text{O}$  at  $23^\circ$  More sol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Smith and Brabury, B 24 2930)

$+ 3\text{H}_2\text{O}$  (Westphal, Dissert 1895)

$\text{BaMoO}_4 \cdot 19 + 3\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$

$\text{Ba}_3\text{MoO}_{24} + 9\text{H}_2\text{O}$  Appreciably sol in  $\text{H}_2\text{O}$  (Jorgensen)

According to Svanberg und Struve =  $\text{Ba}_2\text{Mo}_2\text{O}_{11} + 6\text{H}_2\text{O}$

$+ 12\text{H}_2\text{O}$  or  $5\text{BaO}$ ,  $12\text{MoO}_3 + 20\text{H}_2\text{O}$  (Junius, Z anorg 1905, 46 433)

$+ 22\text{H}_2\text{O}$  Ppt (Westphal, Dissert 1895)

$\text{BaO}$ ,  $4\text{MoO}_3 + 3\frac{1}{2}\text{H}_2\text{O}$  Ppt (Wempe, Z anorg 1912, 78 320)

$+ 12\text{H}_2\text{O}$  Ppt (Rosenham, Z anorg 1913, 79 299)

$\text{BaMoO}_4 \cdot 28 + 4\text{H}_2\text{O}$  Insol in cold or hot  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$  Extremely slightly decomp by  $\text{H}_2\text{SO}_4$ , or  $\text{H}_2\text{SO}_4 + \text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$  (Svanberg and Struve)

#### Barium paramolybdate,

$5\text{BaO}$ ,  $12\text{MoO}_3 + 10\text{H}_2\text{O}$

Ppt Sol in excess of  $\text{BaCl} + \text{Aq}$  (Junius Z anorg 1905, 46 433)

#### Barium tetramolybdate,

$\text{Ba}_2\text{H}_2(\text{MoO}_4)_4 + 17\text{H}_2\text{O}$

Insol in cold, apparently decomp by hot  $\text{H}_2\text{O}$ , a small part dissolving, and the rest forming an insol residue (Ulrik, A 144 336)

+14H<sub>2</sub>O Insol in cold and hot H<sub>2</sub>O  
(Wempe, Z anorg 1912, 78 320)  
BaO, 8MoO<sub>3</sub>+17H<sub>2</sub>O (Felix, Dissert 1912)

#### Barium chromic molybdate

See Chromicomolybdate, barium

#### Barium cobaltic molybdate

See Cobaltmolybdate, barium

#### Barium manganic molybdate

See Permanganomolybdate, barium

#### Barium nickelic molybdate

See Nickelmolybdate, barium

#### Barium nickel hydrogen molybdate,

Ba<sub>2</sub>H<sub>6</sub>[Ni(MoO<sub>4</sub>)<sub>6</sub>]+10H<sub>2</sub>O

See Nickelomolybdate, barium hydrogen

#### Barium vanadium molybdate

See Vanadiomolybdate, barium

#### Barium molybdate hydrogen dioxide, 8BaO, 19MoO<sub>3</sub>, 2H<sub>2</sub>O<sub>2</sub>+13H<sub>2</sub>O

Precipitate (Barwald)

#### Bismuth molybdate, Bi<sub>2</sub>O<sub>3</sub>, 3MoO<sub>3</sub>

Somewhat sol in H<sub>2</sub>O Sol in 500 pts H<sub>2</sub>O and in the stronger acids (Richter)

#### Bromomolybdenum molybdate

See under Bromomolybdenum comps

#### Cadmium molybdate, CdMoO<sub>4</sub>

Insol in H<sub>2</sub>O, sol in NH<sub>4</sub>OH+Aq, KCN+Aq, or acids (Smith and Bradbury, B 24 2390)

CdO, H<sub>2</sub>O, 8MoO<sub>3</sub>+6H<sub>2</sub>O Decomp by boiling with H<sub>2</sub>O (Wempe, Z anorg 1912, 78 323)

#### Cæsium molybdate, Cs O, 3MoO<sub>3</sub>+H<sub>2</sub>O

(Ephraim and Herschfinkel, Z anorg 1909, 64 270)

Cs<sub>2</sub>O, 5MoO<sub>3</sub>+3H<sub>2</sub>O (Ephraim and Herschfinkel, Z anorg 1909, 64 270)

+3½H<sub>2</sub>O Very sl sol in cold, easily sol in hot H<sub>2</sub>O (Wempe, Dissert 1911)

2Cs<sub>2</sub>O, 5MoO<sub>3</sub>+5H<sub>2</sub>O (Ephraim and Herschfinkel, Z anorg 1909, 64 271)

3Cs<sub>2</sub>O, 10MoO<sub>3</sub>+3H<sub>2</sub>O (Ephraim and Herschfinkel, Z anorg 1909, 64 271)

Cs<sub>2</sub>O, 16MoO<sub>3</sub>+8H<sub>2</sub>O (Ephraim and Herschfinkel, Z anorg 1909, 64 271)

3Cs<sub>2</sub>O, 10MoO<sub>3</sub>+3H<sub>2</sub>O (Ephraim and Herschfinkel, Z anorg 1909, 64 271)

#### Cæsium tetramolybdate, Cs<sub>2</sub>O, 4MoO<sub>3</sub>

Only sl sol in H<sub>2</sub>O (Muthmann, B 1898, 31 1841)

+2H<sub>2</sub>O Sl sol in H<sub>2</sub>O (Muthmann, B 1898, 31 1841)

+3H<sub>2</sub>O Easily sol in cold or hot H<sub>2</sub>O (Wempe, Z anorg 1912, 78 317)

+5H<sub>2</sub>O Very sol in cold and hot H<sub>2</sub>O (Wempe, Dissert 1911)

Cs<sub>2</sub>O, MoO<sub>3</sub>, Cs<sub>2</sub>O, 3MoO<sub>3</sub>+4 5H<sub>2</sub>O Sol in H<sub>2</sub>O (Wempe, Z anorg 1912, 78 317)

#### Cæsium paramolybdate, 5Cs<sub>2</sub>O, 12MoO<sub>3</sub>+11H<sub>2</sub>O

Efflorescent Easily sol in H<sub>2</sub>O (Wempe, Z anorg 1912, 78 317)

#### Calcium molybdate, CaMoO<sub>4</sub>

Insol precipitate (Ullik)

Sl sol in H<sub>2</sub>O, insol in alcohol (Smith and Bradbury, B 24 2930)

+H<sub>2</sub>O (Westphal, Dissert 1895)

+2H<sub>2</sub>O (Westphal, Dissert 1895)

+6H<sub>2</sub>O Difficultly sol in cold, easily in hot H<sub>2</sub>O (Ullik, A 144 231)

CaMo<sub>2</sub>O<sub>13</sub>+9H<sub>2</sub>O Easily sol in cold H<sub>2</sub>O  
CaO, 2H<sub>2</sub>O, 12MoO<sub>3</sub>+21H<sub>2</sub>O Efflorescent Sl sol in cold, easily sol in hot H<sub>2</sub>O (Wempe)

#### Calcium hydrogen tetramolybdate,

CaH<sub>2</sub>(Mo<sub>4</sub>O<sub>13</sub>)<sub>2</sub>+17H<sub>2</sub>O

Sl sol in cold, easily sol in hot H<sub>2</sub>O with decomp (Ullik)

+16H<sub>2</sub>O Insol in cold, difficultly sol in hot H<sub>2</sub>O (Wempe, Z anorg 1912, 78 318)

#### Cerium molybdate, Ce<sub>2</sub>(MoO<sub>4</sub>)<sub>3</sub>

Precipitate Insol in H<sub>2</sub>O, sol in acids (Cossa, B 19 536 R)

#### Chromic molybdate

Insol in H<sub>2</sub>O, but sol in acids Sol in NH<sub>4</sub> molybdate+Aq (Berzelius)

See also Chromicomolybdic acid

#### Chromic molybdate, with M molybdate

See Chromicomolybdate M

#### Cobaltous molybdate, CoMoO<sub>4</sub>

Decomp by alkalis and strong acids (Berzelius)

+H<sub>2</sub>O Sl sol in pure, easily sol in acidified H<sub>2</sub>O (Coloriano, Bull Soc (2) 50 451)

CoO, 2MoO<sub>3</sub>+2H O (Marckwald, Dissert 1895)

6½H<sub>2</sub>O Sl sol in H<sub>2</sub>O (Marckwald)

CoMo<sub>2</sub>O<sub>10</sub>+10H<sub>2</sub>O Very sl sol in cold, but very easily sol in hot H<sub>2</sub>O (Ullik, W A B 55, 2 767)

#### Cobaltic potassium molybdate

See Cobaltmolybdate, potassium

#### Cobaltous sodium molybdate,

Na<sub>2</sub>O, 2CoO, 6MoO<sub>3</sub>+18H<sub>2</sub>O

(Marckwald, Dissert 1895)

2Na<sub>2</sub>O, CoO, 7MoO<sub>3</sub>+20H<sub>2</sub>O Sol in cold H<sub>2</sub>O without decomp Decomp on heating (Marckwald)

$3\text{Na}_2\text{O}$ ,  $2\text{CoO}$ ,  $12\text{MoO}_3 + 27\text{H}_2\text{O}$  (Marckwald)

$3\text{Na}_2\text{O}$ ,  $3\text{CoO}$ ,  $14\text{MoO}_3 + 50\text{H}_2\text{O}$  Sol in much cold  $\text{H}_2\text{O}$  (Marckwald)

$4\text{Na}_2\text{O}$ ,  $6\text{CoO}$ ,  $25\text{MoO}_3 + 68\text{H}_2\text{O}$  (Marckwald)

**Cobaltous molybdate ammonia**,  $\text{CoMoO}_4 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Sonnenschein, J pr 53 340)

**Cupric molybdate, basic**,  $4\text{CuO}$ ,  $3\text{MoO}_3 + 5\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Struve, J B 1854 350)

**Cupric molybdate**,  $\text{CuMoO}_4$

Sl sol in  $\text{H}_2\text{O}$ , decomp by acids and alkaline solutions

$\text{CuMoO}_4 \cdot 6\frac{1}{2}\text{H}_2\text{O}$  Easily sol in cold  $\text{H}_2\text{O}$  (Ullik, A 144 233)

+  $9\text{H}_2\text{O}$  Very sl sol in cold, and extraordinarily easily sol in hot  $\text{H}_2\text{O}$  (Ullik)

**Cupric molybdate ammonia**,

$\text{CuMoO}_4 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$

Gives off  $\text{NH}_3$  at ord temp Decomp by  $\text{H}_2\text{O}$

Sol in dil  $\text{NH}_4\text{OH} + \text{Aq}$  from which it can be cryst (Briggs, Chem Soc 1904, 85 674)

$\text{CuMoO}_4 \cdot 4\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$  Sol in dil  $\text{NH}_4\text{OH} + \text{Aq}$  (Jorgensen, Ch Z Repert 1896, 20 225)

**Didymium molybdate**,  $\text{Dy}_2(\text{MoO}_4)_3$

Ppt Insol in  $\text{H}_2\text{O}$  (Cossa, B 19 536R)  $\text{Dy}_2\text{O}_3$ ,  $6\text{MoO}_3 + 3\text{H}_2\text{O}$  (?) Precipitate (Smith)

**Glucinum molybdate, basic**,  $2\text{GfO}$ ,  $\text{MoO}_3 + 3\text{H}_2\text{O}$

Nearly insol in  $\text{H}_2\text{O}$  (Atterberg, J B 1873 258)

**Glucinum molybdate**,  $\text{GfO}$ ,  $\text{MoO}_3 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with decomp (Rosenheim, Z anorg 1897, 15 307)

$\text{GfHMoO}_4$ ,  $\text{MoO}_3 + x\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Atterberg)

**Gold (auric) molybdate** (?)

Sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$  (Richter)

**Hydroxylamine potassium molybdate**

$\text{MoO}_4\text{H}_2(\text{NH}_2\text{O})_3(\text{NH}_2\text{OK})$

Easily sol in  $\text{H}_2\text{O}$ , pptd by alcohol (Hofmann, A 1899, 309 324)

**Indium molybdate**,  $\text{In}_2(\text{MoO}_4)_3 + 2\text{H}_2\text{O}$

Ppt Insol in  $\text{H}_2\text{O}$

Easily sol in  $\text{HCl}$  (Renz, B 1901, 34 2765)

**Iron (ferrous) molybdate**,  $\text{FeMoO}_4$

Insol in  $\text{H}_2\text{O}$  (Schultze, A 126 55)

**Iron (ferric) molybdate**,  $\text{Fe}_2\text{O}_3$ ,  $4\text{MoO}_3 + 7\text{H}_2\text{O}$

Nearly insol in  $\text{H}_2\text{O}$  Slowly sol in cold easily in hot  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$  Dil acid; gradually dissolve out  $\text{Fe}_2\text{O}_3$  in the cold When ignited, difficultly sol in all solvents (Steinacker)

$\text{Fe}_2\text{O}_3$ ,  $5\text{MoO}_3 + 16\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Struve, J B 1854 346)

$2\text{Fe}_2\text{O}_3$ ,  $7\text{MoO}_3 + 34\text{H}_2\text{O}$  Ppt (Hall, J Am Chem Soc 1907, 29 704)

**Ferric potassium molybdate**,  $\text{Fe}_2\text{O}_3$ ,  $3\text{K}_2\text{O}$

$12\text{MoO}_3 + 20\text{H}_2\text{O} = 3\text{K}_2\text{Mo}_2\text{O}_7$ ,  $\text{Fe}_2(\text{Mo}_2\text{O}_7)_3 + 20\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Struve)

**Lanthanum molybdate**,  $\text{LaH}_3(\text{MoO}_4)_3 =$

$\text{La}_2\text{O}_3$ ,  $\text{MoO}_3 + 3\text{H}_2\text{O}$  (?)

Precipitate (Smith)

**Lead molybdate**,  $\text{PbMoO}_4$

Insol in  $\text{H}_2\text{O}$  Sol in warm  $\text{HNO}_3 + \text{Aq}$  decomp by  $\text{H}_2\text{SO}_4$ , sol in conc  $\text{HCl} + \text{Aq}$ , or  $\text{KOH} + \text{Aq}$

Min *Wulfenite* As above

**Lithium molybdate**,  $\text{Li MoO}_4$

Moderately sol in cold, and only sl more sol in hot  $\text{H}_2\text{O}$  (Ephraim, Z anorg 1909, 64 259)

+  $\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$

$5\text{Li}_2\text{O}$ ,  $5\text{MoO}_3 + 2\text{H}_2\text{O}$  46.13 g are present in 100 ccm of the aqueous solution at  $20^\circ$ , and sp gr of the solution = 1.41 (Wempe, Z anorg 1912, 78 309)

$\text{Li}_2\text{O}$ ,  $2\text{MoO}_3 + 5\text{H}_2\text{O}$  Sol in cold, easily sol in hot  $\text{H}_2\text{O}$  (Ephraim, Z anorg 1909, 64 258)

$\text{Li}_2\text{O}$ ,  $3\text{MoO}_3 + 11\text{H}_2\text{O}$  Easily sol in warm  $\text{H}_2\text{O}$  (Wempe, Dissert 1911)

+  $4\text{H}_2\text{O}$  (Wempe)

+  $4\frac{1}{2}\text{H}_2\text{O}$  (Wempe)

+  $7\text{H}_2\text{O}$  Nearly insol in cold, sol in hot  $\text{H}_2\text{O}$  (Ephraim, Z anorg 1909, 64 258)

$2\text{Li}_2\text{O}$ ,  $3\text{MoO}_3$  Sl sol in  $\text{H}_2\text{O}$  (Ephraim, Z anorg 1909, 64 258)

**Lithium paramolybdate**,  $3\text{Li}_2\text{O}$ ,  $7\text{MoO}_3 + 12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1897, 15 181)

+  $28\text{H}_2\text{O}$  Easily sol in cold and hot  $\text{H}_2\text{O}$  (Ephraim, Z anorg 1909, 64 258)

**Lithium tetramolybdate**,  $\text{Li}_2\text{O}$ ,  $4\text{MoO}_3 + 7\text{H}_2\text{O}$

Sol in cold  $\text{H}_2\text{O}$  (Ephraim, Z anorg 1909, 64 258)

$\text{Li}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $8\text{MoO}_3 + 10\text{H}_2\text{O}$  Easily sol

in hot  $\text{H}_2\text{O}$  (Wempe, Z anorg 1912, 78 308)

$\text{Li}_2\text{O}$ ,  $3\text{H}_2\text{O}$ ,  $16\text{MoO}_3 + 6\frac{1}{2}\text{H}_2\text{O}$  Easily sol in warm  $\text{H}_2\text{O}$  (Wempe, Z anorg 1912, 78 308)

Lithium potassium molybdate,  $\text{KLiMoO}_4 + \text{H}_2\text{O}$

(Traube, N Jahrb Mner, 1894, I 194)

Magnesium molybdate,  $\text{MgMoO}_4$

Min *Belonesia*

Insol in  $\text{HCl} + \text{Aq}$  (Scacchi, Zeit Kryst 1888, 14 523)

+  $5\text{H}_2\text{O}$  Easily sol in cold, but still more sol in hot  $\text{H}_2\text{O}$  (Delafontaine)

Sol in 12-15 pts cold  $\text{H}_2\text{O}$  (Brandes)

+  $7\text{H}_2\text{O}$  Easily sol in hot or cold  $\text{H}_2\text{O}$  (Ullik)

$\text{MgMo}_2\text{O}_7 + 10\text{H}_2\text{O}$  Difficultly sol in cold, very easily in hot  $\text{H}_2\text{O}$  (Ullik)

Magnesium paramolybdate,  $\text{Mg}_3\text{Mo}_7\text{O}_{24} + 20\text{H}_2\text{O}$

Quite sol in cold, more easily in hot  $\text{H}_2\text{O}$  (Ullik)

Magnesium tetramolybdate,

$\text{MgO}$ ,  $\text{H}_2\text{O}$ ,  $8\text{MoO}_3 + 19\text{H}_2\text{O}$

Magnesium hydrogen tetramolybdate,

$\text{MgH}_2(\text{Mo}_4\text{O}_{13})_2 + 19\text{H}_2\text{O}$

Easily sol in cold  $\text{H}_2\text{O}$  (Ullik, A 144 335)

Sl sol in cold, easily sol in hot  $\text{H}_2\text{O}$  (Wempe, Dissert 1911)

+  $20\text{H}_2\text{O}$  Ppt (Wempe, Z anorg 1912, 78 323)

Magnesium hydrogen octomolybdate,

$\text{MgH}_2(\text{Mo}_8\text{O}_{25})_2 + 29\text{H}_2\text{O}$

Very difficultly sol in cold, very easily sol in hot  $\text{H}_2\text{O}$  (Ullik, W A B 60, 2 314)

Magnesium potassium molybdate,  $\text{MgMoO}_4$ ,  $\text{K}_2\text{MoO}_4 + 2\text{H}_2\text{O}$

Slowly sol in cold, easily in hot  $\text{H}_2\text{O}$  (Ullik, A 144 343)

Manganous molybdate,  $\text{MnMoO}_4 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sl sol in pure, easily sol in acidified  $\text{H}_2\text{O}$  Decomp by alkalis or alkali carbonates +  $\text{Aq}$  (Coloriano, Bull Soc (2) 50 451)

+  $\frac{1}{2}\text{H}_2\text{O}$  (Marckwald, Dissert 1895)

+  $10\text{H}_2\text{O}$  (Marckwald)

Manganic potassium molybdate

See Permanganomolybdate, potassium

Manganic silver molybdate

See Permanganomolybdate, silver

Mercurous molybdate,  $\text{Hg}_2\text{Mo}_2\text{O}_7$

Decomp by  $\text{H}_2\text{O}$  (Struve, J B 1754 350,)

Sol in 500-600 pts  $\text{H}_2\text{O}$ , decomp by  $\text{HNO}_3 + \text{Aq}$  (Hatchett)

Molybdenum molybdate

See Molybdenum oxides,  $\text{Mo}_2\text{O}_7$ ,  $\text{Mo}_4\text{O}_{11}$ , etc

Neodymium molybdate,  $\text{Nd}_2(\text{MoO}_4)_3$

Very sl sol in  $\text{H}_2\text{O}$

1 pt is sol in 53790 pts  $\text{H}_2\text{O}$  at  $28^\circ$

1 " " " 32466 "  $\text{H}_2\text{O}$  "  $75^\circ$

(Hitchcock, J Am Chem Soc 1895, 17 532)

Nickel molybdate,  $\text{NiMoO}_4 + \frac{2}{3}\text{H}_2\text{O}$ , +  $\frac{3}{4}\text{H}_2\text{O}$  and +  $5\text{H}_2\text{O}$

(Marckwald, Dissert 1895)

$\text{NiO}$ ,  $3\text{MoO}_3 + 18\text{H}_2\text{O}$  Sl sol in cold, easily sol in hot  $\text{H}_2\text{O}$  (Marckwald)

$5\text{NiO}$ ,  $14\text{MoO}_3 + 57\text{H}_2\text{O}$ , and +  $70\text{H}_2\text{O}$

Sl sol in cold, easily sol in hot  $\text{H}_2\text{O}$  (Marckwald)

Nickel potassium molybdate,  $3\text{NiO}$ ,  $5\text{K}_2\text{O}$ ,  $16\text{MoO}_3 + 21\text{H}_2\text{O}$

Can be cryst from  $\text{H}_2\text{O}$  (Hall, J Am Chem Soc 1907, 29 701)

Nickelic potassium molybdate

See Nickelomolybdate, potassium

Nickel potassium hydrogen molybdate,

$\text{K}_4\text{H}_6[\text{Ni}(\text{MoO}_4)_6] + 5\text{H}_2\text{O}$

See Nickelomolybdate, potassium hydrogen

Nickel sodium molybdate,  $2\text{NiO}$ ,  $\text{Na}_2\text{O}$ ,  $6\text{MoO}_3 + 17\text{H}_2\text{O}$

Sol in cold  $\text{H}_2\text{O}$  without decomp but decomp on warming (Marckwald, Dissert 1895)

Nickel molybdate ammonia,  $\text{NiMoO}_4$ ,  $2\text{NH}_3 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Sonnenschein, J pr 53 341)

Potassium molybdate,  $\text{K}_2\text{MoO}_4$

Deliquescent in moist air Very sol in  $\text{H}_2\text{O}$  Insol in alcohol (Svanberg and Struve, J pr 44 265)

184.6 grams are sol in 100 grams  $\text{H}_2\text{O}$  at  $25^\circ$  (Amadori, C A 1912 2878)

Solubility of  $\text{K}_2\text{MoO}_4 + \text{K}_2\text{SO}_4$  at  $25^\circ$

G per 100 g $\text{H}_2\text{O}$		G per 100 g $\text{H}_2\text{O}$	
$\text{K}_2\text{SO}_4$	$\text{K}_2\text{MoO}_4$	$\text{K}_2\text{SO}_4$	$\text{K}_2\text{MoO}_4$
0	184.6	1.50	99.49
0.46	180.7	2.13	45.89
0.72	177	3.95	17.48
0.98	127.2	8.55	4.73
1.27	107.5	12.10	0

(Amadori, Att acc Linc 1912, 21, I 467, 667)



+ $\frac{3}{4}$ H<sub>2</sub>O Easily sol in H<sub>2</sub>O (Wempe, Dissert 1911)

K<sub>2</sub>O, 8MoO<sub>3</sub>+13H<sub>2</sub>O Easily sol in warm H<sub>2</sub>O (Wempe, Dissert 1911)

K<sub>2</sub>O, 10MoO<sub>3</sub>+9H<sub>2</sub>O Nearly insol in hot and cold H<sub>2</sub>O 100 g H<sub>2</sub>O dissolve 0.682 g at 100° (Felix, Dissert 1912)

+15H<sub>2</sub>O Sol in H<sub>2</sub>O (Felix)

5K<sub>2</sub>O, 12MoO<sub>3</sub>+8H<sub>2</sub>O Sl sol in cold H<sub>2</sub>O (Junius, Z anorg 1905, 46 439)

#### Potassium trimolybdate, K<sub>2</sub>Mo<sub>3</sub>O<sub>10</sub>

Difficultly sol in cold, but much more easily in hot H<sub>2</sub>O When ignited is absolutely insol in H<sub>2</sub>O (Svanberg and Struve)

+2H<sub>2</sub>O (Junius, Z anorg 1905, 46 439)

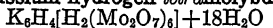
Sl sol in cold, easily sol in hot H<sub>2</sub>O (Wempe, Dissert 1911)

+2 $\frac{1}{2}$ H<sub>2</sub>O Easily sol in H<sub>2</sub>O (Wempe, Dissert 1911)

+3H<sub>2</sub>O Very sl sol in cold, more easily sol in hot H<sub>2</sub>O (Wempe, Dissert 1911)

+11H<sub>2</sub>O Practically insol in H<sub>2</sub>O (Westphal, Dissert 1895)

#### Potassium hydrogen tetramolybdate,



Sl sol in cold H<sub>2</sub>O Decomp by boiling H<sub>2</sub>O (Rosenheim, Z anorg 1913, 79 298)

KHM<sub>4</sub>O<sub>13</sub>+6H<sub>2</sub>O Decomp by H<sub>2</sub>O

#### Potassium paramolybdate, K<sub>2</sub>Mo<sub>7</sub>O<sub>24</sub>+4H<sub>2</sub>O

Decomp even by cold H<sub>2</sub>O (Delafontaine)

Formula is K<sub>8</sub>Mo<sub>9</sub>O<sub>31</sub>+6H<sub>2</sub>O, according to Svanberg and Struve (?)

#### Potassium selenium molybdate

See Selenomolybdate, potassium

#### Potassium sodium molybdate, K<sub>2</sub>MoO<sub>4</sub>, 2Na<sub>2</sub>MoO<sub>4</sub>+14H<sub>2</sub>O

Very easily sol in cold, still more easily in hot H<sub>2</sub>O (Delafontaine)

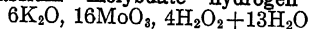
#### Potassium vanadium molybdate

See Vanadiomolybdate, potassium

#### Potassium zinc molybdate

Sol in H<sub>2</sub>O (Berzelius)

#### Potassium molybdate hydrogen rhoxide,



Sol in H<sub>2</sub>O (Barwald, C C 1885 424)

#### Potassium molybdate sulphocyanide, KSCN, K<sub>2</sub>Mo<sub>3</sub>O<sub>10</sub>+4H<sub>2</sub>O

Decomp by H<sub>2</sub>O Sol in dil HCl+Ag (Péchar, C R 1894, 118 806)

#### Praseodymium molybdate, Pr<sub>2</sub>(MoO<sub>4</sub>)<sub>3</sub>

Very sl sol in H<sub>2</sub>O

1 pt is sol in 65820 pts H<sub>2</sub>O at 23°

1 " " " 69800 " " 75°

(Hitchcock, J Am Chem Soc 1895, 17 530)

#### Rubidium molybdate, Rb<sub>2</sub>O, MoO<sub>3</sub>

Hygroscopic (Ephraim, Z anorg 1909 64 263)

Rb<sub>2</sub>O, 2MoO<sub>3</sub>+2H<sub>2</sub>O Easily sol in H<sub>2</sub>O (Ephraim, Z anorg 1909, 64 263)

Rb<sub>2</sub>Mo<sub>3</sub>O<sub>10</sub>+4H<sub>2</sub>O Very sl sol in cold much more easily sol in hot H<sub>2</sub>O (Delafontaine, N Arch Sc phys nat 30 233)

(Ephraim, Z anorg 1909, 64 263)

+4 $\frac{1}{2}$ H<sub>2</sub>O (Wempe, Dissert 1911)

2Rb<sub>2</sub>O, 7MoO<sub>3</sub>+5H<sub>2</sub>O Very sl sol in cold, very easily sol in hot H<sub>2</sub>O (Wempe

5Rb<sub>2</sub>O, 7MoO<sub>3</sub>+14H<sub>2</sub>O (Ephraim and Herschfinkel, Z anorg 1909, 64 268)

3Rb<sub>2</sub>O, 8MoO<sub>3</sub>+6H<sub>2</sub>O (Ephraim and Herschfinkel, Z anorg 1909, 64 269)

5Rb<sub>2</sub>O, 12MoO<sub>3</sub>+H<sub>2</sub>O 100 cc H<sub>2</sub>O dissolve 1.941 g at 24° (Wempe, Z anorg 1912, 78 258)

Rb<sub>2</sub>O, 3MoO<sub>3</sub> Insol in H<sub>2</sub>O (Muthmann, B 1898, 31 1839)

+H<sub>2</sub>O (Muthmann, B 1898, 31 1839)

+3H<sub>2</sub>O Sl sol in cold, easily sol in hot H<sub>2</sub>O (Wempe, Dissert 1911)

6 $\frac{1}{2}$ H<sub>2</sub>O (Ephraim and Herschfinkel, Z anorg 1909, 64 269)

2Rb<sub>2</sub>O, 3MoO<sub>3</sub>+4H<sub>2</sub>O Sl sol in cold easily in hot H<sub>2</sub>O (Wempe, Dissert 1911)

Rb<sub>2</sub>O, 4MoO<sub>3</sub> Difficultly sol in cold easily in hot H<sub>2</sub>O (Wempe, Z anorg 1912 78 312)

+ $\frac{1}{2}$ H<sub>2</sub>O Practically insol in H<sub>2</sub>O Very sol by addition of NH<sub>3</sub> (Ephraim and Herschfinkel, Z anorg 1909, 64 266)

+2.5H<sub>2</sub>O Insol in H<sub>2</sub>O (Ephraim, Z anorg 1909, 64 263)

+4H<sub>2</sub>O Sol in cold, more easily sol in hot H<sub>2</sub>O (Wempe, Z anorg 1912 78 312)

Rb<sub>2</sub>O, MoO<sub>3</sub>, Rb<sub>2</sub>O 3MoO<sub>3</sub>+5H<sub>2</sub>O Sol in cold or hot H<sub>2</sub>O (Wempe, Z anorg 1912 78 312)

Rb<sub>2</sub>O, H<sub>2</sub>O, 8MoO<sub>3</sub>+3H<sub>2</sub>O Difficultly sol in cold, easily in hot H<sub>2</sub>O (Wempe, Z anorg 1912, 78 312)

Rb<sub>2</sub>O, 11MoO<sub>3</sub>+5.5H<sub>2</sub>O Ppt (Ephraim, Z anorg 1909, 64 263)

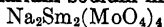
Rb<sub>2</sub>O, 13MoO<sub>3</sub>+4H<sub>2</sub>O Ppt (Ephraim

Rb<sub>2</sub>O, 18MoO<sub>3</sub> Ppt (Ephraim)

#### Samarium molybdate, Sm<sub>2</sub>(MoO<sub>4</sub>)<sub>3</sub>

Insol in H<sub>2</sub>O (Cleve)

#### Samarium sodium molybdate,



Insol in H<sub>2</sub>O Easily sol in warm dil HNO<sub>3</sub>+Ag (Cleve)

**ver (argentous) molybdate**,  $\text{Ag}_4\text{O}$ ,  $2\text{MoO}_3$   
Sol in  $\text{HNO}_3 + 4\text{q}$   $\text{KOH} + \text{Aq}$  dissolves  
 $\text{O}_2$  and  $\text{Ag}_2\text{O}$  separates out Not decomp  
dil  $\text{NH}_4\text{OH} + \text{Aq}$  (Wohler and Rauten-  
rg, A 114 119)  
Does not exist (Muthmann, B 20 983)

**ver (argentic) molybdate**,  $\text{Ag}_2\text{MoO}_4$   
Somewhat sol in  $\text{H}_2\text{O}$ , less when  $\text{HNO}_3$  is  
esent (Richter)  
Very sl sol in pure  $\text{H}_2\text{O}$ , easily sol in  
 $\text{O}$  acidulated with  $\text{HNO}_3$  (Struve and  
anberg)  
Sol in  $\text{KCN}$  or  $\text{NaOH} + \text{Aq}$  (Smith and  
adbury)

$\text{Ag}_2\text{O}$ ,  $2\text{MoO}_3$  Sl sol in  $\text{H}_2\text{O}$  Sol in  
 $\text{CN} + \text{Aq}$  (Junius, Dissert 1905)  
 $2\text{Ag}_2\text{O}$ ,  $5\text{MoO}_3$  Somewhat sol in  $\text{H}_2\text{O}$   
vanberg and Struve, J B 1847-48 412)  
 $\text{Ag}_2\text{O}$ ,  $4\text{MoO}_3 + 6\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  with  
comp (Wempe, Z anorg 1912, 78 322)

**ver thorium molybdate**

See Thoromolybdate, silver

**ver molybdate ammonia**,  $\text{Ag}_2\text{MoO}_4$ ,  $4\text{NH}_3$   
Sol in  $\text{H}_2\text{O}$  with rapid decomposition  
idmann, Bull Soc (2) 20 64)

**ver molybdate hydrogen dioxide**,  $13\text{Ag}_2\text{O}$ ,  
 $2\text{H}_2\text{O}_2$ ,  $32\text{MoO}_3$

Ppt (Barwald, B 17 1206)

**dum molybdate**,  $\text{Na}_2\text{MoO}_4$

Anhydrous Easily and completely sol in  
 $\text{O}$

$+2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

$+10\text{H}_2\text{O}$  Efflorescent

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

Solid phase	$t^\circ$	Per cent of anhydrous salt	Mols $\text{H}_2\text{O}$ to 1 mol of anhydrous salt	Mols of anhydrous salt to 100 mols $\text{H}_2\text{O}$
$\text{Na}_2\text{MoO}_4$ , $10\text{H}_2\text{O}$	6	30.63	25.92	3.86
"	4	33.83	22.38	4.47
"	6	35.58	20.72	4.83
"	90	38.16	18.54	5.39
$\text{Na}_2\text{MoO}_4$ , $2\text{H}_2\text{O}$	10	39.28	17.70	5.65
"	15.5	39.27	17.70	5.65
"	32	39.82	17.30	5.78
"	51.5	41.27	16.28	6.14
"	100	45.57	13.67	7.32

(Funk, B 1900, 33 3699)

Insol in methyl acetate (Naumann, B  
09, 42 3790)

$\text{Na}_2\text{MoO}_4\text{O}_7$  After ignition, very difficultly  
l in cold, and very slowly sol in hot  $\text{H}_2\text{O}$   
vanberg and Struve)

$+ \text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$

$+3\frac{1}{2}\text{H}_2\text{O}$  Easily sol in cold or hot  $\text{H}_2\text{O}$   
(Wempe, Dissert 1911)

$+4\text{H}_2\text{O}$  Easily and completely sol in  
cold  $\text{H}_2\text{O}$  (Ullik)

$+6\frac{1}{2}\text{H}_2\text{O}$  Sl sol in cold, very easily sol  
in hot  $\text{H}_2\text{O}$  (Wempe, Dissert 1911)

$+7\text{H}_2\text{O}$  Difficultly sol in cold  $\text{H}_2\text{O}$ , but  
more easily than the corresponding K salt  
100 pts  $\text{H}_2\text{O}$  dissolve 3.878 pts at  $20^\circ$  and  
13.7 pts at  $100^\circ$  (Ullik, A 144 244)

$+9\text{H}_2\text{O}$  Easily sol in cold, very easily  
sol in hot  $\text{H}_2\text{O}$  (Wempe)

$+11\text{H}_2\text{O}$  (Junius, Z anorg 1905, 46  
437)

$3\text{Na}_2\text{O}$ ,  $7\text{MoO}_3$  Easily sol in cold, very  
easily sol in hot  $\text{H}_2\text{O}$  (Ott, Dissert 1911)

$+20\text{H}_2\text{O}$  (Westphal, Dissert 1895)

$+22\text{H}_2\text{O}$  Efflorescent Easily sol in  
 $\text{H}_2\text{O}$  (Ullik, A 144 219)

$\text{Na}_2\text{O}$ ,  $8\text{MoO}_3 + \frac{1}{2}\text{H}_2\text{O}$  Very sol in cold  
or hot  $\text{H}_2\text{O}$  (Wempe, Dissert 1911)

$+4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Ullik, W A B  
60, 2 312)

$+15\text{H}_2\text{O}$  (Rosenheim, Z anorg 1897, 15  
188)

$\text{Na}_2\text{O}$ ,  $10\text{MoO}_3 + 6\text{H}_2\text{O}$  Very sl sol in  
 $\text{H}_2\text{O}$  100 g  $\text{H}_2\text{O}$  dissolve 0.842 g at  $100^\circ$   
(Felix, Dissert 1912)

$+7\text{H}_2\text{O}$  (Felix) Nearly insol in hot and  
cold  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1903, 37  
323)

$+12\text{H}_2\text{O}$  Difficultly sol in  $\text{H}_2\text{O}$

$+21\text{H}_2\text{O}$  Abundantly but slowly sol in  
cold  $\text{H}_2\text{O}$   $= \text{NaHNa}_5\text{O}_{16} + 10\text{H}_2\text{O}$  (Ullik)

$5\text{Na}_2\text{O}$ ,  $12\text{MoO}_3 + 8\text{H}_2\text{O}$  Sl sol in cold,  
easily sol in hot  $\text{H}_2\text{O}$  (Wempe, Dissert  
1911)

$+20\text{H}_2\text{O}$  Sl sol in cold, easily sol in  
hot  $\text{H}_2\text{O}$  (Wempe, Dissert 1911)

$+36\text{H}_2\text{O}$  (Junius, Z anorg 1905, 46 436)

$+44\text{H}_2\text{O}$  Sl sol in cold, easily sol in hot  
 $\text{H}_2\text{O}$  (Wempe, Dissert 1911)

**Sodium tetramolybdate**,  $\text{Na}_2\text{Mo}_4\text{O}_{13} + 6\text{H}_2\text{O}$

Difficultly sol in cold, easily in hot  $\text{H}_2\text{O}$   
(Ullik)

100 cc  $\text{H}_2\text{O}$  dissolve at  $21^\circ$ , 28.39 g  
of the salt Sp gr of the solution = 1.47

(Wempe Z anorg 1912, 78 306)

$+17\text{H}_2\text{O}$  (Felix, Dissert 1912)

$\text{Na}_2\text{H}_4[\text{H}_2(\text{Mo}_2\text{O}_7)_6] + 21\text{H}_2\text{O}$  Slowly sol  
in cold, easily sol in hot  $\text{H}_2\text{O}$  (Rosenheim,  
Z anorg 1913, 79 298)

$\text{NaHMo}_4\text{O}_{13} + 8\text{H}_2\text{O}$  Very sol in hot or  
cold  $\text{H}_2\text{O}$  (Ullik, A 144 333)

$\text{NaHMo}_3\text{O}_{25} + 4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$   
(Ullik)

**Sodium manganous molybdate**,  $2\text{Na}_2\text{O}$ ,  $\text{MnO}$ ,  
 $6\text{MoO}_3 + 19\text{H}_2\text{O}$

(Marckwald, Dissert 1895)

**Sodium molybdate molybdenum oxide**,  
 $\text{Na}_2\text{Mo}_5\text{O}_{15}$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  and aqua  
regia Insol in  $\text{HCl}$  and in  $\text{H}_2\text{SO}_4$  Sol in

alkalies (Stavenhagen and Engels, B 1895, 28 2280)

### Strontium molybdate, $\text{SrMoO}_4$

Sl sol in  $\text{H}_2\text{O}$  (Schultze)  
Sol in 9600 pts  $\text{H}_2\text{O}$  at  $17^\circ$  (Smith and Bradbury, B 24 2930)

$\text{SrO}$ ,  $3\text{MoO}_3 + \frac{1}{2}\text{H}_2\text{O}$  Scarcely sol in cold, easily in hot  $\text{H}_2\text{O}$  (Wempe, Dissert 1911)

$\text{SrO}$ ,  $\text{H}_2\text{O}$ ,  $8\text{MoO}_3 + 6\text{H}_2\text{O}$  Scarcely sol in cold, easily in hot  $\text{H}_2\text{O}$  (Wempe, Dissert 1911)

$2\text{SrO}$ ,  $3\text{H}_2\text{O}$ ,  $20\text{MoO}_3 + 21\text{H}_2\text{O}$  Ppt (Wempe, Z anorg 1912, 78 321)

### Thalious molybdate, $\text{Ti}_2\text{MoO}_4$

Insol in  $\text{H}_2\text{O}$  Sol in alkalies Insol in alcohol (Oettinger, J B 1864, 254)

Sl sol in hot or cold  $\text{H}_2\text{O}$  (Ullik, J B 1867, 234)

$8\text{Ti}_2\text{O}_3$ ,  $11\text{MoO}_3$  Sol in hot  $\text{H}_2\text{O}$  (Fleming, J B 1868, 250)

$3\text{Ti}_2\text{O}_3$ ,  $8\text{MoO}_3$  (Fleming)

### Thalious tetramolybdate, $\text{Ti}_2\text{O}_3 \cdot 4\text{MoO}_3 + \text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  with decomp (Wempe, Z anorg 1912, 78 322)

### Thalious paramolybdate, $5\text{Ti}_2\text{O}_3 \cdot 12\text{MoO}_3$

Insol in  $\text{H}_2\text{O}$  Easily sol in mineral acids and in alkali hydroxides and carbonates (Junius, Z anorg 1905, 46 432)

### Tin (stannic) molybdate

Insol in  $\text{H}_2\text{O}$  Sol in dil or conc  $\text{HCl} + \text{Aq}$ , or in  $\text{KOH} + \text{Aq}$  Not decomp by  $\text{HNO}_3 + \text{Aq}$  (Berzelius)

### Uranous molybdate

Precipitate Sol in  $\text{HCl} + \text{Aq}$  Decomp by  $\text{KOH} + \text{Aq}$   
 $\text{U}(\text{MoO}_4)_3$  (Lancien, C C 1908, I 1763)

### Uranyl molybdate, $(\text{UO}_2)_2\text{MoO}_4$

Insol in  $\text{H}_2\text{O}$ , methyl and ethyl alcohol, ether, acetic acid,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$  and  $\text{C}_7\text{H}_8$  Sol in mineral acids (Lancien, C C 1907, I 784)

$2\text{UO}_3$ ,  $3\text{MoO}_3$  (?) Insol in  $\text{H}_2\text{O}$  Sol in strong acids and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Berzelius)

$3\text{UO}_3$ ,  $7\text{MoO}_3$  Insol in hot and cold  $\text{H}_2\text{O}$  Insol in  $\text{NaOH}$ ,  $\text{KOH}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in all min acids and decomp by an excess of  $\text{H}_2\text{O}$  Insol in acetic acid (Lancien, C C 1908, I 1763)

$\text{UO}_3$ ,  $8\text{MoO}_3$  (Lancien)  
 $+13\text{H}_2\text{O}$  Insol in  $\text{HNO}_3$  (Lancien)

### Ytterbium molybdate, $\text{Yb}_2\text{O}_3 \cdot 7\text{MoO}_3 + 6\text{H}_2\text{O}$

Insol in hot  $\text{H}_2\text{O}$  (Cleve, Z anorg 1902, 32 152)

$2\text{Yb}_2\text{O}_3$ ,  $\text{MoO}_3$  Ppt (Cleve)

### Yttrium molybdate

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3 + \text{Aq}$  (Berlin)

### Zinc molybdate, $\text{ZnMoO}_4$

Difficultly sol in  $\text{H}_2\text{O}$ , easily in acids (Schultze, A 126 49)

$+ \text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  Easily sol in dil acids (Coloriano, Bull Soc (2) 50 451)

$\text{ZnMo}_3\text{O}_{13} + 10\text{H}_2\text{O}$  Very difficultly sol in cold, but extraordinarily easily sol in hot  $\text{H}_2\text{O}$  (Ullik, W A B 55, 2 767)

### Zinc tetramolybdate, $\text{ZnMo}_4\text{O}_{13} + 8\text{H}_2\text{O}$

Easily sol in cold  $\text{H}_2\text{O}$  (Ullik)

$\text{ZnO}$ ,  $\text{H}_2\text{O}$ ,  $8\text{MoO}_3 + 14\text{H}_2\text{O}$  Ppt (Wempe, Z anorg 1912, 78 324)

### Zinc molybdate ammonia, $\text{ZnMoO}_4 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$

(Sonnenschein, J pr 53 339)

### Permolybdic acid

See Permolybdic acid

### Molybdic sulphuric acid, $\text{MoO}_3 \cdot \text{SO}_3$

Deliquescent (Schultz-Sellack, B 4 14)

Very deliquescent Very sol in  $\text{H}_2\text{O}$  (Muthmann, A 1886, 238 126)

$\text{MoO}_3$ ,  $3\text{SO}_3 + 2\text{H}_2\text{O}$  (?)

### Molybdocyanhydric acid, $\text{H}_4\text{Mo}(\text{CN})_8 + 6\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  and abs alcohol Solutions are stable at ord temp (Rosenheim and Garfunkel, Z anorg 1910, 65 168)

### Cadmium molybdocyanide, $\text{Cd}_2\text{Mo}(\text{CN})_8 + 8\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Rosenheim)

### Cadmium molybdocyanide ammonia,

$\text{Cd}_2\text{Mo}(\text{CN})_8 \cdot 4\text{NH}_3 + 2\text{H}_2\text{O}$   
(Rosenheim)

### Cupric molybdocyanide ammonia,

$\text{Cu}_2\text{Mo}(\text{CN})_8 \cdot 4\text{NH}_3 + 7\text{H}_2\text{O}$   
(Rosenheim)

### Potassium molybdocyanide, $\text{K}_4\text{Mo}(\text{CN})_8 + 2\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Rosenheim)

### Thalious molybdocyanide, $\text{Ti}_4\text{Mo}(\text{CN})_8$

Very sl sol in  $\text{H}_2\text{O}$  (Rosenheim)

### Molybdiiodic acid, $\text{HIO}_3 \cdot \text{H}_2\text{MoO}_4 + \text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Blomstrand, J pr (40 320)

$\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3 + 2\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  Insol in cold, sol in hot  $\text{HNO}_3$  Sol in alcohol (Chrétien, A ch 1898, (7) 15 402)

**Ammonium molybdoiodate,  $\text{NH}_4\text{IO}_3$ ,  $\text{H}_2\text{MoO}_4$** 

Somewhat more sol than K salt (Blomstrand)

$(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  Very sl sol in cold  $\text{H}_2\text{O}$  More sol in hot  $\text{H}_2\text{O}$  (Rosenheim and Liebknecht, A 1899, 308 50)  
 $+\text{H}_2\text{O}$  1 l  $\text{H}_2\text{O}$  dissolves 5.39 g salt at  $15^\circ$ , 30.94 g at  $100^\circ$  More sol in dil  $\text{HNO}_3$   
 $+\text{Aq}$  (Chrétien, A ch 1898, (7) 15 409)  
 $3(\text{NH}_4)_2\text{O}$ ,  $(\text{I}_2\text{O}_5)_4$ ,  $2\text{MoO}_3$ ,  $4+6\text{H}_2\text{O}$  (Chrétien)

**Barium molybdoiodate,  $\text{BaO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ ,  $2\text{H}_2\text{O}$** 

4.23 g are sol in 1 l  $\text{H}_2\text{O}$  at ord temp (Chrétien)

**Cadmium molybdoiodate, acid,  $3\text{CdO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $5+16\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  (Chrétien)

**Calcium molybdoiodate,  $\text{CaO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ ,  $6\text{H}_2\text{O}$** 

1 l  $\text{H}_2\text{O}$  dissolves 7.8 g of the salt at  $15^\circ$ , 20.89 g at  $90^\circ$  (Chrétien)

**Cobaltous molybdoiodate,  $\text{CoO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ ,  $6\text{H}_2\text{O}$** 

5.11 g are sol in 1 l  $\text{H}_2\text{O}$  at  $15^\circ$ , 22.27 g at  $100^\circ$  (Chrétien)

**Cobaltous molybdoiodate acid,  $\text{CoO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $5+18\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  (Chrétien)

**Cupric molybdoiodate,  $\text{CuO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ ,  $3\text{H}_2\text{O}$** 

1 l  $\text{H}_2\text{O}$  dissolves 10.63 g of the salt at  $15^\circ$ , 25.55 g at  $100^\circ$  (Chrétien)

**Lithium molybdoiodate,  $\text{Li}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ ,  $2\frac{1}{2}\text{H}_2\text{O}$** 

197.83 g are sol in 1 l  $\text{H}_2\text{O}$  at  $15^\circ$  Sol in dil  $\text{HNO}_3$  +  $\text{Aq}$  (Chrétien)

**Magnesium molybdoiodate,  $\text{MgO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ ,  $6\text{H}_2\text{O}$** 

1 l  $\text{H}_2\text{O}$  dissolves 3.85 g of the salt at  $15^\circ$ , 16.2 g at  $100^\circ$  (Chrétien)

**Manganous molybdoiodate,  $3\text{MnO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $4+9\text{H}_2\text{O}$** 

1 l  $\text{H}_2\text{O}$  dissolves 17.05 g of the salt at  $15^\circ$ , 55.05 g at  $100^\circ$  (Chrétien)

**Nickel molybdoiodate,  $\text{NiO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ ,  $6\text{H}_2\text{O}$** 

5.43 g are sol in 1 l  $\text{H}_2\text{O}$  at  $15^\circ$ , 21.8 g at  $100^\circ$  (Chrétien)

$2\text{NiO}$ ,  $2\text{I}_2\text{O}_5$ ,  $3\text{MoO}_3$ ,  $23\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  Not decomp by acids (Maass, Dissert 1901)

**Nickel molybdoiodate, acid,  $2\text{NiO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $5+15\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  (Chrétien)

**Potassium molybdoiodate,**

$\text{KH}_2\text{IO}_2$ ,  $\text{MoO}_3$ ,  $\text{OH}$ , or  $\text{KIO}_3$ ,  $\text{MoO}_3$ ,  $2\text{H}_2\text{O}$

Ppt Sl sol in  $\text{H}_2\text{O}$  (Blomstrand, J pr (2) 40 320)

$\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  Only sl sol in cold  $\text{H}_2\text{O}$ , sol on long boiling 4.48 grs are sol in 1 l  $\text{H}_2\text{O}$  at  $12^\circ$  (Compare Blomstrand not identical) (Rosenheim, A 1899, 308 50)

$+\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  3.45 g are sol in 1 l  $\text{H}_2\text{O}$  at  $15^\circ$ , 28.38 g at  $100^\circ$  More sol in dil  $\text{HNO}_3$  +  $\text{Aq}$  (Chrétien, A ch 1898, (7) 15 404)

**Potassium molybdoiodate, acid**

$(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $4\text{K}_2\text{O}$ ,  $7\text{H}_2\text{O}$   
 $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $3\text{K}_2\text{O}$ ,  $13\text{H}_2\text{O}$   
 $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $2\text{K}_2\text{O}$ ,  $4\text{H}_2\text{O}$   
 $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $3\text{K}_2\text{O}$ ,  $7\text{H}_2\text{O}$   
 $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $4\text{K}_2\text{O}$ ,  $5\text{H}_2\text{O}$  (Chrétien)

**Silver molybdoiodate,  $\text{Ag}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ ,  $1\frac{1}{2}\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$

$4\text{Ag}_2\text{O}$ ,  $4\text{I}_2\text{O}_5$ ,  $3\text{MoO}_3$  Sol in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$  (Chrétien)

**Sodium molybdoiodate,  $\text{Na}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ ,  $\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  with decomp (Chrétien, C R 1896, 123 178)

1 l  $\text{H}_2\text{O}$  dissolves 6.97 g of the salt at  $15^\circ$ , 22.75 g at  $90^\circ$

1 l  $\text{HNO}_3$  +  $\text{Aq}$  (1 10) dissolves 23.78 g of the salt at ord temp (Chrétien, A ch 1898, (7) 15 410)

$+\text{H}_2\text{O}$  Only sl sol in cold  $\text{H}_2\text{O}$ , sol on long boiling 3.35 grams are sol in 1 l  $\text{H}_2\text{O}$  at  $12^\circ$  (Rosenheim, A 1899, 308 50)

**Strontium molybdoiodate,  $\text{SrO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ ,  $3\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  (Chrétien, A ch 1898, (7) 15 415)

**Strontium molybdoiodate, acid,  $3\text{SrO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $4+15\text{H}_2\text{O}$** 

1 l  $\text{H}_2\text{O}$  dissolves 2.94 g of the salt at  $15^\circ$ , 13.64 g at  $100^\circ$  (Chrétien)

**Uranyl molybdoiodate,  $2\text{UO}_3$ ,  $4\text{I}_2\text{O}_5$ ,  $3\text{MoO}_3$ ,  $3\text{H}_2\text{O}$  (Chrétien)****Zinc molybdoiodate,  $\text{ZnO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ ,  $5\text{H}_2\text{O}$** 

1 l  $\text{H}_2\text{O}$  dissolves 4.08 g of the salt at  $15^\circ$ , 16.25 g at  $100^\circ$  (Chrétien)

**Zinc molybdodiodate acid**,  $\text{ZnO}$ ,  $(\text{I}_2\text{O}_5, 2\text{MoO}_3)_2$   
 $+16\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Chrétien)

### Molybdoperiodic acid

**Ammonium molybdoperiodate**,  $5(\text{NH}_4)_2\text{O}$ ,  
 $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Blomstrand, Sv V A H Bih 1892 No 6)

$4(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $8\text{MoO}_3+7\text{H}_2\text{O}$  Very sl  
 sol in cold  $\text{H}_2\text{O}$  (Blomstrand)

**Ammonium sodium** —,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  
 $\text{I}_2\text{O}_7$ ,  $2\text{MoO}_3+10\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$  (B)

**Barium sodium** —,  $9\text{BaO}$ ,  $\text{Na}_2\text{O}$ ,  $2\text{I}_2\text{O}_7$ ,  
 $24\text{MoO}_3+28\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$  (B)

**Calcium** —,  $5\text{CaO}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+26\text{H}_2\text{O}$

Extremely sol in  $\text{H}_2\text{O}$  (Blomstrand)

$4\text{CaO}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+21\text{H}_2\text{O}$  Less sol in  
 $\text{H}_2\text{O}$  than above salt

**Lithium** —,  $5\text{Li}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+30\text{H}_2\text{O}$

Not so efflorescent as Na salt Sol in  $\text{H}_2\text{O}$   
 $(\text{B})$

$+18\text{H}_2\text{O}$  (B)

**Manganous sodium** —,  $2\text{MnO}$ ,  $3\text{Na}_2\text{O}$ ,  
 $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+32\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (B)

**Potassium** —,  $5\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+$   
 $12\text{H}_2\text{O}$

Not efflorescent (Blomstrand)

**Sodium** —,  $5\text{Na}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+34\text{H}_2\text{O}$

Efflorescent Very sol in  $\text{H}_2\text{O}$  (Blom-  
 strand, Sv V A H Bih 1892 No 6 24)

$+26\text{H}_2\text{O}$  Not efflorescent Very sol in  
 $\text{H}_2\text{O}$  (Blomstrand)

**Sodium strontium** —,  $\text{Na}_2\text{O}$ ,  $4\text{SrO}$ ,  $\text{I}_2\text{O}_7$ ,  
 $12\text{MoO}_3+20\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (B)

### Molybdophosphoric acid

See Phosphomolybdic acid

### Molybdosubphosphoric acid

**Sodium molybdosubphosphate**,  
 $\text{Na}_2[\text{P}(\text{MoO}_7)_3]+8\text{H}_2\text{O}$

Ppt (Rosenheim, Z anorg 1913, 84 222)

### Molybdophosphorous acid

**Potassium molybdophosphate**,  
 $\text{K}_3[\text{HP}(\text{MoO}_7)_3]+11\text{H}_2\text{O}$

Difficultly sol in cold  $\text{H}_2\text{O}$  (Rosenheim,  
 Z anorg 1913, 84 219)

**Sodium molybdophosphate**,  
 $\text{Na}_2[\text{HP}(\text{MoO}_7)_3]+11\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Rosenheim, Z anorg  
 1913, 84 218)

### Molybdophosphovanadic acid

See Phosphovanadiomolybdic acid

### Molybdoselenious acid

**Ammonium molybdoselenite**,  $4(\text{NH}_4)_2\text{O}$ ,  
 $3\text{SeO}_2$ ,  $10\text{MoO}_3+4\text{H}_2\text{O}$

More sol in hot than cold  $\text{H}_2\text{O}$ , insol in  
 alcohol (Péchar, A ch (6) 30 403)

**Ammonium potassium molybdoselenite**,  
 $2(\text{NH}_4)_2\text{O}$ ,  $2\text{K}_2\text{O}$ ,  $3\text{SeO}_2$ ,  $10\text{MoO}_3+$   
 $5\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , insol in alcohol (Péch  
 ard)

**Barium molybdoselenite**,  $4\text{BaO}$ ,  $3\text{SeO}_2$ ,  
 $10\text{MoO}_3+3\text{H}_2\text{O}$

Sl sol in cold, easily in warm  $\text{H}_2\text{O}$   
 (Péchar)

**Potassium molybdoselenite**,  $4\text{K O}$ ,  $3\text{SeO}_2$ ,  
 $10\text{MoO}_3+5\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , insol in alcohol (Péch  
 ard)

**Sodium molybdoselenite**,  $4\text{Na O}$ ,  $3\text{SeO}_2$ ,  
 $10\text{MoO}_3+15\text{H}_2\text{O}$

Very efflorescent, and sol in  $\text{H}_2\text{O}$ , insol i  
 alcohol (Péchar)

### Molybdosilicic acid

See Silicomolybdic acid

### Molybdosilicovanadic acid

See Silcovanadiomolybdic acid

### Molybdosulphuric acid

Appreciably sol in  $\text{H}_2\text{O}$  (Hoffmann  
 Dissert 1903)

**Ammonium molybdosulphate**,  $(\text{NH}_4)_2\text{O}$ ,  
 $2\text{MoO}_3$ ,  $\text{SO}_3+4\text{H}_2\text{O}$ , ind  $+9\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Wernlund Z anorg  
 1907, 54 261)

$(\text{NH}_4)_2\text{O}$ ,  $2\text{MoO}_3$ ,  $3\text{SO}_3+10\text{H}_2\text{O}$  (Wern  
 lund)

**Ammonium molybdenyl molybdosulphat**  
 $(\text{NH}_4)_2\text{O}$ ,  $\text{MoO}$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+11\text{H}_2\text{O}$

$1\frac{1}{2}(\text{NH}_4)_2\text{O}$ ,  $\text{MoO}_2$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+5\text{H}_2\text{O}$   
 $2(\text{NH}_4)_2\text{O}$ ,  $\text{MoO}_2$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+14\text{H}_2\text{O}$

(Hoffmann, Dissert 1903)

$3\text{NH}_3$ ,  $\text{MoO}_2$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+10\text{H}_2\text{O}$  Ver  
 sol in  $\text{H}_2\text{O}$  Very sl sol in  $\text{NH}_4$  salts + A

Very stable toward alkali + Aq (Péchar  
 C R 1893, 116 1441)

$5\text{NH}_3$ ,  $\text{MoO}_2$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+8\text{H}_2\text{O}$  (Pé-  
chard, C R 1893, 116 1441)

Potassium molybdosulphate,  $\text{K}_2\text{O}$ ,  $2\text{MoO}_3$ ,  
 $\text{SO}_3+2\text{H}_2\text{O}$

$\text{K}_2\text{O}$ ,  $2\text{MoO}_3$ ,  $\text{SO}_3+6\text{H}_2\text{O}$   
 $\text{K}_2\text{O}$ ,  $2\text{MoO}_3$ ,  $3\text{SO}_3+6\text{H}_2\text{O}$  (Wenland, Z  
anorg 1907, 54 260)

Potassium molybdenyl molybdosulphate,  
 $\text{K}_2\text{O}$ ,  $\text{MoO}_2$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+8\text{H}_2\text{O}$   
(Hoffmann, Dissert 1903)

### Molybdosulphurous acid

Ammonium molybdosulphite,  $4(\text{NH}_4)_2\text{O}$ ,  
 $3\text{SO}_2$ ,  $10\text{MoO}_3+6\text{H}_2\text{O}$

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$   
Insol in alcohol (Péchard, A ch (6) 30  
396)

$3(\text{NH}_4)_2\text{O}$ ,  $8\text{MoO}_3$ ,  $2\text{SO}_2+5\text{H}_2\text{O}$  Sl sol  
in cold, easily sol in warm  $\text{H}_2\text{O}$  Easily de-  
comp by  $\text{H}_2\text{O}$ , and can be recryst only in  
presence of an excess of sulphurous acid  
(Rosenheim, Z anorg 1894, 7 177)

Ammonium potassium molybdosulphite,  
 $2(\text{NH}_4)_2\text{O}$ ,  $2\text{K}_2\text{O}$ ,  $3\text{SO}_2$ ,  $10\text{MoO}_3+9\text{H}_2\text{O}$

Sl sol in cold  $\text{H}_2\text{O}$  Decomp on warming  
(Péchard)

Barium molybdosulphite,  $2\text{BaO}$ ,  $5\text{MoO}_3$ ,  
 $2\text{SO}_2+10\text{H}_2\text{O}$

(Rosenheim, Z anorg 1897, 15 185)

Cæsium molybdosulphite,  $2\text{Cs}_2\text{O}$ ,  $5\text{MoO}_3$ ,  
 $2\text{SO}_2+6\text{H}_2\text{O}$

Unstable As K salt (Rosenheim)

Potassium molybdosulphite,  $4\text{K}_2\text{O}$ ,  $3\text{SO}_2$ ,  
 $10\text{MoO}_3+10\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , but decomp on warm-  
ing (Péchard)

$2\text{K}_2\text{O}$ ,  $5\text{MoO}_3$ ,  $2\text{SO}_2+\text{H}_2\text{O}$  (Rosenheim)

Rubidium molybdosulphite,  $2\text{Rb}_2\text{O}$ ,  $5\text{MoO}_3$ ,  
 $2\text{SO}_2+12\text{H}_2\text{O}$

As K salt (Rosenheim)

Sodium molybdosulphite,  $4\text{N}_2\text{O}$ ,  $3\text{SO}_2$ ,  
 $10\text{MoO}_3+12\text{H}_2\text{O}$

Very sol in cold  $\text{H}_2\text{O}$ , insol in alcohol  
(Péchard)

$+16\text{H}_2\text{O}$  Very efflorescent (Péchard)  
 $2\text{N}_2\text{O}$ ,  $5\text{MoO}_3$ ,  $2\text{SO}_2+4\text{H}_2\text{O}$  In dry state  
it gradually gives off  $\text{SO}_2$  and soon effloresces  
(Rosenheim)

Strontium molybdosulphite,  $2\text{SrO}$ ,  $5\text{MoO}_3$ ,  
 $2\text{SO}_2+12\text{H}_2\text{O}$

(Rosenheim)

### Molybdotitanic acid

See Titanomolybdic acid

### Molybdous acid

Magnesium molybdite,  $\text{Mg}_2\text{Mo}_3\text{O}_8=2\text{MgO}$ ,  
 $3\text{MoO}_2$

Not attacked by  $\text{KOH}$ , and  $\text{HCl}+\text{Ag}$   
(Muthmann, A 238 108)

Zinc molybdite,  $\text{Zn}_2\text{Mo}_3\text{O}_8=2\text{ZnO}$ ,  $3\text{MoO}_2$

Easily sol in aqua regia (Muthmann, A  
238 108)

### Molybdovanadates

See Vanadiomolybdates

### Neodymicotungstic acid

Ammonium neodymicotungstate,  $3(\text{NH}_4)_2\text{O}$ ,  
 $\text{Nd}_2\text{O}_3$ ,  $16\text{WO}_3+20\text{H}_2\text{O}$

Difficultly sol in  $\text{H}_2\text{O}$  (E F Smith, J  
Am Chem Soc 1904, 26 1480)

Barium neodymicotungstate,  $6\text{BaO}$ ,  $\text{Nd}_2\text{O}_3$ ,  
 $16\text{WO}_3+17\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (E F Smith)

### Neodymium

See also under Didymium

Neodymium bromide,  $\text{NdBr}_3$

(Matignon, C R 1905, 140 1638)

Neodymium carbide,  $\text{NdC}$

Decomp by  $\text{H}_2\text{O}$ , insol in conc  $\text{HNO}_3$ ,  
decomp by dil  $\text{HNO}_3$  (Moissan, C R  
1900, 131 597)

Neodymium chloride,  $\text{NdCl}_3$

100 g  $\text{H}_2\text{O}$  dissolve 98.68 g  $\text{NdCl}_3$  at  $13^\circ$ ,  
140.4 g at  $100^\circ$

Sp gr at  $15^\circ/4^\circ$  of the solution sat at  $13^\circ=$   
1.74 (Matignon, A ch 1906, (8) 8 249)

44.5 g are sol in 100 g abs alcohol at  $20^\circ$   
1.8 g " " " " pyridine at  $15^\circ$

Insol in ether,  $\text{CHCl}_3$ , quinoline, toluidine,  
etc Sl sol in aniline and in phenylhydraz-  
ine (Matignon, A ch 1906, (8) 8 266)

$+6\text{H}_2\text{O}$  Deliquescent

At  $13^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve 246.2 pts of  
the hydrated salt

At  $100^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve 511 pts of  
hydrated salt

Sat solution at  $13^\circ$  has a sp gr  $15^\circ/4^\circ=$   
1.741 (Matignon, C R 1901, 133 289)

Neodymium chloride ammonia,  $\text{NdCl}_3$ ,  
 $12\text{NH}_3$

Decomposes on heating into  $\text{NdCl}_3+\text{NH}_3$ ,  
 $+2\text{NH}_3$ ,  $+4\text{NH}_3$ ,  $+5\text{NH}_3$ ,  $+8\text{NH}_3$ , and  
 $+11\text{NH}_3$  (Matignon, C R 1906, 142 1043)

### Neodymium hydroxide

Sol in citric acid (Baskerville, J Am  
Chem Soc 1904, 26 49)

Solubility in glycerine+Aq containing about 60% by vol of glycerine 100 cem of the solution contain 4.5 g neodymium oxide (Muller, Z anorg 1905, **43** 322)

### Neodymium hydride, NdH<sub>2</sub> (?)

Slowly attacked by boiling H<sub>2</sub>O Sol in acids with violent evolution of H<sub>2</sub> (Muthmann, A 1904, **331** 58)

### Neodymium iodide, NdI<sub>3</sub>

(Matignon, C R 1905, **140** 1638)

### Neodymium nitride, NdN

Decomp in moist air with evolution of NH<sub>3</sub> (Muthmann, A 1904, **331** 59)

### Neodymium oxide, Nd<sub>2</sub>O<sub>3</sub>

Easily sol in acids (v Welsbach, M 6 477)

### Neodymium oxychloride, NdOCl

(Matignon, C R 1905, **140** 1638)

### Neon, Ne

Less sol than argon in H<sub>2</sub>O, sol in liquid oxygen (Ramsay, B 1898, **31** 3118)

Absorption by H<sub>2</sub>O at t°

t°	Coefficient of absorption
0	0 0114
10	0 0118
20	0 0147
30	0 0158
40	0 0203
50	0 0317

(Antropoff, Roy Soc Proc 1910, **83** A, 480)

### Nickel, Ni

Not attacked by H<sub>2</sub>O Very slowly sol in dilute H<sub>3</sub>PO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>, or HCl+Aq (Tupputi, A ch **78** 133)

Very easily attacked by HNO<sub>3</sub>+Aq, and difficultly by hot H<sub>2</sub>SO<sub>4</sub> When pure, is converted into passive condition by conc HNO<sub>3</sub> (Nickles, C R **38** 284)

Very sl attacked by cold acids, except HNO<sub>3</sub>+Aq (Tissier, C R **50** 106)  
Not attacked by NaOH+Aq (Venator, Dingl **261** 133)

Insol in liquid NH<sub>3</sub> (Gore, Am Ch J 1898, **20** 828)

### Nickel amide, Ni(NH<sub>2</sub>)<sub>2</sub>

Decomp by H<sub>2</sub>O, slowly sol in min acids Insol in liquid NH<sub>3</sub> (Bohart, J phys Chem 1915, **19** 560)

### Nickel antimonide, NiSb

Insol in HCl+Aq, easily sol in HNO<sub>3</sub>+Aq (Christofle, **1863**)

Min *Brenthauptite* Insol in acids, easily sol in aqua regia

Ni<sub>3</sub>Sb<sub>2</sub> (Christofle)

Nickel antimonide sulphide, NiSb<sub>2</sub>, NiS<sub>2</sub>=NiSbS

Min *Nickel glance*, *Ullmannite*

Decomp by HNO<sub>3</sub>+Aq, completely sol in aqua regia with separation of S

### Nickel arsenide, NiAs

Min *Niccolite* Sol in conc HNO<sub>3</sub>+Ac with separation of As<sub>2</sub>O<sub>3</sub>, more easily sol in aqua regia

NiAs<sub>2</sub> Min *Chloanthite*, *Rammelsbergite* Sol in HNO<sub>3</sub>+Aq

Ni<sub>3</sub>As<sub>2</sub> Sol in HNO<sub>3</sub> and in aqua regia Readily attacked by fused alkali (Granger C R 1900, **130** 915)

### Nickel arsenide sulphide, NiAs<sub>2</sub>, NiS<sub>2</sub>

Min *Gersdorffite* Partly sol in HNO<sub>3</sub>+Aq with separation of S and As<sub>2</sub>O<sub>3</sub>, not attacked by KOH+Aq

### Nickel azoimide, basic, Ni(OH)N<sub>3</sub>

Insol in H<sub>2</sub>O (Curtius, J pr 1898, (2) **58** 300)

### Nickel azoimide, NiN<sub>3</sub>+H<sub>2</sub>O

Sol in H<sub>2</sub>O, insol in alcohol and ether (Curtius, J pr 1900, (2) **61** 418)

### Nickel potassium azoimide, Ni(N<sub>3</sub>)<sub>2</sub>, KN<sub>3</sub> (?)

Sol in H<sub>2</sub>O (Curtius, J pr 1898, (2) **58** 302)

### Nickel boride, Ni<sub>2</sub>B

Attacked by HNO<sub>3</sub> Slowly sol in ho HCl (Jassoneix, C R 1907, **145** 240)

NiB Decomp by moist air and by alkali nitrates, chlorates, hydroxides and carborates, decomp by steam at red heat Not attacked by HCl Easily attacked by HNC and aqua regia, by H<sub>2</sub>SO<sub>4</sub> only on heating (Moissan, C R 1896, **122** 425)

NiB<sub>2</sub> (Jassoneix, C R 1907, **145** 241)

### Nickel bromide, NiBr<sub>2</sub>

Deliquescent Slowly sol in H<sub>2</sub>O

Sat NiBr<sub>2</sub>+Aq contains at

—21° —6° +19° 38°  
47.1 51.7 56.6 58.9% NiBr<sub>2</sub>,

58° 77° 98° 100° 140°  
60.5 60.3 61.0 61.0 60.7% NiBr

(Étard, A ch 1894, (7) **2** 542)

Somewhat hygroscopic Nearly insol in cold H<sub>2</sub>O but begins to dissolve appreciably at 50°, and somewhat more rapidly at 90° but even at that temp 1 g requires 1–2 hou for solution HNO<sub>3</sub> does not appreciably hasten solution (Richards and Cushma Z anorg 1898, **16** 169)

Sl sol in benzonitrile (Naumann, B 1914, **47** 1369)  
 Sol in quinoline (Beckmann and Gabel, Z anorg 1906, **51** 236)  
 +3H<sub>2</sub>O Deliquescent Very sol in H<sub>2</sub>O, HCl+Aq, NH<sub>4</sub>OH+Aq, alcohol, and ether (Berthelot, A ch **44** 389)  
 +6H<sub>2</sub>O (Bolschakoff, C C **1897**, II 331 and 726)  
 +9H<sub>2</sub>O (Bolschakoff, C C **1897**, II 726 and 331)

### Nickel stannic bromide

See Bromostannate, nickel

### Nickel bromide ammonia, NiBr<sub>2</sub>, 6NH<sub>3</sub>

Sol in little H<sub>2</sub>O, but decomp by more (Rammelsberg, Pogg **55** 243)  
 Sol in warm conc NH<sub>4</sub>OH+Aq, insol in cold (Richards and Cushman, Z anorg **1898**, **16** 175)

### Nickel bromide cupric oxide, NiBr<sub>2</sub>, 3CuO + 4H<sub>2</sub>O

Not decomp by H<sub>2</sub>O (Mailhe, A ch 1902, (7) **27** 377)

### Nickel bromide hydrazine, NiBr, 2N H<sub>4</sub>

Easily sol in dil acids and NH<sub>4</sub>OH+Aq  
 NiBr<sub>2</sub>, 3N<sub>2</sub>H<sub>4</sub> Sol in dil acids (Franzen, Z anorg 1903, **60** 263-4)

### Nickel carbonyl, Ni(CO)<sub>4</sub>

Insol in H<sub>2</sub>O, not attacked by dil acids or alkalis or conc HCl+Aq Easily sol in conc HNO<sub>3</sub>+Aq and in aqua regia Sol in alcohol, benzene, and chloroform (Mond, Langer, and Quincke, Chem Soc **57** 749)

Sol in hydrocarbons, especially oil of turpentine (Berthelot, C R **1891**, **112** 1346)  
 Sol in acetone, toluene, methyl and ethyl alcohol, etc (I enher and Loos, J Am Chem Soc **1900**, **22** 114)

### Nickel chloride, NiCl<sub>2</sub>

*Anhydrous* Not immediately sol in H<sub>2</sub>O, but gradually dissolves on boiling or by addition of HCl+Aq Deliquesces on air, and is then easily sol in H<sub>2</sub>O Sol in NH<sub>4</sub>OH+Aq Sol in alcohol Sol in hot HCl+Aq only slowly

Sp gr of NiCl<sub>2</sub>+Aq containing

5	10	15	20	25%
1 0493	1 0995	1 1578	1 2245	1 3000

(B Franz, J pr (2) **5** 285)

Sp gr of NiCl<sub>2</sub>+Aq containing, in 1000

grms H <sub>2</sub> O, g NiCl <sub>2</sub> +7H <sub>2</sub> O at 23 1°	128 g (= ½ mol)	256	384	512
1 057		1 107	1 149	1 187
	640	768	896	1024
	1 220	1 249	1 276	1 301

Containing g NiCl<sub>2</sub> (anhydrous)

65 g (= ½ mol)	130	195	260	325	390
1 061	1 119	1 176	1 230	1 284	1 335

(Gerlach, Z anal **28** 468)

Sp gr of NiCl<sub>2</sub>+Aq at room temp containing

11 449	22 69	30 40%
1 1093	1 2264	1 3371

(Wagner, W Ann **1883**, **18** 269)

Sp gr of NiCl<sub>2</sub>+Aq at 25°

Concentration of NiCl <sub>2</sub> +Aq	Sp gr
1-normal	1 0591
1/2-	1 0308
1/4-	1 0144
1/8-	1 0067

(Wagner, Z phys Ch **1890**, **5** 39)

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J **1898**, **20** 828)

100 pts absolute alcohol dissolve at room temperature 10 05 pts NiCl<sub>2</sub> (Bodtker, Z phys Ch **1897**, **22** 511)

Sol in quinoline (Beckmann and Gabel, Z anorg 1906, **51** 236)

Difficultly sol in methyl acetate (Naumann, B 1909, **42** 3790)

Insol in ethyl acetate (Naumann, B 1910, **43** 314)

Solubility in glycol=16 1-16 3% (de Coninck, C C **1905**, II 1234)

Sl sol in benzonitrile (Naumann, B 1914, **47** 1369)

Anhydrous NiCl<sub>2</sub> is insol in acetone (Krug and M'Elroy, J Anal Ch **6** 184)

Insol in acetone and in methylal (Eidmann, C C **1899**, II 1014)

+H<sub>2</sub>O (Baubigny)  
 11 sat HCl+Aq at 12° contains 40 g NiCl<sub>2</sub>

dissolved from NiCl<sub>2</sub>, H<sub>2</sub>O (Ditte)  
 +2H<sub>2</sub>O (Sabatier, Bull Soc (3) **1** 88)

+6H<sub>2</sub>O Deliquescent in moist, efflorescent in dry air, sol in H<sub>2</sub>O with evolution of heat Sol in 1 5 to 2 pts H<sub>2</sub>O Easily sol in alcohol (Lupputi)

1 l H<sub>2</sub>O dissolves 600 g NiCl<sub>2</sub>+6H<sub>2</sub>O (Ditte, A ch **1879**, (5) **22** 551)

Sat aq solution contains at

-17°	-16°	+10°	18°
29 7	31 0	37 3	38 5% NiCl <sub>2</sub>
38°	59°	78°	96°
41 9	45 0	46 6	46 7% NiCl <sub>2</sub>

(Étard, A ch **1894**, (7) **2** 539)

Solubility of NiCl<sub>2</sub>+6H<sub>2</sub>O=37 53% NiCl<sub>2</sub> at 25° (Foote, J Am Chem Soc **1912**, **34** 882)

100 pts absolute alcohol dissolve at room temperature 53 71 pts NiCl<sub>2</sub>+6H<sub>2</sub>O (Bodtker, Z phys Ch **1897**, **22** 511)



+7H<sub>2</sub>O 100 g absolute alcohol dissolve 2.16 g NiCl<sub>2</sub>+7H<sub>2</sub>O at 17° and 1.4 g at 3° (de Bruyn, R t c 1892, 11 156)

**Nickel hydrogen chloride**, 3NiCl<sub>2</sub>, 2HCl+1½H<sub>2</sub>O  
(Reitzenstein, Z anorg 1898, 18 270)

**Nickel rubidium chloride**, NiCl<sub>2</sub>, 2RbCl  
Easily sol in H<sub>2</sub>O and HCl+aq (Godefroy, B 8 9)

**Nickel thallic chloride**, NiCl<sub>2</sub>, 2TiCl<sub>3</sub>+8H<sub>2</sub>O  
Deliquescent Can be cryst from H<sub>2</sub>O (Gewecke, A 1909, 366 221)

**Nickel tin (stannous) chloride**, NiCl<sub>2</sub>, SnCl<sub>2</sub>+6H<sub>2</sub>O  
Sol in H<sub>2</sub>O (Jorgensen)

**Nickel tin (stannic) chloride**  
*See Chlorostannate, nickel*

**Nickel chloride ammonia**, NiCl<sub>2</sub>, 2NH<sub>3</sub>  
Sol in H<sub>2</sub>O, decomp on boiling, insol in alcohol  
(Andre, C R 1888,

Sol in cold H<sub>2</sub>O without in alcohol Very sl sol in aq  
in a sat solution of NH<sub>4</sub>Cl  
+NH<sub>4</sub>OH+aq (Sorensen, Z anorg 1894, 5 363)

**Nickel chloride cupric oxide**, NiCl<sub>2</sub>, 3CuO+4H<sub>2</sub>O  
Not decomp by H<sub>2</sub>O (Mailhe, A ch 1902, (7) 27 377)

**Nickel chloride hydrazine**, NiCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>  
Sol in dil acids and NH<sub>3</sub>+aq (Franzen, Z anorg 1908, 60 262)  
NiCl<sub>2</sub>, 3N<sub>2</sub>H<sub>4</sub> Sol in dil acids (F)

**Nickel fluoride**, NiF<sub>2</sub>  
Sol in about 5000 pts H<sub>2</sub>O, insol in alcohol and ether Not attacked by HCl, HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub> even when hot (Poulenc, C R 114 1426)

Insol in liqnd NH<sub>3</sub> (Gore, Am Ch J 1898, 20 828)  
+2H<sub>2</sub>O Decomp by pure H<sub>2</sub>O Sol in H<sub>2</sub>O acidulated with HF (Berzelius)  
+3H<sub>2</sub>O (Clarke, Sill Am J (3) 13 291)

**Nickel hydrogen fluoride**, NiF<sub>2</sub>, 5HF+6H<sub>2</sub>O  
Easily sol in H<sub>2</sub>O and dil acids Sol in NH<sub>4</sub>OH+aq with decomp (Bohm, Z anorg 1905, 43 330)

**Nickel potassium fluoride**, NiF<sub>2</sub>, KF  
+H<sub>2</sub>O Sol in H<sub>2</sub>O (Wagner, B 19 896)

NiF<sub>2</sub>, 2KF Sl sol in H<sub>2</sub>O Scarcely sol in methyl or ethyl alcohol or benzene (Poulenc, C R 114 747)

**Nickel potassium zirconium fluoride**  
*See Fluozirconate, nickel potassium*

**Nickel manganic fluoride**  
*See Fluomanganate, nickel*

**Nickel sodium fluoride**, NiF<sub>2</sub>, NaF+H<sub>2</sub>O  
Sol in H<sub>2</sub>O (Wagner, B 19 896)

**Nickel stannic fluoride**  
*See Fluostannate, nickel*

**Nickel titanium fluoride**  
*See Fluotitanate, nickel*

**Nickel tungstyl fluoride**  
*See Fluoxytungstate, nickel*

**Nickel vanadium fluoride**  
*See Fluovanadate, nickel*

**Nickel zirconium fluoride**  
*See Fluozirconate, nickel*

**Nickel fluoride ammonia**, 5NiF<sub>2</sub>, 6NH<sub>3</sub>+8H<sub>2</sub>O  
Insol in cold H<sub>2</sub>O Decomp by hot H<sub>2</sub>O Easily sol in dil acids (Bohm, Z anorg 1905, 43 334)

**Nickelous hydroxide**, 4NiO<sub>2</sub>H, H<sub>2</sub>O  
Very sl sol in H<sub>2</sub>O Sol in acids Insol in KOH or NaOH+aq Somewhat diff cultly sol in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> or NH<sub>4</sub>OH+aq, but easily sol in presence of NH<sub>4</sub> salts Sol in NH<sub>4</sub> salts+aq Sol in KCN+aq (Rodgers, 1834)  
Sol in boiling NH<sub>4</sub>Cl+aq

NiO<sub>2</sub>H<sub>2</sub>  
Solubility in NH<sub>4</sub>OH+aq at 25°

NH <sub>4</sub> norm	C Ni ppt l	C NiO <sub>2</sub> H ppt l
1	0 054	0 00287
2	0 170	0 00579
3	0 257	0 00875
4	0 360	0 01227
4 911	2 580	0 0879
3 900	1 780	0 0607
2 101	0 835	0 0281
0 602	0 158	0 0054

The non-agreement of the results is due to the formation of different modifications of NiO<sub>2</sub>H<sub>2</sub>  
(Bonsdorff, Z anorg 1904, 41 185)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$   
 Conc of  $\text{Ni} = 0.014\text{N}$  in  $1\text{N } \text{NH}_4\text{OH} + \text{Aq}$   
 " "  $= 0.036\text{N}$  "  $2\text{N } \text{NH}_4\text{OH} + \text{Aq}$   
 (Starck, B 1903, 36 3840)  
 Sol in hot  $\text{NH}_4\text{F} + \text{Aq}$  (von Helmholtz, Z anorg 1893, 3 133)  
 Insol in methyl or amyl amine (Wurtz)  
 Not pptd in presence of Na citrate (Spiller)  
 Not pptd in presence of a large number of non-volatile organic substances, particularly  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$  (Rose)

#### Nickelonickelic hydroxide, $\text{Ni}_3\text{O}_4 \cdot 2\text{H}_2\text{O}$

Sol in acids, insol in  $\text{H}_2\text{O}$  and alkalies (Dudley, J Am Chem Soc 1896, 18 901)

#### Nickelic hydroxide, $\text{Ni}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ (?)

(Wernicke, Pogg 141 122)  
 $\text{Ni}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$  (?) Sol in acids as nickelous salts Not attacked by boiling  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$  Slowly sol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$   
 Sol in  $\text{NH}_4\text{OH}$ , and  $\text{NH}_4$  salts +  $\text{Aq}$  (Odling)

#### Nickel iodide, $\text{NiI}_2$

Deliquescent and sol in  $\text{H}_2\text{O}$  (Erdmann, J pr 7 254)

Sat  $\text{NiI}_2 + \text{Aq}$  contains at

$-23^\circ$	$-6^\circ$	$+11^\circ$	$16^\circ$
51.8	54.3	57.8	59.0% $\text{NiI}_2$

$43^\circ$	$80^\circ$	$85^\circ$	$90^\circ$
64.1	65.0	65.2	65.7% $\text{NiI}_2$

(Étard, A ch 1894, (7) 2 546)

+  $6\text{H}_2\text{O}$  Deliquescent Easily sol in  $\text{H}_2\text{O}$  (Erdmann)

#### Nickel iodide ammonia, $\text{NiI}_2 \cdot 4\text{NH}_3$

(Rammelsberg, Pogg 48 119)  
 $\text{NiI}_2 \cdot 6\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$  Sol in warm dil  $\text{NH}_4\text{OH} + \text{Aq}$  Very sl sol in conc  $\text{NH}_4\text{OH} + \text{Aq}$  (Erdmann)

#### Nickel iodide hydrazine, $\text{NiI}_2 \cdot (\text{N}_2\text{H}_4)_2$

Insol in  $\text{H}_2\text{O}$  Sol in acids (Franzen, Z anorg 1911, 70 150)

#### Nickel suboxide, $\text{Ni}_3\text{O} + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ , also in  $\text{KCN} + \text{Aq}$  (Moore, C N 1895, 71 81)

#### Nickelous oxide, $\text{NiO}$

Insol in  $\text{H}_2\text{O}$  Sol in conc acids, except when crystalline, when it is scarcely attacked by acids (Fehmen, C R 33 256)  
 Very sl sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$  (Demarçay)  
 Very slowly sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Insol in  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq}$   
 Sol in min acids, especially  $\text{HCl} + \text{Aq}$ , when warmed, insol in  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{NH}_4\text{Cl}$ ,

and  $\text{NH}_4\text{SCN} + \text{Aq}$  Insol in conc  $\text{NaOH} + \text{Aq}$  (Zimmerman, A 232 324)

1 l solution containing 418.6 g sugar and 34.3 g  $\text{CaO}$  dissolves 0.29 g  $\text{NiO}$  (Bodenbender, J B 1865 600)

Min *Bunsemitte*

#### Nickelonickelic oxide, $\text{Ni}_3\text{O}_4$

Sol in acids (Baubigny, C R 87 1082)  
 +  $2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , and in alkalies +  $\text{Aq}$  Sol in acids (Dudley, J Am Chem Soc 1896, 18 901)  
 $6\text{NiO} \cdot \text{Ni}_2\text{O}_3 + \text{H}_2\text{O}$  (Schonbein, J pr 93 35)

#### Nickelic oxide, $\text{Ni}_2\text{O}_3$

Sol in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HCl} + \text{Aq}$  with decomp, also in  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Winkelblech, A 13 259)

#### Nickel peroxide, $\text{Ni}_3\text{O}_5$ (?)

(Bayley, C N 39 81)  
 Correct composition is  $\text{Ni}_2\text{O}_3$  (Carnot, C R 108 610)  
 $\text{Ni}_4\text{O}_7$  (?) (Wicke, Zeit Ch 1865 303)  
 $\text{NiO}_4$  (Hollard, C R 1903, 136 230)

#### Nickel oxychloride

Sl sol in  $\text{H}_2\text{O}$  (Berzelius)  
 $\text{NiCl} \cdot 8\text{NiO} + 13\text{H}_2\text{O}$  (Raoult, C R 69 826)

#### Nickel oxyiodide, $\text{NiI}_2 \cdot 9\text{NiO} + 15\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3 + \text{Aq}$  or acetic acid Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  Alcohol dissolves out  $\text{NiI}$  (Erdmann)

#### Nickel oxyseleamide

Almost insol in boiling  $\text{HCl}$ , decomp by  $\text{HNO}_3$  (Fonze-Diacon, C R 1900, 131 557)

#### Nickel phosphide, $\text{Ni}_3\text{P}$

Sol in  $\text{HNO}_3 + \text{Aq}$  and aqua regia, insol in  $\text{HCl} + \text{Aq}$  (Struve, J pr 79 321)  
 Sol in aqua regia and in  $\text{HNO}_3$ , sol in fused alkali (Granger, Bull Soc 1896, (3) 15 1089)

Easily sol in  $\text{HNO}_3$  (Granger, C N 1898, 77 229)

When prepared by heating phosphorus, copper and nickel in electric furnace, is insol in all acids except a mixture of  $\text{HNO}_3$  and  $\text{HF}$  (Maronneau, C R 1900, 130 657)

$\text{Ni}_3\text{P}$  Sol in  $\text{HNO}_3$ , decomp by fused  $\text{NaOH}$  (Johbois, C R 1910, 150 107)

$\text{Ni}_3\text{P}$  Sol in  $\text{HNO}_3$ , decomp by fused  $\text{NaOH}$  (J)

$\text{Ni}_3\text{P}_2$  Insol in  $\text{HNO}_3$ ,  $\text{HCl}$  and aqua regia stable in the air even when heated (Granger, Bull Soc 1896, (3) 15 1086)

$\text{Ni}_3\text{P}_2$  Not attacked by  $\text{HCl}$  Easily attacked by  $\text{HNO}_3$  (Rose, Pogg 1832, 24 232)

$\text{Ni}_3\text{P}_2$  Sol in  $\text{HNO}_3$ , aqua regia and in fused alkali (Granger, C R 1896, **123** 177)

### Nickel phosphosulphide, $\text{Ni}_3\text{PS}_2$

Decomp by hot  $\text{H}_2\text{O}$  or by aqua regia  
Sl attacked by  $\text{HNO}_3$  (Ferrand, A ch 1899, (7) **17** 417)

### Nickel semiselenide, $\text{Ni}_2\text{Se}$

Almost insol in boiling  $\text{HCl}$ , decomp by  $\text{HNO}_3$  (Fonzes-Diacon, C R 1900, **131** 557)

### Nickel selenide, $\text{NiSe}$

Insol in  $\text{H}_2\text{O}$ , dil or conc  $\text{HCl}+\text{Aq}$ , slowly sol in  $\text{HNO}_3+\text{Aq}$ , easily in aqua regia (Little, A **112** 211)

Almost insol in boiling  $\text{HCl}$ , decomp by  $\text{HNO}_3$  (Fonzes-Diacon, C R 1900, **131** 557)

$\text{NiSe}_2$  (Fonzes-Diacon)  
 $\text{Ni}_2\text{Se}_3$   
 $\text{Ni}_3\text{Se}_4$  } Almost insol in boiling  $\text{HCl}$ ,  
decomp by  $\text{HNO}_3$  (Fonzes-Diacon)

### Nickel silicide, $\text{Ni}_2\text{Si}$

Sol in  $\text{HF}$  and aqua regia, insol in cold  $\text{H}_2\text{O}$ , decomp by steam at red heat, sol in fused alkali carbonates (Vigouroux, C R 1895, **121** 687)

### Nickel semisulphide, $\text{Ni}_2\text{S}$

Sol in  $\text{HNO}_3+\text{Aq}$ , with residue of S  
Difficultly sol in conc  $\text{HCl}+\text{Aq}$ , insol in dil  $\text{HCl}+\text{Aq}$  (Arfvedson, Pogg **1** 65, Gautier, C R **108** 1111)

Does not exist (Bornemann, C A **1908** 1686)

### Nickel monosulphide, $\text{NiS}$

Anhydrous Insol in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4+\text{Aq}$  Sol in  $\text{HNO}_3+\text{Aq}$  or aqua regia  
Min *Millerite*

$+x\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , but decomp by  $\text{H}_2\text{O}$  in contact with the air (Clermont and Guot, C R **84** 714), or by boiling with  $\text{H}_2\text{O}$  (Geitner, A **139** 354)

When pptd with  $(\text{NH}_4)_2\text{S}$ , is somewhat sol in  $\text{H}_2\text{O}$  1 l  $\text{H}_2\text{O}$  dissolves  $39.87 \times 10^{-6}$  moles  $\text{NiS}$  at  $18^\circ$  (Weigel, Z phys Ch 1907, **58** 294)

Very sl sol in dil  $\text{HCl}+\text{Aq}$ , and still less in  $\text{HCl}_2\text{H}_2\text{O}_2+\text{Aq}$  (Fresenius)

More sol in  $\text{HNO}_3+\text{Aq}$ , and easily in aqua regia

Somewhat sol in  $\text{NH}_4\text{OH}+\text{Aq}$  or solutions of alkali sulphides Insol in  $\text{NH}_4\text{SH}+\text{Aq}$  (Fresenius)

Sol at moment of formation in  $\text{Na}_2\text{S}$  but not in  $(\text{NH}_4)_2\text{S}+\text{Aq}$  (Villiers, C R 1894, **119** 1264)

Sol while yet moist in  $\text{H}_2\text{SO}_3+\text{Aq}$  (Berthier)

When recently pptd, sol in  $\text{KCN}+\text{Aq}$  (Haidlen)

Pptd in presence of non-volatile organic substances as tartaric acid, etc (Rose)

Sol in potassium thiocarbonate +  $\text{Aq}$  (Rosenblatt, Z anal **26** 15)

Exists in a colloidal form in a very dil solution (Winnsinger, Bull Soc (2) **49** 452)

$\alpha$  modification  
Very sol in  $2\text{N}-\text{HCl}+\text{Aq}$  sat with  $\text{H}_2\text{S}$

$\beta$  modification  
0.033 g is sol in 1 l  $2\text{N}-\text{HCl}+\text{Aq}$  sat with  $\text{H}_2\text{S}$ , very sol in  $2\text{N}-\text{HCl}+\text{Aq}$

$\gamma$  modification  
Insol in  $2\text{N}-\text{HCl}+\text{Aq}$  sat with  $\text{H}_2\text{S}$

0.013 g is sol in  $2\text{N}-\text{HCl}+\text{Aq}$  (Thiel, C C **1914**, I 19)

### Nickel sulphide, $\text{Ni}_3\text{S}_2$

(Bornemann, C A **1908** 1686)

$\text{Ni}_3\text{S}_4$  (Bornemann)

$\text{Ni}_4\text{S}_5$  (Bornemann)

$\text{Ni}_4\text{S}_6$  Min *Polydymite* Insol in  $\text{HCl}+\text{Aq}$

Sol in  $\text{HNO}_3+\text{Aq}$  with separation of S  
 $\text{Ni}_3\text{S}_7$  Min *Beyrichite* Sol in  $\text{HCl}+\text{Aq}$

### Nickel disulphide, $\text{NiS}_2$

(Fellenberg, Pogg **50** 75)

Does not exist (Bellucci, C A **1909** 293)

### Nickel potassium sulphide, $3\text{NiS}, \text{K}_2\text{S}$

Insol in  $\text{H}_2\text{O}$  (Schneider, J pr (2) **9** 209)

$\text{K}_2\text{Ni}_{11}\text{S}_{10}$  Not attacked by hot  $(\text{NH}_4)_2\text{S}$ , slowly attacked by  $\text{HCl}$  or cold aqua regia, quickly by hot aqua regia  $\text{HF}$  and  $\text{H}_2\text{SO}_4$  dissolve only on heating Insol in organic acids, alkalies and 12%  $\text{HCl}$ , also in  $\text{KCN}$ ,  $\text{AgNO}_3$  or  $\text{CuSO}_4+\text{Aq}$  (Milbauer, Z anorg **1904**, **42** 447)

### Nickel telluride, $\text{Ni}_2\text{Te}_3$

Min *Melonite* Sol in  $\text{HNO}_3+\text{Aq}$

$\text{NiTe}$  (Fabre, C R **105** 277)

### Nickelicotungstic acid

Ammonium nickelicotungstate,  $2(\text{NH}_4)_2\text{O}, 2\text{Ni}_2\text{O}_3, 8\text{WO}_3+14\text{H}_2\text{O}$

(Rogers and Smith, J Am Chem Soc **1904**, **26** 1476)

$3(\text{NH}_4)_2\text{O}, \text{Ni}_2\text{O}_3, 16\text{WO}_3+22\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Rogers and Smith)

Barium nickelicotungstate,  $19\text{BaO}, \text{Ni}_2\text{O}_3, 16\text{WO}_3$

Ppt Very insol in  $\text{H}_2\text{O}$  (E F Smith)

### Nickelmolybdic acid

Barium nickelmolybdate,  $3\text{BaO}, \text{NiO}_2, 9\text{MoO}_3+12\text{H}_2\text{O}$

Ppt (Hall, J Am Chem Soc **1907**, **29** 702)

**Potassium nickelomolybdate**,  $3K_2O, NiO_2, 9MoO_3 + 6\frac{1}{2}H_2O$

Very insol even in hot  $H_2O$  (Hall)

### Nickelomolybdic acid

**Ammonium hydrogen nickelomolybdate**,  $(NH_4)_4H_6[Ni(MoO_4)_6] + 5H_2O$

Sl sol in  $H_2O$ , easily in dil acids (Barbieri, C A 1915 897)

**Barium hydrogen nickelomolybdate**,  $Ba_2H_6[Ni(MoO_4)_6] + 10H_2O$

Ppt (Barbieri)

**Potassium hydrogen nickelomolybdate**,  $K_4H_6[Ni(MoO_4)_6] + 5H_2O$

Sl sol in  $H_2O$ , easily in acids (Barbieri)

**Silver hydrogen nickelomolybdate**,  $Ag_4H_6[Ni(MoO_4)_6] + 3H_2O$

Insol in  $H_2O$ , sol in  $NH_4OH$ , or  $HNO_3 + Aq$  (Barbieri)

### Nickelonickelous acid

**Potassium nickelonickelite**,  $K_2Ni_2O_4$  or  $K_2O, NiO, NiO_2$

(Hofmann and Hiendlmaier, B 1906, 39 3186)

**Sodium nickelonickelite**,  $Na_2Ni_2O_6 = Na_2O, NiO, 2NiO_2$

(Bellucci and Rubegni, C C 1907, I 794)

### Nickelous acid

**Barium dnickelite**,  $BaO, 2NiO_2$

Unstable, decomp by cold  $H_2O$ , slowly and very rapidly by hot  $H_2O$  (Dufau, C R 1896, 123 496)

### Niobium, Nb

For niobium and its compounds, see columbium, Cb, and the corresponding compounds

### Nitramide, $NH_2NO_2$

Decomp by conc  $H_2SO_4$  Easily sol in  $H_2O$ , alcohol, ether and acetone Less sol in benzol Almost insol in ligroin (Thiele and Lachman, A 1895, 288 297)

Sol in ether, insol in petroleum ether Very unstable, decomp by hot  $H_2O$  (Thiele and Lachman, B 1894, 27 1909)

### Nitratochloroplatinamine comps

See Chloronitratoptatinamine comps

### Nitratocobalt octamine comps

See Nitratooctamine cobaltic comps

### Nitratooctamine cobaltic carbonate,

$(NO_3)_2Co_2(NH_3)_8(CO_3)_2 + H_2O$

Less sol than other octamine carbonates (Vortmann and Blasberg, B 22 2650)

— **chloride**,  $(NO_3)_2Co_2(NH_3)_8Cl_4 + 4H_2O$   
(Vortmann and Blasberg, B 22 2652)

— **iodide**,  $(NO_3)_2Co_2(NH_3)_8I_4 + 2H_2O$   
(Vortmann and Blasberg)

— **nitrate**

See Octamine cobaltic nitrate

— **sulphate**,  $(NO_3)_2Co_2(NH_3)_8(SO_4)_2 + 2H_2O$   
 $+ 4H_2O$  (Vortmann and Blasberg, B 22 2652)

### Nitratoptatinamine nitrate,

$(NO_3)_2Pt(NH_3NO_2)_2$

Sl sol in cold, more easily in hot  $H_2O$ , easily sol in dil  $HNO_3 + Aq$  (Cleve)

— **nitrite**,  $(NO_3)_2Pt(NH_3NO_2)_2$

Easily sol in  $H_2O$  (Cleve)

### Nitratoptatindiamine chloride,

$(NO_3)_2Pt(N_2H_6Cl)_2 + H_2O$

Moderately sol in cold, very easily in hot  $H_2O$

— **chloroplatinate**,  $(NO_3)_2Pt(N_2H_6Cl)_2, PtCl_4 + 2H_2O$

Ppt

— **chromate**,  $(NO_3)_2Pt(N_2H_6)_2CrO_4$

Nearly insol in  $H_2O$  (Cleve)

— **dichromate**,  $(NO_3)_2Pt(N_2H_6)_2Cr_2O_7$

Sl sol in  $H_2O$

— **nitrate**,  $(NO_3)_2Pt(N_2H_6NO_3)_2$

Sol in  $H_2O$  Insol in  $HNO_3 + Aq$

— **phosphate**,  $NO_3Pt(N_2H_6) + H_2O$



Very sl sol in  $H_2O$  (Cleve)

### Nitratoptatindiamine nitrate,

$(NO_3)_2Pt_2(N_2H_6)_4(NO_3)_4$

Sol in  $H_2O$  with decomp

### Nitratopurpureocobaltic bromide,

$Co(NO_3)(NH_3)_5Br$

Resembles the chloride in its properties (Jorgensen, J pr (2) 23 227)

**Nitratopurpureocobaltic carbonate,**  
 $\text{Co}(\text{NO}_3)(\text{NH}_3)_5(\text{CO}_3) + \text{H}_2\text{O}$ 

Less sol in  $\text{H}_2\text{O}$  than other purpureocarbonates (Vortmann and Blasberg, B 22 2648)

— **chloride**,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{Cl}_2$ 

Sl sol in cold  $\text{H}_2\text{O}$ , but more than nitrate, more easily sol in hot  $\text{H}_2\text{O}$ , but is converted into roseo salt Insol in  $\text{HCl} + \text{Aq}$  or alcohol (Jorgensen, J pr (2) 23 227)

— **mercuric chloride**,  
 $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{Cl}_2, \text{HgCl}_2$ 

Not wholly insol in  $\text{H}_2\text{O}$  (Jorgensen)

— **chloroplatinate**,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{Cl}_2, \text{PtCl}_4$ 

Ppt Nearly insol in cold  $\text{H}_2\text{O}$  (Jorgensen)

— **chromate**,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{CrO}_4$ 

Nearly insol in  $\text{H}_2\text{O}$  (Jorgensen)

— **dichromate**

Sl sol in  $\text{H}_2\text{O}$ , but more easily than the neutral salt (Jorgensen)

— **dithionate**,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{S}_2\text{O}_8$ 

Very sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  (Jorgensen)

— **nitrate**,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5(\text{NO}_3)_2$ 

Sol in 273 pts  $\text{H}_2\text{O}$  at  $16^\circ$  Much more sol in hot  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$  (Jorgensen, J pr (2) 23 227)

— **cobaltic nitrite**,  $3\text{Co}(\text{NO}_3)(\text{NH}_3)_5, 2\text{Co}(\text{NO}_2)_6 + 2\text{H}_2\text{O}$ 

Very sl sol in  $\text{H}_2\text{O}$  (Jorgensen, Z anorg 5 176)

— **diamine cobaltic nitrite**,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5(\text{NO}_2)_4\text{Co}(\text{NH}_3)_2$ 

Ppt (Jorgensen)

— **oxalate**,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{C}_2\text{O}_4$ 

Ppt

— **sulphate**,  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{SO}_4 + \text{H}_2\text{O}$ 

Rather difficultly sol in cold  $\text{H}_2\text{O}$  (Jorgensen)

**Nitratopurpureorhodium chloride,**  
 $(\text{NO}_3)_3\text{Rh}(\text{NH}_3)_5\text{Cl}_2$ 

Sl sol in cold  $\text{H}_2\text{O}$ , but more easily than the nitrate (Jorgensen, J pr (2) 34 394)

— **dithionate**,  $(\text{NO}_3)_3\text{Rh}(\text{NH}_3)_5\text{S}_2\text{O}_8 + \text{H}_2\text{O}$ 

Nearly insol in cold  $\text{H}_2\text{O}$  (Jorgensen)

**Nitratopurpureorhodium nitrate,**  
 $(\text{NO}_3)_3\text{Rh}(\text{NH}_3)_5(\text{NO}_3)_2$ 

Very sl sol in cold  $\text{H}_2\text{O}$  Insol in alcohol (Jorgensen)

**Nitric acid,  $\text{HNO}_3$** 

Miscible with  $\text{H}_2\text{O}$  When  $\text{HNO}_3 + \text{Aq}$  is distilled at 760 mm pressure, an acid containing 68%  $\text{HNO}_3$  is formed, which boils at  $120.5^\circ$  under 735 mm pressure By distilling at 150 mm pressure the acid contains 67.6%  $\text{HNO}_3$ , at 70 mm (b-pt  $65-70^\circ$ ) the acid contains 66.7%  $\text{HNO}_3$  The percentage of  $\text{HNO}_3$  in the liquid obtained by passing dry air into  $\text{HNO}_3 + \text{Aq}$  containing 64-68%  $\text{HNO}_3$  varies with the temp, the higher the temp the greater the percentage of  $\text{HNO}_3$  (Roscoe, Chem Soc 13 150)

$\text{HNO}_3 + \text{Aq}$ of 1	51	sp gr contains 67% $\text{N}_2\text{O}_5$
	1 42	54
	1 35	44 4
	1 315	38 6

(Dalton)

$\text{HNO}_3 + \text{Aq}$ of 1	52	sp gr	68.22% $\text{N}_2\text{O}_5$
	1 522		
	1 4		41

(Mitscherlich)

$\text{HNO}_3 + \text{Aq}$  of 1 298 sp gr contains 36.75%  $\text{N}_2\text{O}_5$  (Kirwan)

$\text{HNO}_3 + \text{Aq}$  of 1 298 sp gr contains 18% (Davy)

$\text{HNO}_3 + \text{Aq}$  of 1 298 sp gr contains 32-33% (Berthollet)

For Ure's table of sp gr of  $\text{HNO}_3 + \text{Aq}$ , see Watt's Dict 1st ed

**Sp gr of  $\text{HNO}_3 + \text{Aq}$  at  $0^\circ$  and  $15^\circ$** 

% $\text{HNO}_3$	% $\text{N}_2\text{O}_5$	Sp gr at $0^\circ$	Sp gr at $15^\circ$
100 00	85 71	1 559	1 530
99 84	85 57	1 559	1 530
99 72	85 47	1 558	1 530
99 52	85 30	1 557	1 529
97 89	83 90	1 551	1 523
97 00	83 14	1 548	1 520
96 00	82 28	1 544	1 516
95 27	81 66	1 542	1 514
94 00	80 57	1 537	1 509
93 01	79 72	1 533	1 506
92 00	78 85	1 529	1 503
91 00	78 00	1 526	1 499
90 00	77 15	1 522	1 495
89 56	76 77	1 521	1 494
88 00	75 43	1 514	1 488
87 45	74 95	1 513	1 486
86 17	73 86	1 507	1 482
85 00	72 86	1 503	1 475
84 00	72 00	1 499	1 474
83 00	71 14	1 495	1 470
82 00	70 28	1 492	1 467
80 96	69 39	1 488	1 463
80 00	68 77	1 484	1 460
79 00	67 71	1 481	1 456
77 66	66 56	1 476	1 451
76 00	65 14	1 469	1 445
75 00	64 28	1 465	1 442
74 01	63 44	1 462	1 438

Sp gr of  $\text{HNO}_3$ , etc—Continued

% $\text{HNO}_3$	% $\text{N}_2\text{O}_5$	Sp gr at 6°	Sp gr at 15°
73 00	62 57	1 457	1 435
72 39	62 05	1 455	1 432
71 24	61 06	1 450	1 429
69 96	60 00	1 444	1 423
69 20	59 31	1 441	1 419
68 00	58 29	1 435	1 414
67 00	57 43	1 430	1 410
66 00	56 57	1 425	1 405
65 07	55 77	1 420	1 400
64 00	54 84	1 415	1 395
63 59	54 50	1 413	1 393
62 00	53 14	1 404	1 386
61 21	52 46	1 400	1 381
60 00	51 43	1 393	1 374
59 59	51 08	1 391	1 372
58 88	50 47	1 387	1 368
58 00	49 71	1 382	1 363
57 00	48 86	1 376	1 358
56 10	48 08	1 371	1 353
55 00	47 14	1 365	1 346
54 00	46 29	1 359	1 341
53 81	46 12	1 358	1 339
53 00	45 40	1 353	1 335
52 33	44 85	1 349	1 331
50 99	43 70	1 341	1 323
49 97	42 83	1 334	1 317
49 00	42 00	1 328	1 312
48 00	41 14	1 321	1 307
47 18	40 44	1 315	1 308
46 64	39 97	1 312	1 295
45 00	38 57	1 300	1 284
43 53	37 31	1 291	1 274
42 00	36 00	1 280	1 264
41 00	35 14	1 274	1 257
40 00	34 28	1 267	1 251
39 00	33 43	1 260	1 244
37 95	32 53	1 253	1 237
36 00	30 86	1 240	1 225
35 00	29 99	1 234	1 218
33 86	29 02	1 226	1 211
32 00	27 43	1 214	1 198
31 00	26 57	1 207	1 192
30 00	25 71	1 200	1 185
29 00	24 85	1 194	1 179
28 00	24 00	1 187	1 172
27 00	23 14	1 180	1 166
25 71	22 04	1 171	1 157
23 00	19 71	1 153	1 138
20 00	17 14	1 132	1 120
17 47	14 97	1 115	1 105
15 00	12 85	1 099	1 089
13 00	11 14	1 085	1 077
11 41	9 77	1 075	1 067
7 72	6 62	1 050	1 045
4 00	3 42	1 026	1 022
2 00	1 71	1 013	1 010
0 00	0 00	1 000	0 999

(Kolb, A ch (4) 10 140)

Sp gr of  $\text{HNO}_3$ +Aq at 15° a = % $\text{O}_2$ , b = sp gr if % is  $\text{N}_2\text{O}_5$ , c = sp gr if % is  $\text{HNO}_3$ 

a	b	c	a	b	c
1	1 007	1 006	51	1 372	1 323
2	1 014	1 012	52	1 378	1 329
3	1 021	1 018	53	1 385	1 335
4	1 027	1 024	54	1 390	1 341
5	1 034	1 029	55	1 396	1 346
6	1 040	1 035	56	1 401	1 356
7	1 047	1 040	57	1 407	1 358
8	1 053	1 045	58	1 413	1 363
9	1 061	1 051	59	1 418	1 369
10	1 069	1 057	60	1 423	1 374
11	1 076	1 064	61	1 427	1 380
12	1 083	1 070	62	1 432	1 386
13	1 091	1 077	63	1 436	1 390
14	1 098	1 083	64	1 440	1 395
15	1 104	1 089	65	1 445	1 400
16	1 112	1 095	66	1 449	1 405
17	1 120	1 100	67	1 452	1 410
18	1 126	1 106	68	1 457	1 414
19	1 134	1 112	69	1 461	1 419
20	1 141	1 120	70	1 466	1 422
21	1 149	1 126	71	1 470	1 427
22	1 156	1 132	72	1 474	1 430
23	1 165	1 138	73	1 478	1 435
24	1 172	1 145	74	1 482	1 439
25	1 180	1 151	75	1 486	1 442
26	1 187	1 159	76	1 490	1 445
27	1 195	1 166	77	1 494	1 449
28	1 202	1 172	78	1 499	1 452
29	1 211	1 179	79	1 503	1 456
30	1 218	1 185	80	1 507	1 460
31	1 225	1 192	81	1 511	1 463
32	1 232	1 198	82	1 515	1 467
33	1 240	1 204	83	1 519	1 470
34	1 248	1 210	84	1 523	1 474
35	1 255	1 218	85	1 527	1 478
36	1 264	1 225	86	1 530	1 481
37	1 271	1 230	87		1 484
38	1 280	1 236	88		1 488
39	1 286	1 244	89		1 491
40	1 295	1 251	90		1 495
41	1 304	1 257	91		1 499
42	1 312	1 264	92		1 503
43	1 318	1 270	93		1 506
44	1 325	1 276	94		1 509
45	1 332	1 284	95		1 512
46	1 340	1 290	96		1 516
47	1 346	1 298	97		1 520
48	1 352	1 304	98		1 523
49	1 360	1 312	99		1 526
50	1 366	1 316	100		1 530

(Kolb, calculated by Gerlich, Z anal 8 292)

Sp gr of  $\text{HNO}_3$ +Aq at 17 5°

% $\text{N}_2\text{O}_5$	Sp gr	% $\text{N}_2\text{O}_5$	Sp gr	% $\text{N}_2\text{O}_5$	Sp gr
5	1 032	9	1 060	13	1 089
6	1 038	10	1 068	14	1 096
7	1 045	11	1 075	15	1 104
8	1 053	12	1 082	16	1 111

Sp gr of HNO<sub>3</sub>, etc—Continued

% N <sub>2</sub> O <sub>5</sub>	Sp gr	% N <sub>2</sub> O <sub>5</sub>	Sp gr	% N <sub>2</sub> O <sub>5</sub>	Sp gr
17	1 118	40	1 294	63	1 434
18	1 125	41	1 301	64	1 438
19	1 132	42	1 308	65	1 442
20	1 140	43	1 315	66	1 447
21	1 147	44	1 323	67	1 451
22	1 115	45	1 330	68	1 456
23	1 163	46	1 338	69	1 460
24	1 170	47	1 345	70	1 465
25	1 178	48	1 352	71	1 469
26	1 186	49	1 358	72	1 472
27	1 194	50	1 364	73	1 476
28	1 201	51	1 371	74	1 480
29	1 209	52	1 377	75	1 484
30	1 217	53	1 383	76	1 488
31	1 224	54	1 389	77	1 492
32	1 232	55	1 394	78	1 496
33	1 239	56	1 400	79	1 500
34	1 247	57	1 406	80	1 504
35	1 255	58	1 412	81	1 508
36	1 263	59	1 416	82	1 512
37	1 271	60	1 421	83	1 516
38	1 279	61	1 426	84	1 519
39	1 287	62	1 430	85	1 523

(Hager, Comm 1883)

Sp gr HNO<sub>3</sub>+Aq at 17 5°

% N <sub>2</sub> O <sub>5</sub>	Sp gr	% N <sub>2</sub> O <sub>5</sub>	Sp gr	% N <sub>2</sub> O <sub>5</sub>	Sp gr
10	1 068	40	1 293	70	1 465
15	1 104	50	1 361	80	1 500
20	1 140	60	1 417	85	1 514
30	1 217				

(Hager, Adjumenta varia, Leipzig, 1876)

Sp gr of HNO<sub>3</sub>+Aq at 15°

% HNO <sub>3</sub>	Sp gr	% HNO <sub>3</sub>	Sp gr
1	1 00581	26	1 15869
2	1 01136	27	1 16660
3	1 01713	28	1 17371
4	1 02286	29	1 18073
5	1 02851	30	1 18830
6	1 03439	31	1 19552
7	1 04019	32	1 20276
8	1 04592	33	1 20635
9	1 05234	34	1 21300
10	1 05746	35	1 22013
11	1 06330	36	1 22675
12	1 06951	37	1 23347
13	1 07581	38	1 23980
14	1 08126	39	1 24510
15	1 08843	40	1 25235
16	1 09500	41	1 25850
17	1 10102	42	1 26475
18	1 10725	43	1 27125
19	1 11321	44	1 28895
20	1 12024	45	1 28450
21	1 12714	46	1 29110
22	1 13349	47	1 29780
23	1 13890	48	1 30443
24	1 14460	49	1 31101
25	1 15164	50	1 31722

(Squires, Pharm Era, Jan 1891)

## Most accurate table

Sp gr of HNO<sub>3</sub>+Aq at 15°, H<sub>2</sub>O at 4°=1

Sp gr	% N <sub>2</sub> O <sub>5</sub>	% HNO <sub>3</sub>	Kg HNO <sub>3</sub> in 1 l
1 000	0 08	0 10	0 001
1 005	0 85	1 00	0 010
1 010	1 62	1 90	0 019
1 015	2 39	2 80	0 028
1 020	3 17	3 70	0 038
1 025	3 94	4 60	0 047
1 030	4 71	5 50	0 057
1 035	5 47	6 38	0 066
1 040	6 22	7 26	0 075
1 045	6 97	8 13	0 085
1 050	7 71	8 99	0 094
1 055	8 43	9 84	0 104
1 060	9 15	10 68	0 113
1 065	9 87	11 51	0 123
1 070	10 57	12 33	0 132
1 075	11 27	13 15	0 141
1 080	11 96	13 95	0 151
1 085	12 64	14 74	0 160
1 090	13 31	15 53	0 169
1 095	13 99	16 32	0 179
1 100	14 67	17 11	0 188
1 105	15 34	17 89	0 198
1 110	16 00	18 67	0 207
1 115	16 67	19 45	0 217
1 120	17 34	20 23	0 227
1 125	18 00	21 00	0 236
1 130	18 66	21 77	0 246
1 135	19 32	22 54	0 256
1 140	19 98	23 31	0 266
1 145	20 64	24 08	0 276
1 150	21 29	24 84	0 286
1 555	21 94	25 60	0 296
1 160	22 60	26 36	0 306
1 165	23 25	27 12	0 316
1 170	23 90	27 88	0 326
1 175	24 54	28 63	0 336
1 180	25 18	29 38	0 347
1 185	25 83	30 13	0 357
1 190	26 47	30 88	0 367
1 195	27 10	31 62	0 378
1 200	27 74	32 36	0 388
1 205	28 36	33 09	0 399
1 210	28 99	33 82	0 409
1 215	29 61	34 55	0 420
1 220	30 24	35 28	0 430
1 225	30 88	36 03	0 441
1 230	31 53	36 78	0 452
1 235	32 17	37 53	0 463
1 240	32 82	38 29	0 475
1 245	33 47	39 05	0 486
1 250	34 13	39 82	0 498
1 255	34 78	40 58	0 509
1 260	35 44	41 34	0 521
1 265	36 09	42 10	0 533
1 270	36 75	42 87	0 544
1 275	37 41	43 64	0 556
1 280	38 07	44 41	0 568
1 285	38 73	45 18	0 581
1 290	39 39	45 95	0 593
1 295	40 05	46 72	0 605

Sp gr of  $\text{HNO}_3$ , etc—Continued

Sp gr	% $\text{N}_2\text{O}_5$	% $\text{HNO}_3$	Kg $\text{HNO}_3$ in 1 l
1 300	40 71	47 49	0 617
1 305	41 37	48 26	0 630
1 310	42 06	49 07	0 643
1 315	42 76	49 89	0 656
1 320	43 47	50 71	0 669
1 325	44 17	51 53	0 683
1 330	44 89	52 37	0 697
1 335	45 62	53 22	0 710
1 340	46 35	54 07	0 725
1 345	48 07	54 93	0 739
1 350	47 82	55 79	0 753
1 355	48 57	56 66	0 768
1 360	49 35	57 57	0 783
1 365	50 13	58 48	0 798
1 370	50 91	59 39	0 814
1 375	51 69	60 30	0 829
1 380	52 52	61 27	0 846
1 385	53 35	62 24	0 862
1 390	54 20	63 23	0 879
1 395	55 07	64 25	0 896
1 400	55 97	65 30	0 914
1 405	56 92	66 40	0 933
1 410	57 86	67 50	0 952
1 415	58 83	68 63	0 971
1 420	59 83	69 80	0 991
1 425	60 84	70 98	1 011
1 430	61 86	72 17	1 032
1 435	62 91	73 39	1 053
1 440	64 01	74 68	1 075
1 445	65 13	75 98	1 098
1 450	66 24	77 28	1 121
1 455	67 38	78 60	1 144
1 460	68 56	79 98	1 168
1 465	69 79	81 42	1 193
1 470	71 06	82 90	1 219
1 475	72 39	84 45	1 246
1 480	73 76	86 05	1 274
1 485	75 18	87 70	1 302
1 490	76 80	89 60	1 335
1 495	78 57	91 60	1 369
1 500	80 65	94 09	1 411
1 501	81 09	94 60	1 420
1 502	81 50	95 08	1 428
1 503	81 91	95 55	1 436
1 504	82 29	96 00	1 444
1 505	82 63	96 39	1 451
1 506	82 94	96 76	1 457
1 507	83 26	97 13	1 464
1 508	83 58	97 50	1 470
1 509	83 87	97 84	1 476
1 510	84 09	98 10	1 481
1 511	84 28	98 32	1 486
1 512	84 46	98 53	1 490
1 513	84 63	98 73	1 494
1 514	84 87	98 90	1 497
1 515	84 92	99 07	1 501
1 516	85 04	99 21	1 504
1 517	85 15	99 34	1 507
1 518	85 26	99 46	1 510
1 519	85 35	99 57	1 512
1 520	85 44	99 67	1 515

Sp gr of  $\text{N-HNO}_3 + \text{Aq}$  at  $18^\circ/4^\circ = 1.0324$   
(Loomis, W Ann 1896, 60 550)

Sp gr (reduced to a vacuum) of  $\text{HNO}_3$  from  
78–100% concentration at  $4^\circ/4^\circ$ ,  
14  $2^\circ/4^\circ$  and 24  $2^\circ/4^\circ$

% $\text{HNO}_3$	Sp gr		
	$4^\circ/4^\circ$	14 $2^\circ/4^\circ$	24 $2^\circ/4^\circ$
78 22	1 47129	1 45504	1 43964
79 14		1 46011	1 44372
79 59	1 47496		
81 97	1 48391	1 46680	1 45092
84 90	1 49495		
85 21	1 49581		
85 80		1 47826	1 46224
87 55	1 50211		
87 90		1 48491	1 46891
89 73	1 50898	1 49125	
92 34	1 51804	1 49968	1 48264
94 04	1 51949	1 50149	1 48516
95 62	1 52192	1 50358	1 48677
96 64	1 52510	1 50632	1 48887
97 33		1 50911	1 49137
98 07	1 53212	1 51298	1 49543
99 97	1 54212	1 52236	1 50394

(Veley and Manley, Chem Soc 1903, 83  
1016)

Sp gr at  $20^\circ$  of  $\text{HNO}_3 + \text{Aq}$  containing M  
g mols  $\text{HNO}_3$  per liter

M 0 025 0 05 0 075 0 10  
Sp gr 1 000926 1 001798 1 002653 1 003496

M 0 25 0 5 0 75 1 0

Sp gr 1 008481 1 01686 1 02503 1 0336

M 2 0

Sp gr 1 0670

(Jones and Pearce, Am Ch J 1907, 38 732)

For sp gr of  $\text{HNO}_3 + \text{H}_2\text{SO}_4$ , see under  
 $\text{H}_2\text{SO}_4$

Partition coefficient for  $\text{HNO}_3$  between  
ether and  $\text{H}_2\text{O}$  is increased by the addition  
of nitrates (Tanret, C R 1897, 124 464)

The hydrates described by Erdmann do  
not exist. There are only two authentic hy-  
drates, the mono- and the tri-hydrate  
(Kuster, Ch Z 1904, 28 132)

The composition of the hydrates formed  
by  $\text{HNO}_3$  at different dilutions is calculated  
from determinations of the lowering of the  
fr-pt produced by  $\text{HNO}_3$  and of the con-  
ductivity and sp gr of  $\text{HNO}_3 + \text{Aq}$  (Jones,  
Am Ch J 1905, 34 328)

**Dinitric acid**,  $\text{H}_2\text{N}_4\text{O}_{11} = 2\text{N}_2\text{O}_5, \text{H}_2\text{O}$

Fumes on air. Miscible with  $\text{H}_2\text{O}$ , with  
evolution of much heat (Weber, J pr (2)  
6 342)

**Nitrates**

All nitrates are sol in  $\text{H}_2\text{O}$  except a few  
basic compounds. Most nitrates are insol in



conc  $\text{HNO}_3 + \text{Aq}$ , many are sol in alcohol, some are sol in glycerine

**Aluminum nitrate, basic**,  $2\text{Al}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Ordway, Sil Am J (2) 26 203)

Basic aluminum nitrates containing 2 mols or less of  $\text{Al}_2\text{O}_3$  to one of  $\text{N}_2\text{O}_5$  may be obtained sol in  $\text{H}_2\text{O}$ , but the compounds containing more than 2 mols  $\text{Al}_2\text{O}_3$  are insol in  $\text{H}_2\text{O}$  (Ordway, l c)

$2\text{Al}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 + 10\text{H}_2\text{O}$  (Ditte, C R 110 782)

$\text{Al}_6\text{O}_{14}\text{H}_{10}$ ,  $\text{HNO}_3$  Sol in  $\text{H}_2\text{O}$  (Schlumberger, Bull Soc 1895, (3) 13 59)

**Aluminum nitrate**,  $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$

Deliquescent Very sol in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3 + \text{Aq}$ , or alcohol (Berzelius)

Melts in its crystal  $\text{H}_2\text{O}$  at  $72^\circ$  (Ordway Sol in 1 pt strong alcohol (Wenzel)

Difficultly sol in acetone (Naumann, B 1904, 37 4328)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

**Ammonium nitrate**,  $\text{NH}_4\text{NO}_3$

Deliquescent

Sol in 0.502 pt  $\text{H}_2\text{O}$  at  $18^\circ$  (Karsten)

Sol in 0.54 pt  $\text{H}_2\text{O}$  at  $10^\circ$  (Harris C R 24 816)

Much more sol in hot than cold  $\text{H}_2\text{O}$  (Harris)

Sol in 2 pts  $\text{H}_2\text{O}$  at  $15^\circ$  and 0.5 pt boiling  $\text{H}_2\text{O}$  (Foureroy)

Sol in 1 pt cold and 0.5 pt boiling  $\text{H}_2\text{O}$  (Foureroy)

Sol in 0.5 pt  $\text{H}_2\text{O}$  at  $18^\circ$  (Berzelius)

Sol in 2 pts  $\text{H}_2\text{O}$  at  $18^\circ$  (Abi)

Decomp by boiling  $\text{H}_2\text{O}$

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{NH}_4\text{NO}_3$	$t^\circ$	Pts $\text{NH}_4\text{NO}_3$	$t^\circ$	Pts $\text{NH}_4\text{NO}_3$
0	97	24	205	48	351
1	101	25	210	49	358
2	105	26	216	50	365
3	109	27	221	51	372
4	113	28	226	52	379
5	117	29	232	53	387
6	121	30	238	54	395
7	125	31	244	55	402
8	130	32	250	56	410
9	134	33	256	57	418
10	139	34	262	58	425
11	143	35	268	59	433
12	148	36	274	60	441
13	152	37	280	61	449
14	157	38	286	62	457
15	161	39	292	63	465
16	166	40	298	64	473
17	170	41	304	65	481
18	175	42	311	66	490
19	180	43	317	67	499
20	185	44	324	68	508
21	190	45	331	69	517
22	195	46	337	70	526
23	200	47	344		

(Mulder, Scheek Verhandel 1864 95)

100 pts  $\text{H}_2\text{O}$  dissolve 183 pts  $\text{NH}_4\text{NO}_3$  at  $19.5^\circ$  (Mulder)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Specific gravity of the saturated solution	Mols of $\text{NH}_4\text{NO}_3$ soluble in 100 mols of water
12 2	1 2945	34 50
20 2	1 3116	43 30
23 0	1 3159	46 57
25 0	1 3197	48 19
27 7	1 3257	51 67
28 0	1 3260	51 86
30 0	1 3299	54 40
30 2	1 3308	54 61
31 9	1 3348	57 20
32 1	1 3344	57 60
32 7	1 3356	57 90
34 0	1 3375	58 89
35 0	1 3394	59 80
35 1	1 3397	60 00
35 6	1 3408	60 62
36 0	1 3412	61 00
36 6	1 3420	
37 5	1 3432	62 90
38 0	1 3438	63 60
38 5	1 3440	64 10
39 0	1 3448	65 09
39 5	1 3460	65 88
40 0	1 3464	66 80

(Muller and Kaufmann, Z phys Ch 19, 42 499)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	G $\text{NH}_4\text{NO}_3$ per 100 g		Solid phase
	solution	water	
0	54 19	118 3	$\text{NH}_4\text{NO}_3$ rhomb $\beta$
12 2	60 53	153 4	
20 2	65 80	192 4	
25 0	68 17	214 2	
30 0	70 73	241 8	$\text{NH}_4\text{NO}_3$ rhomb $\beta$
32 1	71 97	256 9	
35	72 64	265 8	rhomb $\alpha$
40	74 82	297 0	
50	77 49	344 0	$\text{NH}_4\text{NO}_3$ rhomb $\alpha$
60	80 81	421 0	
70	83 32	499 0	$\text{NH}_4\text{NO}_3$ rhomb (
80	85 25	580 0	
90	88 08	740 0	
100	89 71	871 0	

(Saidell's Solubilities 1st ed 28 Cule f m  
Muller & Kauffmann, see above, id  
Schwarz, Ostwald's Lehrb, p 425)

100 g  $\text{NH}_4\text{NO}_3 + \text{Aq}$  contain

54 19 g  $\text{NH}_4\text{NO}_3$  at  $0^\circ$

70 10 g " "  $30^\circ$

84 03 g " "  $70^\circ$

(de Waal, Dissert Leiden, 1910)

70.19 g  $\text{NH}_4\text{NO}_3$  are contained in 100 g  $\text{NH}_4\text{NO}_3 + \text{Aq}$  sat at  $30^\circ$  (Schreinemakers and de Baat, Arch near Sc 1911, (2) 15 415)

60 pts  $\text{NH}_4\text{NO}_3$  mixed with 100 pts  $\text{H}_2\text{O}$  lower the temperature from  $13.6^\circ$  to  $-13.6^\circ$ , that is  $27.2^\circ$ , but if the initial temperature is  $0^\circ$  it will fall only to  $-16.7^\circ$  the freezing-point of the mixture (Rudorff, B 2 68)

Sp gr of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $18^\circ$

Pts $\text{NH}_4\text{NO}_3$	Pts $\text{H}_2\text{O}$	Sp gr
80	1800	1.0180
80	900	1.0331
80	360	1.0743

(Thomsen and Gerlach, Z anal 28 520)

Sp gr of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $15^\circ$

% $\text{NH}_4\text{NO}_3$	Sp gr	% $\text{NH}_4\text{NO}_3$	Sp gr
5	1.0201	30	1.1304
10	1.0419	40	1.1780
20	1.0860	50	1.2279

(Kohlrausch, W Ann 1879 1)

Sp gr of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $17.5^\circ$

% $\text{NH}_4\text{NO}_3$	Sp gr	% $\text{NH}_4\text{NO}_3$	Sp gr
1	1.0042	33	1.1454
2	1.0085	34	1.1502
3	1.0127	35	1.1550
4	1.0170	36	1.1598
5	1.0212	37	1.1646
6	1.0255	38	1.1694
7	1.0297	39	1.1742
8	1.0340	40	1.1790
9	1.0382	41	1.1841
10	1.0425	42	1.1892
11	1.0468	43	1.1942
12	1.0512	44	1.1994
13	1.0555	45	1.2045
14	1.0599	46	1.2096
15	1.0642	47	1.2147
16	1.0686	48	1.2198
17	1.0729	49	1.2249
18	1.0773	50	1.2300
19	1.0816	51	1.2353
20	1.0860	52	1.2407
21	1.0905	53	1.2460
22	1.0950	54	1.2514
23	1.0995	55	1.2567
24	1.1040	56	1.2621
25	1.1085	57	1.2674
26	1.1130	58	1.2728
27	1.1175	59	1.2781
28	1.1220	60	1.2835
29	1.1265	61	1.2888
30	1.1310	62	1.2942
31	1.1358	63	1.3005
32	1.1406	64	1.3059

(Gerlach, Z anal 27 310)

Sp gr of  $\text{NH}_4\text{NO}_3 + \text{Aq}$

% $\text{NH}_4\text{NO}_3$	Sp gr $16^\circ/16^\circ$
0	1.000000
0.6419	1.000271
1.4101	1.000593
2.7501	1.001153
5.4890	1.002300
11.7981	1.004916
23.4480	1.009758
47.9500	1.019952

(Dyken Z phys Ch 1897, 24 107)

Sp gr  $20^\circ/4^\circ$  of a normal solution of  $\text{NH}_4\text{NO}_3$  = 1.030435, of a 0.5-normal solution = 1.014505 (Haugh, J Am Chem Soc 1912, 34 1151)

B-pt of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  containing pts  $\text{NH}_4\text{NO}_3$  to 100 pts  $\text{H}_2\text{O}$  G = according to Gerlach (Z anal 26 445), L = according to Legrand (A ch (2) 59 426)

B-pt	G	L	B-pt	G	L
101°	10	10	140°	682	770 5
102	20	20 5	141	719	
103	30	31 3	142	737	840 6
104	41	42 4	143	765	
105	52	53 8	144	793	915 5
106	63	65 4	145	823	
107	74	77 3	146	853	995 5
108	85	89 4	147	883	
109	96	101 9	148	914	1081 5
110	108	114 9	149	945	
111	120	128 4	150	977	1173 5
112	132	142 4	151	1009	
113	145	156 9	152	1043	1273
114	158	172	153	1079	
115	172	188	154	1116	1383
116	187	204 4	155	1155	
117	202	221 4	156	1196	1504
118	217	238 4	157	1238	
119	232	256 8	158	1281	1637
120	248	275 3	159	1325	
121	265		160	1370	1775
122	283	314	161	1417	
123	301		162	1464	1923
124	319	354	163	1511	
125	337		164	1558	2084
126	356	396	165	1606	
127	376		166	1653	
128	396	440 2	167	1700	
129	417		168	1748	
130	439	487 4	169	1796	
131	461		170	1844	
132	484	537 3	180	2400	$\infty$
133	507		190	3112	
134	530	590	200	4099	
135	554		210	5618	
136	578	645	220	8547	
137	603		230	16950	
138	629	705 5	240	$\infty$	
139	655				

Very sol in  $\text{HNO}_3 + \text{Aq}$  (Schulz, Zeit Ch 1869 531)

### Solubility of $\text{NH}_4\text{NO}_3$ in $\text{HNO}_3$

Solution temp	% by wt $\text{NH}_4\text{NO}_3$	Solid phase
+8°	21 1	$\text{NH}_4\text{NO}_3, 2\text{HNO}_3$ (solution in $\text{HNO}_3$ )
23 0	28 7	"
28 5	34 5	"
29 5 *	38 8	(solution in $\text{NH}_4\text{NO}_3$ )
27 5	44 6	"
27 0	45 8	"
23 5	49 4	"
23 0	50 0	"
17 5	54 0	"
16 5	54 3	"
4 0	45 8	$\text{NH}_4\text{NO}_3, \text{HNO}_3$ labile (solution in $\text{HNO}_3$ )
9 5	49 4	"
11 0	51 7	"
11 5	52 7	"
12 0	54 3	"
12 0	54 7	"
11 5	57 6	(solution in $\text{NH}_4\text{NO}_3$ )
11 5	54 0	$\text{NH}_4\text{NO}_3$ (labile)
14 5	54 3	"
		stable
		"
		"
		"
		"
	68 1	"

\* Mpt of  $\text{NH}_4\text{NO}_3, 2\text{HNO}_3$

(Groschuff Z anorg 1904, 40 6)

### Solubility of $\text{NH}_4\text{NO}_3$ in $\text{NH}_4\text{OH} + \text{Aq}$

Grams of $\text{NH}_4\text{NO}_3$	Grams of $\text{NH}_3$	Molecules of $\text{NH}_4\text{NO}_3$ in 100 molecules $\text{NH}_4\text{NO}_3 + \text{NH}_3$	Temperature at which the solutions are in equilibrium with the solid phase
		100	about 168°
0 7578	0 0588	74 2	109 8
0 6439	0 0665	67 3	94 0
4 2615	0 7747	53 8	68 8
0 7746	0 1857	47 0	35 9
0 9358	0 2352	45 9	33 3
0 7600	0 2607	38 3	0
0 9675	0 3515	36 9	-10 5
0 8308	0 3700	32 3	-30 0
0 9526	1 2457	13 9	-44 5
1 3918	4 4327	6 25	-60
0	100	0	about -80

(Kurloff, Z phys Ch 1898, 25 109)

$\text{NH}_4\text{NO}_3 + \text{NH}_4\text{Cl}$

100 pts  $\text{H}_2\text{O}$  dissolve 29 1 pts  $\text{NH}_4\text{Cl}$  and 173 8 pts  $\text{NH}_4\text{NO}_3$  (Rudorff, B 6 484)

Sol in sat  $\text{NH}_4\text{Cl} + \text{Aq}$  with pptn of  $\text{NH}_4\text{Cl}$  until a state of equilibrium is reached (Karsten)

Addition of  $\text{KClO}_3$  to  $\text{NH}_4\text{Cl} + \text{Aq}$  prevents pptn of  $\text{NH}_4\text{Cl}$ , and dissolves any  $\text{NH}_4\text{Cl}$  that may have been pptd (Margueritte, C R 38 306)

See also under Ammonium chloride  
 $\text{NH}_4\text{NO}_3 + \text{KNO}_3$

100 pts  $\text{H}_2\text{O}$  dissolve

	At 9° (1)	At 11° (2)	At 11° (3)	At 11° (4)	At 15° (5)	At 15° (6)
$\text{KNO}_3$	20 2	40 6		26 0	46 2	
$\text{NH}_4\text{NO}_3$		88 8	143		130 4	161

2, Sat at 11° with  $\text{NH}_4\text{NO}_3$  and then at 9° with  $\text{KNO}_3$ , 5, sat at 11° with  $\text{NH}_4\text{NO}_3$  and then at 15° with  $\text{KNO}_3$  (Mulder)

Sol in sat  $\text{HNO}_3 + \text{Aq}$  without causing ppt (Karsten), with separation of  $\text{KNO}_3$  (Rudorff)

Composition of solution is dependent on the relative excess of the salts present (Rudorff)

100 pts  $\text{H}_2\text{O}$  dissolve 77 1 pts  $\text{NaNO}_3$  and 162 9 pts  $\text{NH}_4\text{NO}_3$  at 16° (Rudorff B 6 484)

If a sat solution of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at 11° is sat with  $\text{Ba}(\text{NO}_3)_2$  at 9°, 100 pts  $\text{H}_2\text{O}$  dissolve

	At 11	At 9°
$\text{NH}_4\text{NO}_3$	143	101 3
$\text{Ba}(\text{NO}_3)_2$		6 2
		6 8

(Mulder)

### Solubility of $\text{NH}_4\text{NO}_3 + \text{AgNO}_3$ in $\text{H}_2\text{O}$ at t°

t°	% $\text{AgNO}_3$	% $\text{NH}_4\text{NO}_3$	Solid phase
-7 3°	47 1	0	$\text{Ice} + \text{AgNO}_3$ rhomb
-10 7	44 52	8 43	
-14 9	42 0	16 80	$\text{Ice} + \text{AgNO}_3, \text{NH}_4\text{NO}_3 + \text{AgNO}_3$ rh
-14 8	39 51	18 79	$\text{Ice} + \text{AgNO}_3, \text{NH}_4\text{NO}_3$
-18 7	15 99	37 30	$\text{Ice} + \text{AgNO}_3, \text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3, \beta$ rh
-17 4	0	41 2	$\text{Ice} + \text{NH}_4\text{NO}_3, \beta$ rh
0	50 36	19 59	$\text{AgNO}_3, \text{NH}_4\text{NO}_3 + \text{AgNO}_3$ rh
18	55 36	22 06	
30	58 80	23 42	
55	63 32	26 12	
109 6	67 9	32 1	
0	22 13	44 87	$\text{AgNO}_3, \text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3, \beta$ rh
18	27 07	49 22	
30	29 76	52 50	
40	32 68	52 22	$\text{AgNO}_3, \text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3, \alpha$ rh
55	36 60	52 38	
101 5	47 5	52 5	$\text{AgNO}_3, \text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3$ rh

(Schreinemakers and de Baat, Arch ncer Sc 1911 (2) 15 414)

Solubility in  $\text{NH}_4\text{NO}_3$  and  $\text{AgNO}_3$  in  $\text{H}_2\text{O}$  at  $30^\circ$ 

Composition of the solution		Solid phase
$\text{NH}_4\text{NO}_3$	$\text{AgNO}_3$	
0	73 0	$\text{AgNO}_3$
6 59	69 08	
15 62	63 27	
23 40	58 84	$\text{AgNO}_3 + \text{AgNO}_3, \text{NH}_4\text{NO}_3$
23 45	58 93	
24 33	57 93	
26 22	55 32	$\text{AgNO}_3, \text{NH}_4\text{NO}_3$
28 86	52 45	
34 47	45 85	
39 60	41 09	"
45 44	35 62	
52 49	29 77	
52 11	29 86	$\text{NH}_4\text{NO}_3 + \text{AgNO}_3, \text{NH}_4\text{NO}_3$
52 89	29 66	
54 12	27 75	
58 64	21 31	$\text{NH}_4\text{NO}_3$
63 59	12 51	
70 10	0	

(Schreinemakers and de Baat, Z phys Ch 1909, 65 572)

Solubility of  $\text{NH}_4\text{NO}_3 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	g per 100 g $\text{H}_2\text{O}$		Sp gr
	$\text{NH}_4\text{NO}_3$	$\text{NaNO}_3$	
0	0	73 33	1 354
	105 5	66	1 407
	118 4	0	1 264
15	0	83 9	1 375
	24 03	81 21	1 386
	42 81	79 34	1 392
	64 6	78 06	1 401
	110 9	75 81	1 417
	152	75 35	1 428
	155 3	75 38	1 429
	156 1	60 76	1 405
	159	36 50	1 364
	160	27 79	1 350
	162 3	17 63	1 330
	167 4	0	1 298
30	0	96 12	1 401
	220 8	88 31	1 450
	232 6	0	1 329

(Fedotieff and Koltunoff, Z anorg 1914, 85 251)

Solubility of  $\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at  $30^\circ$ 

$\text{NH}_4\text{NO}_3$	$(\text{NH}_4)_2\text{SO}_4$	Solid phase
70 1	0	$\text{NH}_4\text{NO}_3$
67 63	2 38	"
66 93	3 46	$\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$
63 84	4 96	$3\text{NH}_4\text{NO}_3$
58 06	8 22	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3$
52 75	11 42	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
49 80	13 27	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$
37 20	19 48	$(\text{NH}_4)_2\text{SO}_4$
19 91	28 83	"
12 05	34 7	"
0	44 1	"

(Schreinemakers and Haenen, Chem Weekbl 1909, 6 51)

Solubility of  $\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$  in  $\text{H}_2\text{O}$ 

Temp = $0^\circ$		
$\text{NH}_4\text{NO}_3$	$(\text{NH}_4)_2\text{SO}_4$	Solid phase
0	41 4	$(\text{NH}_4)_2\text{SO}_4$
5 61	37 89	$(\text{NH}_4)_2\text{SO}_4 + (\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
29 58	41 64	
29 81	21 33	
31 04	20 40	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$
30 87	20 43	
31 61	19 50	
45 99	9 53	$3\text{NH}_4\text{NO}_3$
49 12	6 00	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3$
54 19	0	$\text{NH}_4\text{NO}_3$

Temp = $70^\circ$		
$\text{NH}_4\text{NO}_3$	$(\text{NH}_4)_2\text{SO}_4$	Solid phase
0	47 81	$(\text{NH}_4)_2\text{SO}_4$
11 10	40 81	$(\text{NH}_4)_2\text{SO}_4 + (\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
70 15	6 71	
71 58	5 82	
73 48	5 14	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$
76 01	3 96	$3\text{NH}_4\text{NO}_3$
80 25	2 68	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3$
81 01	2 45	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3$
81 38	2 41	$\text{NH}_4\text{NO}_3$
84 03	0	"

(de Waal Dissert Leiden 1910)

Very easily sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 826)

1 pt  $\text{NH}_4\text{NO}_3$  dissolves in 2.29 pts alcohol of 66.8% at 25° (Pohl W A B 6 599)  
1 pt  $\text{NH}_4\text{NO}_3$  dissolves in 1.1 pt boiling alcohol (Wenzel)

100 pts absolute methyl alcohol dissolve 17.1 pts at 20.5° (de Bruyn, Z phys Ch 10 783)

100 g absolute methyl alcohol dissolve 14.6 g  $\text{NH}_4\text{NO}_3$  at 14° and 16.3 g at 18.5° (Schiiff and Monsacchi, Z phys Ch 1896, 21 277)

100 pts absolute ethyl alcohol dissolve 3.8 pts at 20.5° (de Bruyn, Z phys Ch 10 783)

100 g absolute ethyl alcohol dissolve 4.6 g at 14° (Schiiff and Monsacchi, Z phys Ch 1896, 21 277)

Solubility of  $\text{NH}_4\text{NO}_3$  in  $\text{H}_2\text{O}$  is decreased by presence of ethyl alcohol but increased by presence of methyl alcohol.  $\text{NH}_4\text{NO}_3$  is only very sl sol in abs ethyl alcohol and the solubility increases slowly with rise in temp, it is more sol in abs methyl alcohol and the solubility increases rapidly with rise in temp (Fleckenstein, Phys Zeit 1905, 6 419)

### Solubility of $\text{NH}_4\text{NO}_3$ in alcohol

t°	% $\text{NH}_4\text{NO}_3$	% Alcohol	% $\text{H}_2\text{O}$
0	54.19	0	45.81
"	42.69	12.70	44.61
"	1.96	97.93	0.11
30	70.10	0	29.90
"	59.83	10.60	29.57
"	8.06	85.30	6.64
"	3.60	96.51	0
70	84.03	0	15.97
"	72.37	11.12	16.51
"	61.11	22.87	16.02
"	41.25	44.64	14.11
"	24.71	67.23	8.06
"	7.51	92.49	0

(de Waal Dissert Leiden, 1910)

Sp gr of alcoholic solution of  $\text{NH}_4\text{NO}_3$  at 15°

Pts $\text{NH}_4\text{NO}_3$	Pts alcohol	Sp gr
0	100	0.83904
2	98	0.84746
4	96	0.85604
6	94	0.86524

(Gerlach, Z anal 28 521)

### Solubility in methyl alcohol + Aq at 30°

% by wt $\text{H}_2\text{O}$	% by wt alcohol	% by wt $\text{NH}_4\text{NO}_3$
29.9	0	70.1
21.6	24.5	53.9
20.6	31.3	48.1
16.5	46.0	37.5
11.5	59.4	29.1
0	83.3	16.7

(Schreinemakers, Z phys Ch 1909, 65 556)

Solubility of  $\text{NH}_4\text{NO}_3$  in ethyl alcohol + Aq at 30° Composition of sat solution

% by wt $\text{H}_2\text{O}$	% by wt alcohol	% by wt $\text{NH}_4\text{NO}_3$
29.9	0	70.1
26.9	18.6	54.5
23.2	39.3	37.5
18.3	58.5	23.2
11.6	76.5	11.9
5.8	86.2	8.0
0	96.4	3.6

(Schreinemakers, Z phys Ch 1909 65 555)

Insol in benzonitrile (Naumann, B 1914 47 1370)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Very sl sol in acetone (Krug and M'Elroy, J Anal Ch 6 184)

Sol in acetone (Eidmann, C C 1899 II 1014)

**Ammonium hydrogen nitrate,  $\text{NH}_4\text{H}(\text{NO}_3)_2$**

Sol in  $\text{H}_2\text{O}$  (Ditte, C R 89 576, 641)

Decomp by  $\text{H}_2\text{O}$  (Groschuff, B 1904, 37 1487)

**Ammonium dihydrogen nitrate,**

$\text{NH}_4\text{H}_2(\text{NO}_3)_3$

Sol in  $\text{H}_2\text{O}$  (Ditte)

### Solubility in $\text{H}_2\text{O}$

Solution temp	% by wt $\text{NH}_4\text{NO}_3$	% by wt $\text{HNO}_3$
-8.0	34.2	53.9
-2.5	34.8	54.8
+3.0	35.4	55.8
3.5	36.0	56.8
19.5	37.4	58.9
25.0	38.1	60.0
29.5 mpt	38.8	61.2

(Groschuff, Z anorg 1904, 40 7)

**Ammonium cerous nitrate,  $3\text{NH}_4\text{NO}_3$ ,  $2\text{Ce}(\text{NO}_3)_3 + 12\text{H}_2\text{O}$** 

Very deliquescent Very sol in  $\text{H}_2\text{O}$  and alcohol (Holzmann, J pr 84 78)  
 $+10\text{H}_2\text{O}$  Hygroscopic Sol in  $\text{H}_2\text{O}$  (Drossbach, B 1900, 33 3507)  
 $2\text{NH}_4\text{NO}_3$ ,  $\text{Ce}(\text{NO}_3)_3 + 4\text{H}_2\text{O}$  As above (Marignac, A ch (4) 30 64)

**Solubility in  $\text{H}_2\text{O}$** 

100 g  $\text{H}_2\text{O}$  dissolve at  
 8 75° 25° 45°  
 235 5 296 8 410 2 g anhydrous salt,

60° 65 06°  
 681 2 817 4 g anhydrous salt  
 (Wolff, Z anorg 1905, 45 98)

**Ammonium ceric nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{Ce}(\text{NO}_3)_4$** 

Very sol in  $\text{H}_2\text{O}$  without decomp Sol in  $\text{HNO}_3$  (Meyer, B 1900, 33 2137)  
 Sol in alcohol (Meyer, Z anorg 1901, 27 369)

**Solubility in  $\text{H}_2\text{O}$** 

100 g  $\text{H}_2\text{O}$  dissolve at t°  
 25° 35 2° 45 3°  
 140 9 161 7 174 9 g anhydrous salt,

64 5° 85 60° 122°  
 201 6 226 8 735 4 g anhydrous salt  
 (Wolff, Z anorg 1905, 45 94)

$+1\frac{1}{2}\text{H}_2\text{O}$  Very deliquescent (Holzmann, J pr 84 78)

**Ammonium cobalt nitrate**

Permanent Sol in  $\text{H}_2\text{O}$  (Thenard)

**Ammonium copper nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{Cu}(\text{NO}_3)_2$** 

Very sol in  $\text{H}_2\text{O}$

**Ammonium didymium nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{D}_1(\text{NO}_3)_3 + 4\text{H}_2\text{O}$** 

Somewhat deliquescent

**Ammonium gadolinium nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{Gd}(\text{NO}_3)_3$** 

Deliquesces in the air (Benedicks, Z anorg 1900, 22 407)

**Ammonium gold (auric) nitrate (Ammonium auronitrate),  $\text{NH}_4\text{Au}(\text{NO}_3)_4$** 

Extremely deliquescent  
 $\text{H}(\text{NH}_4)_2\text{Au}(\text{NO}_3)_6$  (Schottlander, A 217 312)

**Ammonium lanthanum nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{La}(\text{NO}_3)_3 + 4\text{H}_2\text{O}$** 

Not deliquescent Sol in  $\text{H}_2\text{O}$  (Marignac)

**Ammonium magnesium nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{Mg}(\text{NO}_3)_2$** 

Slowly deliquescent Sol in 10 pts  $\text{H}_2\text{O}$  at 12 5°, and much less hot  $\text{H}_2\text{O}$  (Fourcroy)

**Ammonium mercurous nitrate,  $4\text{NH}_4\text{NO}_3$ ,  $\text{Hg}_2(\text{NO}_3)_2 + 5\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Pagenstecher, Report 14 188)

**Ammonium nickel nitrate**

Sol in 3 pts cold  $\text{H}_2\text{O}$  (Thénard, Scher J 10 428)

**Ammonium praseodymium nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{Pr}(\text{NO}_3)_3 + 4\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (von Scheele, Z anorg 1898, 18 356)

**Ammonium silver nitrate,  $\text{NH}_4\text{NO}_3$ ,  $\text{AgNO}_3$** 

Very sol in  $\text{H}_2\text{O}$  (Russell and Maskelyne, Roy Soc Proc 26 357)

Sol in  $\text{H}_2\text{O}$  without decomp (Schreinemakers and de Baat, Chem Weekbl 1910, 7 6)

See also solubility of  $\text{NH}_4\text{NO}_3 + \text{AgNO}_3$  under  $\text{NH}_4\text{NO}_3$

**Ammonium thorium nitrate,  $(\text{NH}_4)_2\text{Th}(\text{NO}_3)_6$** 

Sol in strong  $\text{HNO}_3$  (Meyer, Z anorg 1901, 27 383)

$\text{NH}_4\text{Th}(\text{NO}_3)_5 + 5\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  of sp gr 1 25 (Meyer, Z anorg 1901, 27 382)

**Ammonium uranyl nitrate,  $\text{NH}_4\text{NO}_3$ ,  $\text{UO}_2(\text{NO}_3)_2$** 

Decomp by  $\text{H}_2\text{O}$  Sol in conc  $\text{HNO}_3$  (Meyer, B 1903, 36 4057)

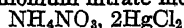
**Solubility in  $\text{H}_2\text{O}$  at t°**

t°	In 100 pts by wt of the solution			Solid phase
	Pts by wt $\text{UO}_2$	Pts by wt $\text{NH}_4$	Pts by wt total salt	
0 5	29 71	2 92		Double salt + $\text{UO}_2(\text{NO}_3)_2$
13 5	32 3	3 42		
24 9 a	36 40	3 54	68 72	
	36 53	3 54	68 97	
35 0	42 07	3 44		Double salt
50 0	44 37	2 90		
80 7 a	44 90	2 98	78 76	
	45 01	2 98	78 79	

Ammonium uranyl nitrate is decomp by  $\text{H}_2\text{O}$  at temp below 60° above 60° it is sol in  $\text{H}_2\text{O}$  without decomp (Rumbach, B 1904, 37 475)

**Ammonium nitrate ammonia,  $2\text{NH}_4\text{NO}_3$ ,  $3\text{NH}_3$** 

Known only as a solution of  $\text{NH}_3$  in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Troost, C R 94 789)  
 $\text{NH}_4\text{NO}_3$ ,  $3\text{NH}_3$  As above

**Ammonium nitrate mercuric chloride,**

Insol in  $\text{H}_2\text{O}$  Ether dissolves out  $\text{HgCl}_2$   
(Kosmann, A ch (3) 27 240)

$2\text{NH}_4\text{NO}_3, \text{HgCl}_2$  Sol in  $\text{H}_2\text{O}$  (Hofmann and Marburg, A 1899, 305 199)

**Ammonium nitrate sulphate,  $2(\text{NH}_4)_2\text{O}, \text{N}_2\text{O}_5, 2\text{SO}_3, \text{H}_2\text{O}$** 

Very hygroscopic and sol in  $\text{H}_2\text{O}$  (Friedheim, Z anorg 1894, 6 297)

$2\text{NH}_4\text{NO}_3, (\text{NH}_4)_2\text{SO}_4$  (de Waal, Dissert 1910)

$3\text{NH}_4\text{NO}_3, (\text{NH}_4)_2\text{SO}_4$  (de Waal)

See also solubility of  $\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$  under  $\text{NH}_4\text{NO}_3$

**Ammonium nitrate metatungstate,  $\text{NH}_4\text{NO}_3, 2(\text{NH}_4)_2\text{W}_2\text{O}_{13} + 4\text{H}_2\text{O}$** 

Decomposes by recrystallising out of  $\text{H}_2\text{O}$   
(Marignac, A ch (3) 69 61)

**Antimony nitrate,  $\text{Sb}_4\text{O}_6, \text{N}_2\text{O}_5$** 

Decomp by cold  $\text{H}_2\text{O}$  (Bucholz)

Aqueous solution sat at  $10^\circ$  contains 30.4% salt (Eller)

Sol in strong, less sol in dil  $\text{HNO}_3 + \text{Aq}$   
(Peligot, A ch (3) 20 288)

Insol in acetone (Naumann, B 1904, 37 4329)

**Barium nitrate,  $\text{Ba}(\text{NO}_3)_2$** 

Sol in  $\text{H}_2\text{O}$  with absorption of heat

100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 5.0 parts

$\text{Ba}(\text{NO}_3)_2$  (Gay-Lussac, A ch 11 313)

100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 5.2 parts

$\text{Ba}(\text{NO}_3)_2$  (Mulder)

$\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  sat at  $20^\circ$  contains 8.57 pts

$\text{Ba}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$ , and has 1.0679 sp gr (Karsten), sat at  $20^\circ$  has 1.064 sp gr, and contains 7.94 pts  $\text{Ba}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$  (Michel and Kiafft)

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{Ba}(\text{NO}_3)_2$  at  $t^\circ$

$t^\circ$	Pts $\text{Ba}(\text{NO}_3)_2$	$t^\circ$	Pts $\text{Ba}(\text{NO}_3)_2$
0	5.00	52 11	17.97
14 95	8.18	73 75	25.01
17 62	8.54	86 21	29.57
37 87	13.67	101 65	35.18
49 22	17.07		

(Gay-Lussac, A ch (2) 11 313)

**Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$** 

$t^\circ$	Pts $\text{Ba}(\text{NO}_3)_2$	$t^\circ$	Pts $\text{Ba}(\text{NO}_3)_2$
0	5.0	52	17.7
1	5.1	53	18.1
2	5.3	54	18.4
3	5.5	55	18.7
4	5.7	56	19.0
5	6.0	57	19.3
6	6.2	58	19.6
7	6.4	59	20.0
8	6.6	60	20.3
9	6.8	61	20.6
10	7.0	62	20.9
11	7.3	63	21.0
12	7.5	64	21.6
13	7.7	65	21.0
14	7.9	66	22.3
15	8.1	67	22.6
16	8.3	68	22.9
17	8.5	69	23.3
18	8.8	70	23.6
19	9.0	71	23.9
20	9.2	72	24.3
21	9.5	73	24.9
22	9.7	74	25.0
23	9.9	75	25.4
24	10.1	76	25.7
25	10.4	77	26.0
26	10.6	78	26.4
27	10.8	79	26.7
28	11.1	80	27.0
29	11.3	81	27.4
30	11.6	82	27.7
31	11.8	83	28.1
32	12.1	84	28.4
33	12.3	85	28.8
34	12.6	86	29.1
35	12.8	87	29.5
36	13.1	88	29.8
37	13.4	89	30.2
38	13.7	90	30.6
39	14.0	91	30.9
40	14.2	92	31.3
41	14.5	93	31.7
42	14.8	94	32.0
43	15.1	95	32.4
44	15.4	96	32.7
45	15.6	97	33.1
46	15.9	98	33.5
47	16.2	99	33.8
48	16.5	100	34.2
49	16.8	101	34.5
50	17.1	101.9	34.8
51	17.4		

(Mulder, calculated from his own and other experiments, Scheik Verhandel 1864 50)

Sat  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  contains %  $\text{Ba}(\text{NO}_3)_2$  at  $t^\circ$

$t^\circ$	% $\text{Ba}(\text{NO}_3)_2$	$t^\circ$	% $\text{Ba}(\text{NO}_3)_2$
0 4	4 3	60 0	16 1
2 1	4 9	73 0	19 4
6 0	5 6	92 0	23 4
6 5	5 6	110 0	27 4
11 0	6 4	132 0	31 8
15 3	7 1	134 0	32 5
18 0	7 7	150 0	34 9
28 5	9 7	152 0	35 4
45 5	12 8	171 0	38 3
52 0	14 9	215 0	45 8

(Étard, A ch 1894, (7) 2 528)

100 g  $\text{H}_2\text{O}$  dissolve 8 54 g  $\text{Ba}(\text{NO}_3)_2$  at  $17^\circ$  (Gmelin-Kraut, Handbuch der anorg Chemie)

100 g  $\text{H}_2\text{O}$  dissolve 7 87 g  $\text{Ba}(\text{NO}_3)_2$  at  $15^\circ$ , 8 32 g at  $17^\circ$  (Euler, Z phys Ch 1904, 49 315)

1000 g  $\text{H}_2\text{O}$  dissolve 0 72 gram-equivalents  $\text{Ba}(\text{NO}_3)_2$  at  $21 5^\circ$  (Euler, Z phys Ch 1904, 49 312)

10 30 g anhydrous  $\text{Ba}(\text{NO}_3)_2$  are sol in 100 g  $\text{H}_2\text{O}$  at  $25^\circ$  (Parsons and Colson, J Am Chem Soc 1910, 32 1385)

4 74 g  $\text{Ba}(\text{NO}_3)_2$  are contained in 100 g  $\text{Ba}(\text{NO}_3)_2$  sat at  $0^\circ$  (Coppadoro, Gazz ch it 1911, 42, I 233)

Solubility of  $\text{Ba}(\text{NO}_3)_2$  in  $\text{H}_2\text{O} = 0 427$  mol l at  $30^\circ$  (Masson, Chem Soc 1911, 99 1136)

Solubility of  $\text{Ba}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$  at  $30^\circ = 10 33\%$  (Coppadoro, Gazz ch it 1913, 43 I 240)

Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at

9 1° 21 1° 35°  
6 25 8 46 11 39 g  $\text{Ba}(\text{NO}_3)_2$

(Findlay, Chem Soc 1914, 105 780)

Sp gr of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $19 5^\circ$

$\text{Ba}(\text{NO}_3)_2$	Sp gr	$\text{Ba}(\text{NO}_3)_2$	Sp gr
1	1 009	6	1 050
2	1 017	7	1 060
3	1 025	8	1 069
4	1 034	9	1 078
5	1 042	10	1 087

(Calculated by Gerlach, Z anal 8 286, from Kremers, Pogg 95 110)

Sp gr of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $18^\circ$

% $\text{Ba}(\text{NO}_3)_2$	Sp gr
4 2	1 0340
8 4	1 0712

(Kohlrausch, W Ann 1879 1)

Sp gr of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $17 5^\circ$

$\text{Ba}(\text{NO}_3)_2$	Sp gr	$\text{Ba}(\text{NO}_3)_2$	Sp gr
1	1 0085	6	1 0510
2	1 0170	7	1 0600
3	1 0255	8	1 0690
4	1 0340	Sat sol	1 0690
5	1 0425		

(Gerlach, Z anal 27 283)

Sp gr of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at room temp

% $\text{Ba}(\text{NO}_3)_2$	Sp gr
5 25	1 0507
2 98	1 0274

(Wagner, W Ann 1883, 18 264)

Sp gr of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$	Sp gr
$1/2$ normal	1 0518
$1/4$ "	1 0259
$1/8$ "	1 0130

(Wagner, Z phys Ch 1890, 5 35)

$\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  containing 6 08%  $\text{Ba}(\text{NO}_3)_2$  has sp gr  $20^\circ/20^\circ = 1 0517$

$\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  containing 6 97%  $\text{Ba}(\text{NO}_3)_2$  has sp gr  $20^\circ/20^\circ = 1 0597$

(Le Blanc and Rohland, Z phys Ch 1896, 19 279)

Sp gr of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $20^\circ$  containing M g mols salt per liter

M	0 01	0 025	0 05
Sp gr	1 002031	1 005224	1 010591

M	0 075	0 10	0 15
Sp gr	1 015671	1 021143	1 031770

(Jones and Pearce, Am Ch J 1907, 38 708)

Sp gr of sat  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $t^\circ$

t	g $\text{Ba}(\text{NO}_3)_2$ sol in 100 g $\text{H}_2\text{O}$	Sp gr
0	5 2	1 043
10	7 0	1 056
20	9 2	1 073
30	11 6	1 087
40	14 2	1 104
50	17 1	1 121
60	20 3	1 137
70	23 6	1 146

(Tschernaj, J Russ Phys Chem Soc 1912, 44 1565)

Saturated  $\text{BaNO}_3 + \text{Aq}$  contains —  
36 18 pts  $\text{Ba}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$ , and boils at  $101 1^\circ$  (Griffiths)



# NITRATE, BARIUM

2 pts  $\text{Ba}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$ , and at 101 65° (Gay-Lussac)  
 8 pts  $\text{Ba}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$ , and at 101 9° (Mulder)  
 8 pts  $\text{Ba}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$ , and at 102 5° (Kremers)  
 $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  forms a crust at 101 1°, at temp observed was 101 5° (Gerlach, anal 26 427)

pt of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  containing pts  $\text{Ba}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$

B-pt	Pts $\text{Ba}(\text{NO}_3)_2$
100 5°	12 5
101 0	26 0
101 1	27 5

(Gerlach, Z anal 26 440)

sol in conc  $\text{HNO}_3 + \text{Aq}$ , and much less in dil  $\text{HNO}_3 + \text{Aq}$  or  $\text{HCl} + \text{Aq}$  than in

bility of  $\text{Ba}(\text{NO}_3)_2$  in  $\text{HNO}_3 + \text{Aq}$  at 30°

Solid phase  $\text{Ba}(\text{NO}_3)_2$

gr of sat solution	G mol per l	
	$\text{HNO}_3$	$\text{Ba}(\text{NO}_3)_2$
0891	0 0000	0 4270
0811	0 1318	0 3282
	0 2496	0 3268
0663	0 4995	0 2410
0619	0 7494	0 1785
0609	1 000	0 1353
0633	1 247	0 1056
0668	1 493	0 0847
0783	1 998	0 0598
1050	2 993	0 0334
1341	3 986	0 0218
1341	3 994	0 0223
1645	5 012	0 0147

Masson, Chem Soc 1911, 99 1136)

ss sol in dil  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  than in dil + Aq

ubility in  $\text{NH}_4\text{Cl} + \text{Aq}$  is the same as in

ss sol in  $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 +$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Pearson, Ch (2) 5 662)

$\text{Ba}(\text{NO}_3)_2$  is sol in about

33 pts  $\text{H}_2\text{O}$  at ord temp, and 4 67 pts 30°

67 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (conc) at ord

, and 5 67 pts at 100°

50 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (1 vol conc + 3  $\text{H}_2\text{O}$ ) at ord temp

00 pts  $\text{HCl} + \text{Aq}$  (1 vol conc  $\text{HCl} + 4 \text{H}_2\text{O}$ ) at ord temp

00 pts  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (1 vol commer-

$\text{HC}_2\text{H}_3\text{O}_2 + 1 \text{ vol } \text{H}_2\text{O}$ ) at ord temp

13 67 pts  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 pt  $\text{NH}_4\text{Cl} + 10$  pts  $\text{H}_2\text{O}$ ) at ord temp, and 4 67 pts at 100°

24 00 pts  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (1 pt  $\text{NH}_4\text{NO}_3 + 10$  pts  $\text{H}_2\text{O}$ ) at ord temp

17 33 pts  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  (dil  $\text{NH}_4\text{OH}$  neutralised by dil  $\text{HC}_2\text{H}_3\text{O}_2$ ) at ord temp, and 4 33 pts at 100°

14 67 pts  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (dil  $\text{HC}_2\text{H}_3\text{O}_2$  neutralised by  $\text{Na}_2\text{CO}_3$  and dil with 4 vols  $\text{H}_2\text{O}$ ) at ord temp, and 5 33 pts at 100°

17 33 pts  $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  (see Stolba, Z anal 2 390) at ord temp, and 6 00 pts at 100°

18 67 pts grape sugar (1 pt grape sugar + 10 pts  $\text{H}_2\text{O}$ ) at ord temp (Pearson, Zeit Ch 1869 662)

Sol in sat  $\text{NH}_4\text{Cl} + \text{Aq}$  without pptn at first, but finally  $\text{NH}_4\text{Cl}$  is pptd until a certain state of equilibrium is reached (Karsten)

Solubility in  $\text{BaO}_2\text{H}_2$ ,  $8\text{H}_2\text{O} + \text{Aq}$  at 25°

Sp gr 25°/25°	G $\text{BaO}$ as $\text{Ba}(\text{OH})_2$ in 100 g $\text{H}_2\text{O}$	G $\text{Ba}(\text{NO}_3)_2$ in 100 g $\text{H}_2\text{O}$
1 0797	0	10 30
1 1002	1 55	10 66
1 1210	3 22	11 04
*1 1448	5 02	11 48

\* This solution is sat with respect to both  $\text{Ba}(\text{OH})_2$ ,  $8\text{H}_2\text{O}$  and  $\text{Ba}(\text{NO}_3)_2$

(Parsons J Am Chem Soc 1910, 32 1385)

See also under  $\text{BaO}_2\text{H}_2$

Solubility in  $\text{BaCl}_2 + \text{Aq}$  at t°

t°	Sat solution contains	
	% $\text{BaCl}_2$	% $\text{Ba}(\text{NO}_3)_2$
-7	21 4	4 0
-1	23 0	4 0
+1 5	22 6	4 4
2		5 0
10	24 7	6 1
21	24 5	5 6
32	26 6	7 7
35	26 4	7 7
38	26 7	7 8
48	28 1	8 0
53	28 5	9 0
53	28 3	9 2
66	28 0	10 0
73	30 0	10 5
79	30 3	11 2
90	32 1	12 5
155	32 5	23 1
162	33 1	23 4
210	32 5	31 9

(Étard, A ch 1894, (7) 3 287)

See also under  $\text{BaCl}_2$

$\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2$   
 Very sl sol in sat  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  (Karsten.)

100 pts sat  $\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2 + \text{Aq}$   
 contain 33.95 pts of the two salts at 19–20°  
 (v. Hauer, J pr 98 137)

Solubility of  $\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2$  at 25°

G per l		Sp gr
$\text{Ba}(\text{NO}_3)_2$	$\text{Pb}(\text{NO}_3)_2$	
102.2	0	1.079
54.9	17.63	1.088
86.5	49.80	1.108
79.7	68.10	1.119
77.0	97.20	1.140
69.8	130.7	1.163
66.0	177.3	1.198
57.5	247.7	1.252
25.9	334.3	1.294
28.8	429.7	1.376
0	553.8	1.459

(Fock, Z Kryst Min 1897, 28 365, 397)

100 ccm  $\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat  
 at 17° contain 3.22 g  $\text{Ba}(\text{NO}_3)_2$  and 38.59 g  
 $\text{Pb}(\text{NO}_3)_2$  and solution has sp gr = 1.350  
 (Euler, Z phys Ch 1904, 46 313)

100 pts sat  $\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2 +$   
 $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  contain 45.90 pts of the three  
 salts at 19–20° (v Hauer, l c)

$\text{Ba}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2$   
 100 pts sat  $\text{Ba}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2 + \text{Aq}$  con-  
 tain 45.96 pts of the two salts at 19–20°  
 (v Hauer, l c)

$\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$

100 pts  $\text{H}_2\text{O}$  dissolve

$\text{KNO}_3$ $\text{Ba}(\text{NO}_3)_2$	(Mulder)		
	(1)		
	29.7	28.8	8.9
		5.4	
		34.2	

$\text{KNO}_3$ $\text{Ba}(\text{NO}_3)_2$	(Karstén)		(Kopp)	
	(2)	(3)	(4)	(5)
	13.31	29.03	5.7	3.5
	6.91	1.00	33.1	36.3
	20.22	30.03	38.8	39.8

1 Sat  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  sat with  $\text{KNO}_3$  at 18.5°

2 To sat  $\text{KNO}_3 + \text{Aq}$ ,  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  was added

3 To sat  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$ ,  $\text{KNO}_3$  was added

4 Both salts in excess +  $\text{Aq}$  at 21.5°

5 Both salts in excess +  $\text{Aq}$  at 23°

1 l of the solution contains 59.1 g  $\text{Ba}(\text{NO}_3)_2$   
 + 124.2 g  $\text{KNO}_3$  = 183.35 g mixed salts at 17°  
 Sp gr  $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3 + \text{Aq}$  = 1.120

1 l of the solution contains 88.7 g  $\text{Ba}(\text{NO}_3)_2$   
 + 213.6 g  $\text{KNO}_3$  = 302.3 g mixed salts at 30°  
 Sp gr  $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3 + \text{Aq}$  = 1.191  
 (Euler, Z phys Ch 1904, 49 313)

Solubility in  $\text{KNO}_3 + \text{Aq}$  at 25°

100 pts of solu- tion contain		Solid phase
pts $\text{KNO}_3$	pts $\text{Ba}(\text{NO}_3)_2$	
15.24	6.64	$\text{Ba}(\text{NO}_3)_2 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
14.69	6.60	"
14.79	6.62	"
16.30	5.49	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
21.99	3.04	"
27.66	2.01	$\text{KNO}_3 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
27.81	2.09	"
27.94	1.92	"
27.64	2.05	"

These results show that a double salt of potassium and barium nitrates is formed at 25°

(Foote, Am Ch J 1904, 32 252)

Solubility of  $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$  at t°

t°	% $\text{Ba}(\text{NO}_3)_2$	% $\text{KNO}_3$	Solid phase
9.1	6.25	0	$\text{Ba}(\text{NO}_3)_2$
	4.20	8.15	$\text{Ba}(\text{NO}_3)_2 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	1.98	12.02	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	0.98	16.80	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2 +$ $\text{KNO}_3$
	0	16.76	$\text{KNO}_3$
21.1	8.46	0	$\text{Ba}(\text{NO}_3)_2$
	7.47	2.12	"
	6.35	5.98	"
	6.06	8.47	"
	5.98	13.24	$\text{Ba}(\text{NO}_3)_2 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	3.35	18.24	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	2.30	21.47	$2\text{KNO}_3$ , "
	1.76	24.86	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2 +$ $\text{KNO}_3$
	0	24.77	$\text{KNO}_3$
35	11.39	0	$\text{Ba}(\text{NO}_3)_2$
	8.18	12.99	"
	8.08	17.48	"
	8.42	19.75	$\text{Ba}(\text{NO}_3)_2 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	5.85	24	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	5.02	26.05	"
	3.02	34.87	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2 +$ $\text{KNO}_3$
	1.77	34.98	$\text{KNO}_3$
	0	35.01	"

(Findlay, Chem Soc 1914, 105 779)

$\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$   
 $\text{Ba}(\text{NO}_3)_2$  is sol in sat  $\text{NaNO}_3 + \text{Aq}$  with-  
 out separation

100 pts  $\text{H}_2\text{O}$  dissolve

	(Karsten) At 18 75°		
	86 6	88 14 3 77	8 9
$\text{NaNO}_3$ $\text{Ba}(\text{NO}_3)_2$			
	(Kopp) At 20 2°		
	87 7	88 6 3 6	9 2
$\text{NaNO}_3$ $\text{Ba}(\text{NO}_3)_2$			

Solubility of  $\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at 0°

% $\text{NaNO}_3$	% $\text{Ba}(\text{NO}_3)_2$	Solid phase
0	4 74	$\text{Ba}(\text{NO}_3)_2$
0 41	4 33	"
0 61	4 03	"
1 68	3 34	"
3 54	2 50	"
8 05	1 60	"
12 71	1 56	"
20 24	1 53	"
20 92	1 43	"
27 74	1 56	"
30 81	1 55	"
33 79	1 53	"
35 83	1 49	"
41 30	1 55	$\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$
41 68	0 51	$\text{NaNO}_3$
42 47	0	"

(Coppadoro, Gazz ch it, 1912, **42** (1) 233)

Solubility of  $\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$   
 at 30°

% $\text{NaNO}_3$	% $\text{Ba}(\text{NO}_3)_2$	Solid phase
0	10 33	$\text{Ba}(\text{NO}_3)_2$
2 33	8 58	"
7 09	5 28	"
12 07	3 89	"
14 41	3 54	"
17 87	3 20	"
19 06	3 07	"
23 55	2 81	"
41 22	2 27	"
48 22	2 11	$\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$
48 50	1 00	$\text{NaNO}_3$
49 16	0	"

(Coppadoro, Gazz ch it 1913, **43**, I 240)

Moderately sol in liquid  $\text{NH}_3$  (Franklin,  
 Am Ch J 1898, **20** 827)

100 pts hydrazine dissolves 81.1 pts  
 $\text{Ba}(\text{NO}_3)_2$  at 12.5–13° (de Bruyn, R t c  
 1899, **18** 297)

100 pts anhydrous hydroxylamine dissolve  
 11.4 pts  $\text{Ba}(\text{NO}_3)_2$  (de Bruyn, R t c  
 1892, **11** 18)

Insol in absolute alcohol

Solubility in dilute alcohol increases with  
 the temp (Gerardin, A ch (4) **5** 145)

Solubility in ethyl alcohol + Aq at 25°

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Ba}(\text{NO}_3)_2$ in the solution
0	0	9 55
10 25	9 5	7 63
18 60	17 5	6 02
25 05	23 7	5 25
40 20	38 8	3 53
58 00	57 0	1 85
78 70	78 2	0 62
90 10	89 9	0 18
99 40	99 39	0 005

(D'Ans and Sregler, Z phys Ch 1913, **82** 37)

Completely insol in boiling amyl alcohol  
 (Browning, Sill Am J **143** 314)

Solubility in organic solvents

Solvent	% $\text{Ba}(\text{NO}_3)_2$ in the solution at 25°
Methyl alcohol	0 50
Ethyl alcohol	0 005
Acetone	0 00
Ether	very small
Paracetaldehyde	" "

(D'Ans and Siegler, Z phys Ch 1913, **82** 44)

Solubility in phenol + Aq at 25°

Concentration of the phenol Mol / Liter	Solubility of $\text{Ba}(\text{NO}_3)_2$ Mol / Liter
0 000	0 3835
0 045	0 3785
0 082	0 3746
0 146	0 3664
0 310	0 3492
0 401	0 3400
0 501	0 3299
0 728 (sat)	0 3098

(Rothmund and Wilsmore, Z phys Ch 190  
**40** 620)

Insol in benzonitrile (Naumann, B 1914  
**47** 1370)

Insol in methyl acetate (Naumann, F  
 1909, **42** 3790), ethyl acetate (Naumann  
 B 1904, **37** 3602)

Insol in acetone (Krug and M'Elroy,  
 Anal Ch **6** 184)

Difficultly sol in acetone (Naumann, F  
 1904, **37** 4328)

Sol in acetone (Eidmann, C C 1899, I  
 1014)

**Barium mercurous nitrate**,  $2\text{BaO}$ ,  $2\text{Hg}_2\text{O}$ ,  $3\text{N}_2\text{O}_5$

Decomp by  $\text{H}_2\text{O}$  Sol in hot dil  $\text{HNO}_3$  + Aq and hot  $\text{Hg}_2(\text{NO}_3)_2$  + Aq, from which it crystallises on cooling (Stadeler, A 87 129)

**Barium potassium nitrate**,  $\text{Ba}(\text{NO}_3)_2$ ,  $2\text{KNO}_3$

Ppt (Wallbridge, Am Ch J 1903, 30 154)

Solubility determinations show that the only double salt formed by barium and potassium nitrates at  $25^\circ$  is  $\text{Ba}(\text{NO}_3)_2 \cdot 2\text{KNO}_3$

See  $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$  under  $\text{Ba}(\text{NO}_3)_2$  (Foote, Am Ch J 1904, 32 252)

**Barium nitrate metatungstate**,  $2\text{Ba}(\text{NO}_3)_2$ ,  $\text{BaW}_4\text{O}_{13} + 6\text{H}_2\text{O}$

Efflorescent Sol in warm  $\text{H}_2\text{O}$  (Péchar, A ch (6) 22 198)

**Bismuth nitrate, basic**,  $\text{Bi}_2\text{O}_3$ ,  $\text{N}_2\text{O}_5 + 2\text{H}_2\text{O}$

Sol in a large amount of  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  + Aq (Heintz)

Sol in 135 pts  $\text{H}_2\text{O}$  at  $90$ – $93^\circ$  (Ruge, J B 1862 163)

$+ \frac{1}{2}\text{H}_2\text{O}$  Sol in much  $\text{H}_2\text{O}$  (Yvon, C R 84 1161)

$+ \text{H}_2\text{O}$  (Ruge)  
 $2\text{Bi}_2\text{O}_3$ ,  $\text{N}_2\text{O}_5$  Not acted upon by  $\text{H}_2\text{O}$  (Ditte, C R 84 1317)

$+ \text{H}_2\text{O}$  (Yvon)  
 $\text{Bi}_2\text{O}_3$ ,  $2\text{N}_2\text{O}_5 + \text{H}_2\text{O}$  (Ruge)

$11\text{Bi}_2\text{O}_3$ ,  $5\text{N}_2\text{O}_5 + 16\text{H}_2\text{O}$  Not decomp by  $\text{H}_2\text{O}$  (Yvon)

$5\text{Bi}_2\text{O}_3$ ,  $4\text{N}_2\text{O}_5 + 8\text{H}_2\text{O}$  Ppt Not attacked by  $\text{H}_2\text{O}$  (Schulten, Bull Soc 1903, (3) 29 722)

$5\text{Bi}_2\text{O}_3$ ,  $5\text{N}_2\text{O}_5 + 9\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with decomp (Schulten)

$6\text{Bi}_2\text{O}_3$ ,  $5\text{N}_2\text{O}_5 + 8\text{H}_2\text{O}$ , and  $+ 9\text{H}_2\text{O}$  (Rutten, Z anorg 1902, 30 368)

At  $25^\circ$  the salt  $\text{Bi}_{10}\text{O}_{13}(\text{NO}_3)_{10}$ ,  $9\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq from 0 03–0 32–N, the salt  $\text{BiO}(\text{NO}_3)$ ,  $\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq from 0 425–0 72–N

At  $50^\circ$  the salt  $\text{Bi}_4\text{O}_5(\text{NO}_3)_2$ ,  $\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq from 0 057–0 285–N, the salt  $\text{Bi}_{10}\text{O}_{13}(\text{NO}_3)_{10}$ ,  $9\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq from 0 285–0 446–N

At  $75^\circ$  the salt  $\text{Bi}_4\text{O}_5(\text{NO}_3)_2$ ,  $\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq from 0 109–0 314–N (Allan, Am Ch J 1901, 25 314)

**Bismuth nitrate**,  $\text{Bi}(\text{NO}_3)_3$

Permanent Decomp by little  $\text{H}_2\text{O}$  with separation of a basic salt This decomposition is prevented by slight excess of  $\text{HNO}_3$ , and then the salt is completely sol in a large amount of  $\text{H}_2\text{O}$  (Rose)

Sol in dil  $\text{HNO}_3$  + Aq Not decomp by  $\text{H}_2\text{O}$  in presence of  $\text{HC}_2\text{H}_3\text{O}_2$  or  $-\frac{1}{10}$  pt  $\text{NH}_4\text{NO}_3$  (Lowe, J pr 74 341)

Completely sol in  $\text{HNO}_3$  + Aq containing 83 g  $\text{HNO}_3$  per liter (Ditte)

Solubility of  $\text{Bi}(\text{NO}_3)_3$  in  $2\text{N-HNO}_3$  + Aq = 2 04 g at Bi per l, in  $0\ 922\text{N-HNO}_3$  + Aq = 2 23 g at Bi per l (Dubrisay, C R 1911, 153 1077)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Insol in acetone (Krug and M'Elroy)

Solubility of  $\text{Bi}(\text{NO}_3)_3$  in 6 67% acetone +  $2\text{N-HNO}_3$  + Aq = 1 89 g at Bi per l, in 6 67% acetone +  $0\ 922\text{N-HNO}_3$  + Aq = 2 17 g at Bi per l, in 13 33% acetone +  $0\ 922\text{N-HNO}_3$  + Aq = 2 08 g at Bi per l (Dubrisay, C R 1911, 153 1077)

When  $\text{Bi}(\text{NO}_3)_3$  is mixed with mannite (dulcite, sorbite) in proportion to the mol wts and  $\text{H}_2\text{O}$  is added, a clear solution is obtained which is not pptd by addition of much  $\text{H}_2\text{O}$  These solutions are more stable the greater the proportion of mannitol (Vanno and Hunser, Z anorg 1901, 28 211)

$+ \frac{1}{2}\text{H}_2\text{O}$  (Ditte)  
 $+ 5\text{H}_2\text{O}$  If treated with increasing amts of  $\text{H}_2\text{O}$ , the amt of Bi which dissolves decreases, and when 1 pt is treated with 50,000 pts  $\text{H}_2\text{O}$ , no Bi goes into solution (Antony and Gagli, Gazz ch it 1898, 28 245)

48 66 pts are sol in 100 pts acetone at  $0^\circ$   
41 70 " " " " 100 " " "  $19^\circ$

(Laszczynski, B 1894, 27 2287)

$+ \frac{5}{2}\text{H}_2\text{O}$  (Yvon, C R 84 1161)

$+ 10\text{H}_2\text{O}$  Melts in crystal  $\text{H}_2\text{O}$  with decomp at  $74^\circ$  (Ordway)

**Bismuth caesium nitrate**,  $\text{Bi}(\text{NO}_3)_3$ ,  $2\text{CsNO}_3$

Ppt (Wells, Am Ch J 1901, 26 277)

**Bismuth cobalt nitrate**,  $2\text{Bi}(\text{NO}_3)_3$ ,  $3\text{Co}(\text{NO}_3)_2$   
 $+ 24\text{H}_2\text{O}$

100 cc sat solution in  $\text{HNO}_3$  + Aq (sp gr 1 325) contain 54 67 g hydrated salt (Jantsch Z anorg 1912, 76 321)

**Bismuth magnesium nitrate**,  $2\text{Bi}(\text{NO}_3)_3$ ,  $3\text{Mg}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$

Deliquescent Effloresces in dry air Decomp by  $\text{H}_2\text{O}$  (Urban and Lacombe, C R 1903, 137 569)

100 cc sat solution in  $\text{HNO}_3$  + Aq (sp gr 1 325) contain 41 69 g hydrated salt (Jantsch Z anorg 1912, 76 321)

**Bismuth manganous nitrate**,  $2\text{Bi}(\text{NO}_3)_3$ ,  $3\text{Mn}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$

Deliquescent Effloresces in dry air Decomp by  $\text{H}_2\text{O}$  (Urban and Lacombe, C R 1903, 137 569)

100 cc sat solution in  $\text{HNO}_3$  + Aq (sp gr 1 325) contain 65 77 g hydrated salt (Jantsch Z anorg 1912, 76 321)

**Bismuth nickel nitrate,  $2\text{Bi}(\text{NO}_3)_3, 3\text{Ni}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$** 

Deliquescent Effloresces in dry air  
Decomp by  $\text{H}_2\text{O}$  (Urban and Lacombe, C R 1903, 37 569)

100 cc sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1 325) contain 46 20 g hydrated salt at 16° (Jantsch)

**Bismuth zinc nitrate,  $2\text{Bi}(\text{NO}_3)_3, 3\text{Zn}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$** 

Deliquescent Decomp by  $\text{H}_2\text{O}$  (Urban and Lacombe, C R 1903, 137 569)

100 cc sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1 325) contain 57 51 g hydrated salt at 16° (Jantsch)

**Cadmium nitrate, basic,  $\text{Cd}(\text{OH})\text{NO}_3 + \text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$ , or ordinary alcohol (Kluger, B 16 997)

$12\text{CdO}, \text{N}_2\text{O}_5 + 11\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$ , more sol in  $\text{H}_2\text{O}$  than basic sulphate (Haber-mann, 5 432)

$5\text{CdO}, 2\text{N}_2\text{O}_5 + 8\text{H}_2\text{O}$  Decomp by cold  $\text{H}_2\text{O}$  (Rousseau and Tite, C R 114 1184)

**Cadmium nitrate,  $\text{Cd}(\text{NO}_3)_2$** 

Deliquescent, and very sol in  $\text{H}_2\text{O}$

See +4, and  $9\text{H}_2\text{O}$

Sp gr of aqueous solution containing

5 10 15 20 25%  $\text{Cd}(\text{NO}_3)_2$ ,  
1 0528 1 0978 1 1516 1 2134 1 2842

30 35 40 45 50%  $\text{Cd}(\text{NO}_3)_2$   
1 3566 1 4372 1 5372 1 6474 1 7608

(Franz, J pr (2) 5 274)

Sp gr of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  at 18°

%  $\text{Cd}(\text{NO}_3)_2$  1 5 10 15  
Sp gr 1 0069 1 0415 1 0869 1 136

%  $\text{Cd}(\text{NO}_3)_2$  20 25 30 35  
Sp gr 1 1903 1 25 1 3125 1 3802

%  $\text{Cd}(\text{NO}_3)_2$  40 45 48  
Sp gr 1 459 1 543 1 5978

(Grotrian, W Ann 1883, 18 193)

Sp gr of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  at room temp containing

7 81 15 71 22 36%  $\text{Cd}(\text{NO}_3)_2$   
1 0744 1 1593 1 2411

(Wagner, W Ann 1883, 18 265)

Sp gr of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$

% $\text{Cd}(\text{NO}_3)_2$	t	Sp gr at t°	Sp gr at 18
0 0492	17 57	0 99912	0 99904
	21 14	0 99839	
0 100	18 00		0 99945
0 249	17 34	1 0008	1 0007
	20 22	1 0002	
0 464	18 00		1 0025
0 952	18 00		1 0065

(Wershofen, Z phys Ch 1890, 5 493)

Sp gr of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  at 25°

Concentration of $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$	Sp gr
1-normal	1 0954
$1/2$ - "	1 0479
$1/4$ - "	1 0249
$1/16$ - "	1 0119

(Wagner, Z phys Ch 1890, 5 36)

Sp gr of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  at 18°/4°

%  $\text{Cd}(\text{NO}_3)_2$  54 027 43 716 30 8,  
Sp gr 1 711 1 515 1 32

%  $\text{Cd}(\text{NO}_3)_2$  21 353 14 899 8 68  
Sp gr 1 204 1 134 1 0

(de Muynck, W Ann 1894, 53 561)

$\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  containing 7 89%  $\text{Cd}(\text{NO}_3)_2$   
has sp gr  $20^\circ/20^\circ = 1 0673$

$\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  containing 12 14%  
 $\text{Cd}(\text{NO}_3)_2$  has sp gr  $20^\circ/20^\circ = 1 1070$

(Le Blanc and Rohland, Z phys Ch 189 19 282)

Sat  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  boils at 132°

Almost entirely insol in conc  $\text{HNO}_3 + \text{A}$  (Wurtz)

Moderately sol in liquid  $\text{NH}_3$  (Frankh Am Ch J 1898, 20 827)

Sol in alcohol

Sol in ethyl acetate (Naumann, B 190 37 3601)

Sol in acetone and in methylal (Eh mann, C C 1899, II 1014)

$+4\text{H}_2\text{O}$  M-pt of  $\text{Cd}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$   
59 5° (Ordway, Tilden, Chem Soc 45 409)  
Solubility in  $\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$  at t°

t	% $\text{Cd}(\text{NO}_3)_2$ in the solution	Mols $\text{H}_2\text{O}$ to 1 mol $\text{Cd}(\text{NO}_3)_2$
0	52 31	11 96
18	55 90	10 34
30	58 40	9 34
40	61 42	8 24
59 5 mpt	76 54	4 00

(Funk, B 1899, 32 105)

Sat solution of  $\text{Cd}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$  in H at 0° contains 52 3%  $\text{Cd}(\text{NO}_3)_2$  at 18°  
55 9%  $\text{Cd}(\text{NO}_3)_2$  (Mvlius, Z anorg, 191 74 411)

Sol in liquid  $\text{NH}_3$  (Johnson and Wil more, Elektroch Z 1908, 14 227)

Sol in acetone (Naumann, B 1904, 3 4328)

Sol in ethyl acetate (Naumann, B 191 43 314)

$+9\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

—13° —1° +1°  
37 37 47 33 52 73%  $\text{Cd}(\text{NO}_3)_2$

Cryohydrate is formed at  $-16^{\circ}$  (Funk, Z anorg 1899, 20 416)

The composition of the hydrates formed by  $\text{Cd}(\text{NO}_3)_2$  at different dilutions is calculated from determinations of the lowering of the fr-pt produced by  $\text{Cd}(\text{NO}_3)_2$  and of the conductivity and sp gr of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  (Jones, Am Ch J 1905, 34 308)

**Cadmium uranyl nitrate**,  $\text{Cd}(\text{NO}_3)_2 \cdot (\text{UO}_2)(\text{NO}_3)_2 + 30\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  and acids Insol in alcohol and alkalis + Aq (Lancien, C C 1912, I 208)

**Cadmium nitrate ammonia**,  $\text{Cd}(\text{NO}_3)_2 \cdot 6\text{NH}_3 + \text{H}_2\text{O}$   
(André, C R 104 987)

**Cadmium nitrate cupric oxide**,  $\text{Cd}(\text{NO}_3)_2 \cdot \text{CuO} + 5\text{H}_2\text{O}$   
Ppt (Mailhe, C R 1902, 134 235)

**Cadmium nitrate cupric oxide**,  $\text{Cd}(\text{NO}_3)_2 \cdot 3\text{CuO} + 5\text{H}_2\text{O}$   
(Mailhe, A ch 1902, (7) 27 383)

**Cadmium nitrate hydrazine**,  $\text{Cd}(\text{NO}_3)_2 \cdot 3\text{N}_2\text{H}_4$   
Decomp by hot  $\text{H}_2\text{O}$  Sol in warm  $\text{NH}_4\text{OH}$  (Franzen, Z anorg 1908, 60 282)

**Cæsium nitrate**,  $\text{CsNO}_3$

100 pts  $\text{H}_2\text{O}$  dissolve 10.58 pts  $\text{CsNO}_3$  at  $32^{\circ}$  Sl sol in absolute alcohol (Bunsen)

Solubility of  $\text{CsNO}_3$  in  $\text{H}_2\text{O}$  at  $t^{\circ}$

$t^{\circ}$	G $\text{CsNO}_3$ per 100 g		$t^{\circ}$	G $\text{CsNO}_3$ per 100 g	
	Solu tion	Water		Solu tion	Water
0	8.54	9.33	60	45.6	83.8
10	12.97	14.9	70	51.7	107.0
20	18.7	23.0	80	57.3	134.0
30	25.3	33.9	90	62.0	163.0
40	32.1	47.2	100	66.3	197.0
50	39.2	64.4	106.2	68.8	220.3

(Berkeley, Trans Roy Soc 1904, 203 A, 213)

100 g  $\text{H}_2\text{O}$  dissolve 26.945 g  $\text{CsNO}_3$  at  $25^{\circ}$  (Haigh, J Am Chem Soc 1912, 34 1148)

Sp gr  $20^{\circ}/4^{\circ}$  of a normal solution of  $\text{CsNO}_3$  = 1.140905, of a 0.5 normal solution = 1.07001 (Haigh)

Sol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4328)

Solubility in glycol = 8% at ord temp (de Coninck, Belg Acad Bull 1905, 359)

**Cæsium hydrogen nitrate**

$\text{CsNO}_3 \cdot \text{HNO}_3$  Sol in  $\text{H}_2\text{O}$  (Wells, Am Ch J 1901, 26 273)

$\text{CsNO}_3 \cdot 2\text{HNO}_3$  (W)

**Cæsium cerium nitrate**,  $\text{Cs}_2\text{Ce}(\text{NO}_3)_6$

Sol in  $\text{H}_2\text{O}$ , very sl sol in  $\text{HNO}_3$  (Meyer, Z anorg 1901, 27 371)

Sol in  $\text{HNO}_3$  (Meyer, B 1900, 33 2137)

**Cæsium ferric nitrate**,  $\text{CsNO}_3 \cdot \text{Fe}(\text{NO}_3)_3 + 7\text{H}_2\text{O}$

Deliquescent (Wells, Am Ch J 1901, 26 276)

**Cæsium silver nitrate**,  $\text{CsNO}_3 \cdot \text{AgNO}_3$

Sol in  $\text{H}_2\text{O}$  (Russell and Maskelyne, Roy Soc Proc 26 357)

**Cæsium thorium nitrate**,  $\text{Cs}_2\text{Th}(\text{NO}_3)_6$

Decomp by  $\text{H}_2\text{O}$ , sl sol in  $\text{HNO}_3$  (Meyer, Z anorg 1901, 27 384)

**Cæsium uranyl nitrate**,  $\text{Cs}(\text{UO})_2(\text{NO}_3)_6$

Decomp by  $\text{H}_2\text{O}$  Sol in conc  $\text{HNO}_3$  (Meyer, B 1903, 36 4057)

Decomp by  $\text{H}_2\text{O}$  at low temp, so that the solid phase in contact with the solution consists of the double salt and  $\text{CsNO}_3$ . At  $16^{\circ}$  100 pts by wt of the solution in  $\text{H}_2\text{O}$  contain 31.39 pts  $\text{UO}_2$  and 6.59 pts Cs (Rumbach, B 1904, 37 477)

**Calcium nitrate, basic**,  $\text{Ca}(\text{NO}_3)_2 \cdot \text{CaO}_2\text{H}_2 + 2\frac{1}{2}\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Werner, A ch (6) 27 570)

+  $\text{H}_2\text{O}$  As above (Rousseau and Tite, C R 114 1184)

**Calcium nitrate**,  $\text{Ca}(\text{NO}_3)_2$

Deliquescent Very sol in  $\text{H}_2\text{O}$  with evolution of much heat

100 pts  $\text{H}_2\text{O}$  at  $0^{\circ}$  dissolve 84.2 pts  $\text{Ca}(\text{NO}_3)_2$  (Poggiale)

100 pts  $\text{H}_2\text{O}$  at  $0^{\circ}$  dissolve 93.1 pts  $\text{Ca}(\text{NO}_3)_2$  (Mulder)

Sol in 0.25 pt cold  $\text{H}_2\text{O}$  with reduction of temp Sol in all proportions in boiling  $\text{H}_2\text{O}$  (Berzelius)

Sol in 2 pts cold and 0.6667 pt boiling  $\text{H}_2\text{O}$  (Fourcroy)

Sat  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at  $12.5^{\circ}$  contains 33.8% (Hasenfratz A ch 23 29)

Solubility in  $\text{H}_2\text{O}$

100 g of the solution contain at

$55^{\circ}$   $80^{\circ}$   $90^{\circ}$   $100^{\circ}$   
78.16 78.20 78.37 78.43 g  $\text{Ca}(\text{NO}_3)_2$

$125^{\circ}$   $147.5^{\circ}$   $151^{\circ}$  (bpt of sat solution at 760 mm)  
78.57 78.80 79.00 g  $\text{Ca}(\text{NO}_3)_2$

The anhydrous salt is the stable solid phase above  $51.3^{\circ}$  (Bassett and Taylor, Chem Soc 1912, 101 580)

100 g sat  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  contain 77.3 g  $\text{Ca}(\text{NO}_3)_2$  at 25° (Taylor and Henderson, J Am Chem Soc 1915, **37** 1692)  
 See also +2, 3, and  $4\text{H}_2\text{O}$   
 Sp gr of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at room temp containing

17.55 30.10 40.13 %  $\text{Ca}(\text{NO}_3)_2$   
 1.1714 1.2739 1.3857

(Wagner, W Ann 1883, **18** 270)

Sp gr of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 17.5°

$\text{Ca}(\text{NO}_3)_2$	Sp gr	$\text{Ca}(\text{NO}_3)_2$	Sp gr
1	1.009	35	1.328
5	1.045	40	1.385
10	1.086	45	1.447
15	1.129	50	1.515
20	1.174	55	1.588
25	1.222	60	1.666
30	1.272		

(Franz, J pr (2) **5** 274)

Sp gr of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 17.5°

$\text{Ca}(\text{NO}_3)_2$	Sp gr	$\text{Ca}(\text{NO}_3)_2$	Sp gr
10	1.076	40	1.368
20	1.163	50	1.483
30	1.261	60	1.605

(Gerlach, Z anal **27** 283)

Sp gr of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 18°

$\text{Ca}(\text{NO}_3)_2$	Sp gr	$\text{Ca}(\text{NO}_3)_2$	Sp gr
6.25	1.0487	37.5	1.3546
12.5	1.1016	50.0	1.5102
25.0	1.2198		

(Kohlrausch, W Ann **1879** 1)

Sp gr of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 24.65° a=no of g  $\times \frac{1}{2}$  mol wt dissolved in 1000 g  $\text{H}_2\text{O}$ , b=sp gr if a is  $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol wt = 118, c=sp gr if a is  $\text{Ca}(\text{NO}_3)_2$ ,  $\frac{1}{2}$  mol wt = 82

a	b	c	a	b	c
1	1.056	1.059	6	1.243	1.286
2	1.104	1.112	7	1.270	1.323
3	1.145	1.160	8	1.294	
4	1.181	1.205	9	1.316	
5	1.213	1.246	10	1.336	

(Favre and Valson, C R **79** 968)

Sp gr of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 25°

Concentration of $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$	Sp gr
1-normal	1.0596
$\frac{1}{2}$ "	1.0300
$\frac{1}{4}$ "	1.0151
$\frac{1}{8}$ "	1.0076

(Wagner, Z phys Ch 1890, **5** 36)

$\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  containing 7.15%  $\text{Ca}(\text{NO}_3)_2$  has sp gr  $20^\circ/20^\circ = 1.0554$

$\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  containing 7.91%  $\text{Ca}(\text{NO}_3)_2$  has sp gr  $20^\circ/20^\circ = 1.0613$

(Le Blanc and Rohland, Z phys Ch 1896, **19** 284)

Sp gr of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 20° containing M g mols of salt per liter

M 0.0125 0.025 0.05 0.125  
 Sp gr 1.001846 1.003166 1.00604 1.01523

M 0.25 0.5 0.75  
 Sp gr 1.03074 1.06011 1.08874

M 1.00 1.50  
 Sp gr 1.11751 1.17375

(Jones and Pearce, Am Ch J 1907, **38** 704)

Saturated  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  containing 351.2 pts  $\text{Ca}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$  boils at 151° (Legrand), 152° (Kremers)

Forms a crust at 141°, and contains 333.5 pts  $\text{Ca}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$ , highest temp observed, 151° (Gerlach, Z anal **26** 427)

B-pt of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  containing pts  $\text{Ca}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$  G=according to Gerlach (Z anal **26** 447), L=according to Legrand (A ch (2) **59** 436)

B-pt	G	L	B-pt	G	L
101°	10	15	127	215.5	
102	20	25.3	128	222.5	197.0
103	30	34.4	129	230	
104	40	42.6	130	237.5	209.5
105	50	50.4	131	245	
106	60	57.8	132	253	222.2
107	70	64.9	133	261.5	
108	80	71.8	134	270	235.1
109	89	78.6	135	278.5	
110	98	85.3	136	287	248.1
111	106.5	91.9	137	296	
112	114.5	98.4	138	305	261.3
113	122.5	104.8	139	314.5	
114	130	111.2	140	324	271.7
115	137.5	117.5	141	333.5	
116	144	123.8	142	343.5	288.4
117	150.5	130	143	354	
118	157	136.1	144	361.5	302.6
119	163.5	142.1	145	375	
120	170	148.1	146	386	317.4
121	176		147	397.5	
122	182.5	160.1	148	409	333.2
123	189		149	420.5	
124	195.5	172.2	150	432.5	351.2
125	202		151	444.5	362.2
126	208.5	184.5	151.97	455.68	

Sat  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  boils at 132° (Ordway, Sill Am J (2) **27** 14)

Conc  $\text{HNO}_3$  precipitates  $\text{Ca}(\text{NO}_3)_2$  from its aqueous solution (Mitscherlich, Pogg **18** 159)

Very sol in conc  $\text{HNO}_3$  (Rawson, J Soc Chem Ind 1897, **16** 113)

Solubility in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$ 

100 g of the solution contain		Solid phase
G $\text{Ca}(\text{NO}_3)_2$	G $\text{HNO}_3$	
57 98	0 00	$\text{Ca}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$
54 82	3 33	
52 96	5 87	
51 58	7 21	
47 82	11 27	
45 59	13 71	
40 70	19 65	
38 17	22 80	
34 46	28 81	
32 84	32 63	
32 50	33 52	$\text{Ca}(\text{NO}_3)_2 + 3\text{H}_2\text{O}$
33 44	35 63	
29 05	41 66	
27 79	45 70	
31 09	40 56	
26 07	45 70	
17 41	55 48	
12 25	62 05	
9 34	65 69	
8 52	67 20	
5 06	71 12	$\text{Ca}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$
2 53	74 77	
1 05	78 56	
0 54	80 83	
0 36	85 83	
0 01 (about)	90 90	
0 00	96 86	
0 00	96 86	

These results show that the hydrates of  $\text{Ca}(\text{NO}_3)_2$  which are stable at  $25^\circ$  in contact with  $\text{HNO}_3 + \text{Aq}$  are  $\text{Ca}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$ ,  $+3\text{H}_2\text{O}$  and  $+2\text{H}_2\text{O}$

(Bassett and Taylor, Chem Soc 1912, 101 582)

Sol in glacial  $\text{HC}_2\text{H}_3\text{O}_2$  (Persoz)

Sol in sat  $\text{KNO}_3 + \text{Aq}$  with elevation of temp and pptn of a portion of  $\text{KNO}_3$  (Fourcroy and Vauquelin, A ch 11 135)

Solubility of  $\text{Ca}(\text{NO}_3)_2 + \text{NaNO}_3$  at  $t^\circ$ 

$t^\circ$	% $\text{Ca}(\text{NO}_3)_2$	% $\text{NaNO}_3$	Solid phase
9	47 51	9 51	$\text{Ca}(\text{NO}_3)_2, 4\text{H}_2\text{O}$ " $+ \text{NaNO}_3$ $\text{NaNO}_3$ "
	46 08	12 56	
	26 67	23 32	
	11 76	34 26	
25	54 58	7 25	$\text{Ca}(\text{NO}_3)_2, 4\text{H}_2\text{O}$ " $+ \text{NaNO}_3$ $\text{NaNO}_3$ " " "
	53 22	10 70	
	52 73	12 08	
	52 40	11 58	
	37 31	19 48	
	26 91	24 98	
	14 61	36 12	

(Kremann and Rothmund, Z anorg 1914, 86 373)

Solubility of  $\text{Ca}(\text{NO}_3)_2 + \text{CaS}_2\text{O}_8$  at  $t^\circ$ 

$t^\circ$	% $\text{Ca}(\text{NO}_3)_2$	% $\text{CaS}_2\text{O}_8$	Solid phase
9	46 02	5 46	$\text{Ca}(\text{NO}_3)_2, 4\text{H}_2\text{O}$ " $\text{CaS}_2\text{O}_8, 6\text{H}_2\text{O}$ $\text{CaS}_2\text{O}_8, 6\text{H}_2\text{O}$ "
	45 68	6 81	
	27 92	10 46	
	10 49	22 81	
		29 33	$\text{Ca}(\text{NO}_3)_2, 4\text{H}_2\text{O}$ " $+ \text{CaS}_2\text{O}_8, 6\text{H}_2\text{O}$ $\text{CaS}_2\text{O}_8, 6\text{H}_2\text{O}$ " " "
25	54 03	4 27	
	50 25	9 10	
	45 92	13	
	42 93	13 83	
	32 01	17 09	
	19 51	23 78	
	8 15	29 85	

(Kremann and Rothmund, Z anorg 1914, 86 373)

Very easily sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

Sol in 0.8 pt alcohol (Macquer), 1 pt boiling alcohol (Bergmann)

Dry  $\text{Ca}(\text{NO}_3)_2$  is sol in 7 pts alcohol at  $15^\circ$  and 1 pt boiling alcohol (Bergmann)

Sp gr of  $\text{Ca}(\text{NO}_3)_2 + \text{alcohol}$ 

% $\text{Ca}(\text{NO}_3)_2$	Sp gr $20^\circ/20^\circ$
0	0 7949
4 96	0 8278
6 47	0 8383

(Le Blanc and Rohland, Z phys Ch 1896, 19 284)

Solubility in ethyl alcohol + Aq at  $25^\circ$ 

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Ca}(\text{NO}_3)_2$ in the solution
*0	0	82 5
*25 1	5 8	77 0
*50 1	15 2	69 52
*60 1	20 4	66 08
*63 9	22 4	64 94
70 4	26 5	62 3
72 0	27 39	61 96
73 4	28 5	61 15
75 3	29 9	60 3
*84 9	35 9	57 7
*99 1	48 1	51 4

\* Metastable solutions

(D'Ans and Siegler, Z phys Ch 1913, 82 43)



Solubility of  $\text{Ca}(\text{NO}_3)_2 \cdot 2\text{C}_2\text{H}_5\text{OH}$  in  $\text{C}_2\text{H}_5\text{OH}$   
+Aq at  $25^\circ$

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Ca}(\text{NO}_3)_2$ in the solution
98 1	60 2	38 6
94 1	54 6	41 9
85 8	42 5	50 97
80 5	35 8	55 3
75 3	29 9	60 28

(D'Ans and Siegler, *l c*)

See also under  $+4\text{H}_2\text{O}$

#### Solubility in organic solvents

Solvent	% $\text{Ca}(\text{NO}_3)_2$ in the solution at $25^\circ$
Methyl alcohol	65 5
Ethyl alcohol	52 0
Propyl alcohol	36 5
Isobutyl alcohol	25 0
Amyl alcohol	13 3
Acetone	58 5

(D'Ans and Siegler, *l c*)

Sol in 187 pts ether-alcohol (1 1)  
(Fresenius, *Z anal* **32** 191)

Ether ppts  $\text{Ca}(\text{NO}_3)_2$  from its alcoholic solution Easily sol in boiling amyl alcohol  
(Browning, *Sill Am J* **143** 53)

Sol in acetone (Naumann, *B* 1904, **37** 4328)

Insol in benzonitrile (Naumann, *B* 1914, **47** 1370)

Insol in methylal (Eidmann, *C C* **1899**, II 1014)

1 g  $\text{Ca}(\text{NO}_3)_2$  is sol in 1.44 g methyl acetate at  $18^\circ$  Sp gr  $18^\circ/4^\circ$  of sat solution = 1.313 (Naumann, *B* 1909, **42** 3795)

Sol in ethyl acetate (Naumann, *B* 1910, **43** 314)

+ $2\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

100 g of the solution contain at

$49^\circ$   $51^\circ$   
77.49 78.05 g  $\text{Ca}(\text{NO}_3)_2$

Solutions in stable equilibrium with the dihydrate can only exist between the limits of temp  $48.4^\circ$  and  $51.3^\circ$  (Bassett and Taylor, *Chem Soc* 1912, **101** 580)

+ $3\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

100 g of the solution contain at

$40^\circ$   $45^\circ$   $50^\circ$   $51^\circ$   
70.37 71.45 73.79 74.73 g  $\text{Ca}(\text{NO}_3)_2$

Mpt of  $\text{Ca}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} = 51.1^\circ$

(Bassett and Taylor, *l c*)

+ $4\text{H}_2\text{O}$   $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$  melts in its crystal  $\text{H}_2\text{O}$  at  $44^\circ$  (Tilden, *Chem Soc* **45** 409)

#### Solubility in $\text{H}_2\text{O}$ at $t^\circ$

100 g of the solution contain g  $\text{Ca}(\text{NO}_3)_2$  at  $t^\circ$

$t^\circ$	G $\text{Ca}(\text{NO}_3)_2$
$-26.7$	43.37
$-10.0$	47.31
$0.0$	50.50
$+5.0$	51.97
$10.0$	53.55
$15.0$	54.94
$20.0$	56.39
$25.0$	57.98
$30.0$	60.41
$35.0$	62.88
$40.0$	66.21
$42.4$	68.68
$42.5$	68.74
$42.7$	mpt of $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
$42.45$	71.70

(Bassett and Taylor, *l c*)

Solubility of  $\alpha$  and  $\beta$  modifications in  $\text{H}_2\text{O}$  at  $t^\circ$

$\alpha$  modification is the stable form

$t^\circ$	G $\text{Ca}(\text{NO}_3)_2$ in 100 g of solution	Solid phase
0	50.17	$\alpha$ $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
22.2	56.88	$\alpha$ "
25.0	57.90	$\alpha$ "
30.0	60.16	$\alpha$ "
30.0	61.57	$\beta$ "
34.0	63.66	$\beta$ "
35.0	62.88	$\alpha$ "
38.0	64.34	$\alpha$ "
38.0	66.65	$\beta$ "
39.0	67.93	$\beta$ "
$139.6$	69.50	$\beta$ "
$239.0$	75.34	$\beta$ "
40.0	66.21	$\alpha$ "
$142.7$	69.50	$\alpha$ "
$242.4$	71.70	$\alpha$ "

<sup>1</sup> mpt of hydrate

<sup>2</sup> reflex pt

(Taylor and Henderson, *J Am Chem Soc* 1915, **37** 1692)

Sp gr of solution sat at  $18^\circ = 1.548$ , containing 54.8%  $\text{Ca}(\text{NO}_3)_2$  (Mylus, *B* 187, **30** 1718)

## Solubility in ethyl alcohol + Aq at 25°

% C <sub>2</sub> H <sub>5</sub> OH in the solvent	% C <sub>2</sub> H <sub>5</sub> OH in the solution	% Ca(NO <sub>3</sub> ) <sub>2</sub> in the solution
0	0	57.5
18.3	3.5	56.1
39.2	8.1	55.2
59.2	14.1	52.9
80.4	22.3	50.2
90.4	29.4	49.0
99.4	31.1	49.7
99.4	31.2	52.0
99.4	29.5	56.2
60.1	28.3	58.9
60.1	27.8	60.0
60.1	27.3	60.7
60.1	26.5	62.3

(D'Ans and Siegler, Z phys Ch 1913, 82 42)

**Calcium nitrate hydrazine**, Ca(NO<sub>3</sub>)<sub>2</sub> · 2N<sub>2</sub>H<sub>4</sub> + H<sub>2</sub>O

Ppt (Franzen, Z anorg 1908, 60 288)

**Calcium nitrate tungstosilicate**, Ca<sub>2</sub>W<sub>12</sub>SiO<sub>40</sub>, Ca(NO<sub>3</sub>)<sub>2</sub>+13H<sub>2</sub>O and +15H<sub>2</sub>O Decomp by H<sub>2</sub>O (Wyruboff, Chem Soc 1897, 72 (2) 176)**Cerous nitrate**, Ce(NO<sub>3</sub>)<sub>3</sub> · 6H<sub>2</sub>O

Not very deliquescent (Jolin)

Very sol in H<sub>2</sub>O, sol in 2 pts alcohol (Vauquelin)

Sol in acetone (Eidmann, C C 1899 II 1014, Naumann, B 1904, 37 4328)

**Ceric nitrate**, Ce(NO<sub>3</sub>)<sub>4</sub>Deliquescent Decomp by hot H<sub>2</sub>O (Berzelius)

Sol in alcohol (Dumas)

Basic compounds containing 12 mols or less CeO<sub>2</sub> to 1 mol N O<sub>5</sub> may be obtained, which are sol in H<sub>2</sub>O (Ordway)**Cerous cobaltous nitrate**, 2Ce(NO<sub>3</sub>)<sub>3</sub> · 3Co(NO<sub>3</sub>)<sub>2</sub> + 24H<sub>2</sub>O

Deliquescent Easily forms supersaturated solutions (Lange, J pr 82 129)

1 l sat solution in HNO<sub>3</sub> + Aq (sp gr 1.325) contains 103.3 g hydrous salt at 16° (Jantsch, Z anorg 1912, 76 321)**Ceric cobaltous nitrate**, CeCo(NO<sub>3</sub>)<sub>6</sub> · 8H<sub>2</sub>ODecomp by H<sub>2</sub>O when heated, sol in cold H<sub>2</sub>O, sl sol in HNO<sub>3</sub> (Meyer, Z anorg 1901, 27 376)**Cerous magnesium nitrate**, 2Ce(NO<sub>3</sub>)<sub>3</sub> · 3Mg(NO<sub>3</sub>)<sub>2</sub> + 24H<sub>2</sub>OSlightly deliquescent Easily sol in H<sub>2</sub>O or alcohol, and easily forms supersaturated solutions (Holzmann, J pr 75 330)1 l sat solution in HNO<sub>3</sub> + Aq (sp gr 1.325) contains 63.8 g hydrous salt at 16° (Jantsch, Z anorg 1912, 76 321)**Ceric magnesium nitrate**, CeMg(NO<sub>3</sub>)<sub>6</sub> + 8H<sub>2</sub>ODecomp by H<sub>2</sub>O, sol in HNO<sub>3</sub> + Aq without decomp (Meyer, Z anorg 1901, 27 373)**Cerous manganous nitrate**, 2Ce(NO<sub>3</sub>)<sub>3</sub> · 3Mn(NO<sub>3</sub>)<sub>2</sub> + 24H<sub>2</sub>OSol in H<sub>2</sub>O (Lange, J pr 82 129)1 l sat solution in HNO<sub>3</sub> + Aq (sp gr 1.325) contains 193.1 g hydrous salt at 16° (Jantsch)**Ceric manganous nitrate**, CeMn(NO<sub>3</sub>)<sub>6</sub> + 8H<sub>2</sub>ODecomp by H<sub>2</sub>O and dil HNO<sub>3</sub>, sol in conc HNO<sub>3</sub> without decomp (Meyer, Z anorg 1901, 27 377)**Cerous nickel nitrate**, 2Ce(NO<sub>3</sub>)<sub>3</sub> · 3Ni(NO<sub>3</sub>)<sub>2</sub> + 24H<sub>2</sub>OEasily sol in H<sub>2</sub>O (Holzmann, J pr 75 321)1 l sat solution in HNO<sub>3</sub> + Aq (sp gr 1.325) contains 80.3 g hydrous salt at 16° (Jantsch)**Ceric nickel nitrate**, CeNi(NO<sub>3</sub>)<sub>6</sub> · 8H<sub>2</sub>ODecomp by H<sub>2</sub>O when heated, sol in H<sub>2</sub>O in the cold, sl sol in HNO<sub>3</sub> (Meyer, Z anorg 1901, 27 375)**Cerous potassium nitrate**, Ce(NO<sub>3</sub>)<sub>3</sub> · 2KNO<sub>3</sub> + 2H<sub>2</sub>OSol in H<sub>2</sub>O (Lange, J pr 82 136)**Ceric potassium nitrate**, CeK(NO<sub>3</sub>)<sub>6</sub>Sol in H<sub>2</sub>O with decomp (Meyer, Z anorg 1901, 27 370)+1½H<sub>2</sub>O Efflorescent (Holzmann, J pr 75 324)**Ceric rubidium nitrate**, CeRu(NO<sub>3</sub>)<sub>6</sub>Very sol in H<sub>2</sub>O, sl sol in HNO<sub>3</sub> (Meyer)**Ceric sodium nitrate**

Deliquescent Decomp by recrystallization (Holzmann)

**Cerous thalious nitrate**, [Ce(NO<sub>3</sub>)<sub>3</sub>]Tl + 4H<sub>2</sub>OVery hygroscopic Decomp by H<sub>2</sub>O (Jantsch, Z anorg 1911, 69 229)**Cerous zinc nitrate**, 2Ce(NO<sub>3</sub>)<sub>3</sub> · 3Zn(NO<sub>3</sub>)<sub>2</sub> + 24H<sub>2</sub>OSol in H<sub>2</sub>O Easily forms supersat solutions (Lange, J pr 82 129)1 l sat solution in HNO<sub>3</sub> + Aq (sp gr 1.325) contains 124.1 g hydrous salt at 16° (Jantsch, Z anorg 1912, 76 321)**Ceric zinc nitrate**, ZnCe(NO<sub>3</sub>)<sub>6</sub> · 8H<sub>2</sub>ODecomp by H<sub>2</sub>O, sol in HNO<sub>3</sub> + Aq (Meyer, Z anorg 1901, 27 374)

**Ceroceric zinc nitrate** (?),  $\text{Ce}_2\text{O}_3 \cdot 2\text{ZnO}$ ,  $6\text{N}_2\text{O}_5 \cdot 18\text{H}_2\text{O}$  (?)

Easily sol in  $\text{H}_2\text{O}$  (Holzmann, J pr 75 321)

**Chromic nitrate, basic**,  $\text{Cr}_2\text{O}(\text{NO}_3)_4$

Sol in  $\text{H}_2\text{O}$  (Lowel)

+12 $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Ordway)

**Chromic nitrate**,  $\text{Cr}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  and alcohol (Lowel)

Melts in its crystal  $\text{H}_2\text{O}$  at  $36.5^\circ$  Sat  $\text{Cr}(\text{NO}_3)_3 + \text{Aq}$  boils at  $125.6^\circ$  (Ordway)

Sp gr of  $\text{Cr}(\text{NO}_3)_3 + \text{Aq}$

M = concentration of solution in gram mols

W = wt of 25 cc of solution

M 0 0934 0 1868 0 3736 0 5604 0 9340  
W 25 4300 25 8328 26 7302 27 5524 29 3072

M 1 1208 1 3076 1 4944 1 8680

W 30 0668 30 8464 31 6327 33 3379

(Jones and Getman, Z phys Ch 1904, 49 426)

Sol in acetone (Naumann, B 1904, 37 4328, Erdmann, C C 1899, II 1014)

**Chromic nitrate chloride**,  $\text{CrCl}_2(\text{NO}_3)_2$

Sol in  $\text{H}_2\text{O}$  and alcohol (Schiff, A 124 177)

$\text{Cr}(\text{NO}_3)_2\text{Cl}$  (Schiff)

**Chromic nitrate sulphate**,  $\text{Cr}_2(\text{SO}_4)(\text{NO}_3)_4$

Hygroscopic Completely sol in  $\text{H}_2\text{O}$

$\text{Cr}_2(\text{SO}_4)_2(\text{NO}_3)_2$  Sol in  $\text{H}_2\text{O}$  (Schiff, A 124 174)

**Cobaltous nitrate, basic**,  $6\text{CoO} \cdot \text{N}_2\text{O}_5 \cdot 5\text{H}_2\text{O}$

Ppt Gradually sol in  $\text{H}_2\text{O}$  with deposition of  $\text{CoO}$  (Winkelblech, A 13 155)

Sol in cold  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$  Decomp by hot  $\text{KOH} + \text{Aq}$

$4\text{CoO} \cdot \text{N}_2\text{O}_5 \cdot 6\text{H}_2\text{O}$  Ppt (Habermann, M 5 432)

**Cobaltous nitrate**,  $\text{Co}(\text{NO}_3)_2$

Deliquescent in moist air Very sol in  $\text{H}_2\text{O}$

See +3, 6, and 9 $\text{H}_2\text{O}$

Sp gr of aqueous solution at  $17.5^\circ$  containing

5 10 15 20%  $\text{Co}(\text{NO}_3)_2$ ,  
1 0462 1 0906 1 1378 1 1936

25 30 35 40%  $\text{Co}(\text{NO}_3)_2$   
1 2538 1 3190 1 3896 1 4662

Sp gr of sat solution = 1 5382

(Franz, J pr (2) 5 274)

Sp gr of  $\text{Co}(\text{NO}_3)_2 + \text{Aq}$  at room temp containing

8 28 15 96 24 528%  $\text{Co}(\text{NO}_3)_2$   
1 0732 1 1436 1 2288

(Wagner, W Ann 1883, 18 268)

Sp gr of  $\text{Co}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{Co}(\text{NO}_3)_2 + \text{Aq}$	Sp gr
1-normal	1 0728
$\frac{1}{2}$ - " "	1 0369
$\frac{1}{4}$ - " "	1 0184
$\frac{1}{8}$ - " "	1 0094

(Wagner, Z phys Ch 1890, 5 37)

Sp gr at  $20^\circ$  of  $\text{Co}(\text{NO}_3)_2 + \text{Aq}$  containing

M g mols  $\text{Co}(\text{NO}_3)_2$  per liter

M 0 01 0 025 0 05 0 075

Sp gr 1 001496 1 003863 1 007579 1 011289

M 0 10 0 25 0 5 0 75

Sp gr 1 015084 1 03737 1 07415 1 11204

M 1 0 1 5 2 0

Sp gr 1 14612 1 21720 1 28576

(Jones and Pearce, Am Ch J 1907, 38 715)

Sol in liquid  $\text{NH}_3$  (Guntz, Bull Soc 1909 (4) 5 1009)

100 g sat solution in glycol contains 80 g  $\text{Co}(\text{NO}_3)_2$  (de Coninck, C C 1905, II 883)

Sol in ethyl acetate (Naumann, B 1904 37 3601)

+3 $\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

$55^\circ$   $62^\circ$   $70^\circ$   $84^\circ$   $91^\circ$  mpt  
61 74 62 88 64 89 68 84 77 21%  $\text{Co}(\text{NO}_3)_2$

(Funk, Z anorg 1899, 20 408)

+6 $\text{H}_2\text{O}$  Melts in its crystal  $\text{H}_2\text{O}$  at  $56^\circ$  (Ordway),  $38^\circ$  (Tilden)

Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

$-21^\circ$   $-10^\circ$   $-4^\circ$   $0^\circ$

41 55 43 69 44 85 45 66%  $\text{Co}(\text{NO}_3)_2$ ,

+18° 41° 56° mpt

49 73 55 96 62 88%  $\text{Co}(\text{NO}_3)_2$

(Funk, Z anorg 1899, 20 408)

Moderately sol in liquid  $\text{NH}_3$  (Franklin Am Ch J 1898, 20 827)

Easily sol in alcohol Sol in 1 pt stron alcohol at  $12.5^\circ$  (Wenzel)

Easily sol in acetone (Krup, und McElroy J Anal Ch 6 184)

Sol in methyl acetate (Naumann, E 1909, 42 3790)

Difficultly sol in ethyl acetate (Naumann, B 1910, 43 314)

+9 $\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

$-26^\circ$   $-23.5^\circ$   $-20.5^\circ$

39 45 40 40 42 77%  $\text{Co}(\text{NO}_3)_2$

Cryohydrate is formed at  $-29^\circ$  (Funk Z anorg 1899, 20 409)

**Cobaltous didymium nitrate**,  $3\text{Co}(\text{NO}_3)_2$ ,  
 $2\text{D}_1(\text{NO}_3)_2 + 48\text{H}_2\text{O}$

Very deliquescent (Frerichs and Smith,  
A 191 331)

**Cobaltous gadolinium nitrate**,  $3\text{Co}(\text{NO}_3)_2$ ,  
 $2\text{Gd}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

1 l sat solution in  $\text{HNO}_3$  (sp gr 1.325)  
contains 451.4 g hydrous salt at  $16^\circ$   
(Jantsch, Z anorg 1912, 76 303)

**Cobaltous lanthanum nitrate**,  $3\text{Co}(\text{NO}_3)_2$ ,  
 $2\text{La}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr  
1.325) contains 109.2 g hydrous salt at  $16^\circ$   
(Jantsch, Z anorg 1912, 76 303)

**Cobaltous neodymium nitrate**,  $3\text{Co}(\text{NO}_3)_2$ ,  
 $2\text{Nd}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr  
1.325) contains 151.6 g hydrous salt at  $16^\circ$   
(Jantsch)

**Cobaltous praseodymium nitrate**,  $3\text{Co}(\text{NO}_3)_2$ ,  
 $2\text{Pr}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr  
1.325) contains 12.99 g hydrous salt at  $16^\circ$   
(Jantsch)

**Cobaltous samarium nitrate**,  $3\text{Co}(\text{NO}_3)_2$ ,  
 $2\text{Sm}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr  
1.325) contains 34.27 g hydrous salt at  $16^\circ$   
(Jantsch)

**Cobaltous thorium nitrate**,  $\text{CoTh}(\text{NO}_3)_6 +$   
 $8\text{H}_2\text{O}$

Hydroscopic, sol in  $\text{HNO}_3 + \text{Aq}$  (Meyer,  
Z anorg 1901, 27 387)

**Cobaltous nitrate ammonia**,  $\text{Co}(\text{NO}_3)_2 \cdot 6\text{NH}_3$   
 $+ 2\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  with separation of basic  
nitrate (Fromy)

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Hess)

**Cobaltous nitrate cupric oxide**,  $\text{Co}(\text{NO}_3)_2$ ,  
 $3\text{CuO} + 3\text{H}_2\text{O}$

Ppt (Maulhe, C R 1902, 134 234)

**Cobaltous nitrate hydrazine**,  $\text{Co}(\text{NO}_3)_2$ ,  
 $3\text{N}_2\text{H}_4$

Decomp by hot  $\text{H}_2\text{O}$  (Franzen, Z anorg,  
1908, 60 274)

**Cupric nitrate, basic**,  $2\text{CuO}$ ,  $\text{N}_2\text{O}_5$

(Ditte, A ch 1879, (5) 18 339)

$4\text{CuO}$ ,  $\text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Easily  
sol in acids (Graham, A 29 13)

Insol in  $\text{H}_2\text{O}$ , easily sol in acids (Athan  
asesco, Bull Soc 1895, (3) 11 1113)

$+ 3\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , and decomp by  
heat (Casselmann, Z anal 4 24)

**Cupric nitrate**,  $\text{Cu}(\text{NO}_3)_2$

Deliquescent Very easily sol in  $\text{H}_2\text{O}$  or  
alcohol, also in moderately conc  $\text{HNO}_3 + \text{Aq}$ ,  
but is precipitated from conc aqueous solu-  
tion by  $\text{HNO}_3 + \text{Aq}$  of 1.522 sp gr (Mit-  
scherlich, Pogg 18 159)

Sat  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  contains at

$-10^\circ$	$-3^\circ$	$+3^\circ$
38.8	41.6	44.5% $\text{Cu}(\text{NO}_3)_2$

$8^\circ$	$20^\circ$	$32^\circ$
48.5	54.1	61.2% $\text{Cu}(\text{NO}_3)_2$

(Etard, A ch 1894, (7) 2 528)

See +3, 6, and  $9\text{H}_2\text{O}$

Sp gr of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at  $17.5^\circ$  contain-

5	10	15% anhydrous salt,
1.0452	1.0942	1.1442

20	25	30% anhydrous salt,
1.2036	1.2644	1.3298

35	40	45% anhydrous salt
1.3974	1.4724	1.5576

(B Franz, J pr (2) 5 274)

Sp gr of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at  $15^\circ$

% $\text{Cu}(\text{NO}_3)_2$	Sp gr
5.22	1.046
10.44	1.094
15.67	1.146
20.85	1.202
26.12	1.262
35.00	1.377

(Long, W Ann 1880, 11 39)

Sp gr of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at room temp  
containing

18.99	26.68	46.71% $\text{Cu}(\text{NO}_3)_2$
1.1774	1.2637	1.5363

(Wagner, W Ann 1883, 18 272)

Sp gr of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{Cu}(\text{NO}_3)_2 + \frac{1}{2}\text{Aq}$	Sp gr
1-normal	1.0755
$\frac{1}{2}$ " "	1.0372
$\frac{1}{4}$ " "	1.0185
$\frac{1}{8}$ " "	1.0092

(Wagner, Z phys Ch 1890, 5 38)

Sp gr of  $\text{Cu}(\text{NO}_3)_2 + \frac{1}{2}\text{Aq}$  at  $12.5^\circ$

% $\text{Cu}(\text{NO}_3)_2$	1	5	10	14
Sp gr	1.0059	1.0320	1.0655	1.0916

% $\text{Cu}(\text{NO}_3)_2$	20	24	30	34
Sp gr	1.1350	1.1716	1.2320	1.2712

% $\text{Cu}(\text{NO}_3)_2$	40	44	50	56
Sp gr	1.3320	1.3749	1.4440	1.5205

(Hassenfratz, Muspratt, 1893, 4 2243)

Sp gr at 20° of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  containing  
 M g mols salt per liter  
 M 0 01 0 025 0 05 0 075  
 Sp gr 1 001504 1 004076 1 007859 1 011715

M 0 25 0 50 0 75 0 935  
 Sp gr 1 040290 1 07723 1 11469 1 14262

Sp gr 1 5 2 0  
 M 1 22618 1 29262  
 (Jones and Pearce, Am Ch J 1917, **38** 719)

Sat  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  boils at about 173°  
 (Griffiths)

Insol in fuming  $\text{HNO}_3$  (Ditte, A ch 1879 (5) **18** 339)

Solubility of  $\text{Cu}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$   
 at 20°

Sp gr	In 1 l of solution				Solid phase
	Cu(NO <sub>3</sub> ) <sub>2</sub>		Pb(NO <sub>3</sub> ) <sub>2</sub>		
	g	g mol	g	g mol	
1 304	70 5	0 375	359 5	1 086	Pb(NO <sub>3</sub> ) <sub>2</sub>
1 322	139 2	0 742	257 2	0 777	
1 321	226 0	1 207	175 1	0 529	
1 343	301 8	1 608	133 4	0 403	
1 360	341 8	1 821	117 8	0 356	
1 451	519 4	2 767	70 0	0 213	
1 546	681 7	3 632	44 0	0 133	
1 622	798 1	4 252	28 1	0 080	
1 700	943 2	5 028	17 2	0 052	
					Pb(NO <sub>3</sub> ) <sub>2</sub> + Cu(NO <sub>3</sub> ) <sub>2</sub> · 6H <sub>2</sub> O

(Fedotieff, Z anorg 1911, **73** 178)

Very sol in liquid  $\text{NH}_3$  (Guntz, Bull Soc 1909, (4) **5** 1007)

Easily sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, **20** 827)

Insol in liquid  $\text{HF}$  (Franklin, Z anorg 1905, **46** 2)

Insol in ethyl acetate (Naumann, B 1910, **43** 314)

Sl sol in benzonitrile (Naumann, B 1914, **47** 1369)

+3 $\text{H}_2\text{O}$  Melts in crystal  $\text{H}_2\text{O}$  at 114 5°  
 (Ordway, Tilden, Chem Soc **45** 409)

Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

25° 30° 40° 50°  
 60 01 60 44 61 51 62 62%  $\text{Cu}(\text{NO}_3)_2$ ,

60° 70° 80° 114 5° Mpt  
 64 17 65 79 67 51 77 59%  $\text{Cu}(\text{NO}_3)_2$

(Funk, Z anorg 1899, **20** 413)

100 pts  $\text{HNO}_3$  dissolve 2 pts at 13°, considerably more on heating (Ditte, A ch 1879, (5) **18** 339)

Sol in 1 pt strong alcohol at 12 5° (Wenzel)

Insol in methyl acetate (Naumann, B 1909, **42** 3790)

+6 $\text{H}_2\text{O}$  Efflorescent Melts in crystal  $\text{H}_2\text{O}$  at 38° (Ordway)

Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

—21° —10° 0° +10°  
 39 52 42 08 45 00 48 79 %  $\text{Cu}(\text{NO}_3)_2$ ,

18° 20° 26 4° mpt  
 53 86 55 58 63 39%  $\text{Cu}(\text{NO}_3)_2$   
 (Funk, Z anorg 1899, **20** 413)

Sat solution of  $\text{Cu}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at 20° contains 5 04 g mol per l Sp gr of sat solution = 1 688 (Fedotieff, Z anorg 1911, **73** 78)

Sat solution of  $\text{Cu}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  contains 45 0 g  $\text{Cu}(\text{NO}_3)_2$  in 100 g solution at 0°, 53 9 g at 18° (Mylus, Z anorg 1912, **74** 411)

+9 $\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

—23° —21° —20°  
 36 08 37 38 40 92%  $\text{Cu}(\text{NO}_3)_2$

Cryohydrate is formed at —24° (Funk, Z anorg 1899, **20** 414)

**Cupric nitrate ammonia** (Cuprammonium nitrate),  $\text{Cu}(\text{NO}_3)_2 \cdot 4\text{NH}_3$

Easily sol in  $\text{H}_2\text{O}$ , from which it can be recrystallized Sol in alcohol (Berzelius)

Sol in 1 pt liquid  $\text{NH}_3$  (Horn, Am Ch J 1908, **39** 216)

$\text{Cu}(\text{NO}_3)_2 \cdot 5\text{NH}_3$  (Horn, Am Ch J 1907, **37** 620)

4 $\text{Cu}(\text{NO}_3)_2 \cdot 23\text{NH}_3$  (Horn)

**Cupric nitrate hydrazine**,  $\text{Cu}(\text{NO}_3)_2 \cdot \text{N}_2\text{H}_4$

Decomp by  $\text{H}_2\text{O}$  (Hofmann und Marburg, A 1899, **305** 221)

**Cupric nitrate mercuric oxide**,  $\text{Cu}(\text{NO}_3)_2 \cdot \text{HgO} + 3\text{H}_2\text{O}$

Sol in  $\text{HCl}$ ,  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  (Imzi, Gazz ch it 1913, **43** (2) 709)

**Didymium nitrate, basic**,  $4\text{Dy}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 + 15\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Maignac)

2 $\text{Dy}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5$  (Beccard A ch (6) **14** 257)

**Didymium nitrate**,  $\text{Dy}_2(\text{NO}_3)_6$

*Anhydrous* Very sol in  $\text{H}_2\text{O}$  As sol in 96% alcohol as in  $\text{H}_2\text{O}$ , and the solution is not precipitated by much ether Insol in pure ether (Maignac, A ch (3) **36** 161)

Moderately sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, **20** 827)

Sol in acetone (Naumann, B 1904, **37** 4328, Eidmann, C C **1899**, II 1014)

+6 $\text{H}_2\text{O}$  Very deliquescent (Clevc, Bull Soc (2) **43** 361)

**Didymium nickel nitrate**,  $2D_1(NO_3)_3$ ,  $3Ni(NO_3)_2 + 36H_2O$

Very deliquescent (Frenchs and Smith, A 191 355)

See Neodymium and praseodymium

**Didymium zinc nitrate**,  $2D_1(NO_3)_3$ ,  $3Zn(NO_3)_2 + 69H_2O$

Very deliquescent (F and S)

See Neodymium and praseodymium

**Dysprosium nitrate**,  $Dy(NO_3)_3 + 5H_2O$

Very sol in  $H_2O$ , less sol in  $H_2O + HNO_3$   
Sol in alcohol (Urban, C R 1908, 146 129)

**Erbium nitrate, basic**,  $2Er_2O_3$ ,  $3N_2O_5 + 9H_2O$

Decomp by  $H_2O$  SI sol in  $HNO_3$  (Bahr and Bunsen)

$3Er_2O_3$ ,  $4N_2O_5 + 20H_2O$  (Cleve, Bull Soc (2) 21 344)

**Erbium nitrate**,  $Er(NO_3)_3 + 6H_2O$

Easily sol in  $H_2O$ , alcohol, and ether (Hoglund)

Sol in acetone (Naumann, B 1904, 37 4328)

**Gadolinium nitrate**,  $Gd(NO_3)_3 + 6\frac{1}{2}H_2O$

Sol in  $H_2O$  (Benedicks, Z anorg 1900, 22 406)

+5H O Sol in  $HNO_3$  (B)

**Gadolinium magnesium nitrate**,  $2Gd(NO_3)_3$ ,  $3Mg(NO_3)_2 + 24H_2O$

1 l sat solution in  $HNO_3 + Aq$  (sp gr 1 325) contains 352 3 g hydrous salt at  $16^\circ$  (Jantsch, Z anorg 1912, 76 303)

**Gadolinium nickel nitrate**,  $2Gd(NO_3)_3$ ,  $3Ni(NO_3)_2 + 24H_2O$

1 l sat solution in  $HNO_3 + Aq$  (sp gr 1 325) contains 400 8 g hydrous salt at  $16^\circ$  (Jantsch)

**Gadolinium zinc nitrate**,  $2Gd(NO_3)_3$ ,  $3Zn(NO_3)_2 + 24H_2O$

1 l sat solution in  $HNO_3 + Aq$  (sp gr 1 325) contains 472 7 g hydrous salt at  $16^\circ$  (Jantsch)

**Gallium nitrate**,  $Ga(NO_3)_3$

Very deliquescent, and sol in  $H_2O$  (Dupré)

**Glucinum nitrate, basic**,  $2Glo$ ,  $N_2O_5 + 3H_2O$  (?)

Sol in  $H_2O$

$3Glo$ ,  $N_2O_5$  Sol in  $H_2O$  (Ordway, Sill Am J (2) 26 205)

Compounds more basic than this are insol in  $H_2O$  (Ordway)

**Glucinum nitrate**,  $Glo(NO_3)_2 + 3H_2O$

Very deliquescent (Joy, Sill Am J (2) 36 90)

Easily sol in  $H_2O$  and alcohol (Vauquelin)  
Melts in its crystal  $H_2O$  at  $29.4^\circ$  (Ordway)

Sat  $Glo(NO_3)_2 + Aq$  boils at  $140.5^\circ$  (Ordway)

**Gold (auric) nitrate, basic**,  $Au_2O_3$ ,  $N_2O_5 + \frac{2}{3}H_2O$ , or Auryl nitrate,  $(AuO)NO_3 + \frac{1}{3}H_2O$

(Schottlander, A 217 364)

$2Au_2O_3$ ,  $N_2O_5 + 2H_2O = Au_4O_6(NO_3)_2 + 2H_2O$  Slowly sol in  $HNO_3 + Aq$  at  $100^\circ$ , (Schottlander, A 217 356)

**Gold (auric) nitrate**,  $Au(NO_3)_3 + xH_2O$

Decomp by  $H_2O$  Sol in acetone (Hanriot and Raoult, C R 1912, 155 1086)

**Gold (auric) hydrogen nitrate**,  $4u(NO_3)_3$ ,  $HNO_3 + 3H_2O$

Decomp by  $H_2O$  Sol in  $HNO_3 + Aq$  (Schottlander, A 217 356)

**Gold (auric) potassium nitrate**,  $KAu(NO_3)_4$

Easily sol in  $H_2O$

HK  $Au(NO_3)_3$  Decomp immediately by  $H_2O$

$2KAu(NO_3)_4$ ,  $K_2HAu(NO_3)_6$  (Schottlander, J B 1884 453)

**Gold (auric) rubidium nitrate**,  $RbAu(NO_3)_4$

Easily sol in  $H_2O$

HRb $_2$  $Au(NO_3)_6$  As above (Schottlander)

**Gold (auric) thallium nitrate**,  $TlAu(NO_3)_4$

Easily sol in  $H_2O$

$6AuO_3$ ,  $2TlO_3$ ,  $3N_2O_5 + 15H_2O$  Ppt (Schottlander)

**Indrium nitrate**,  $In(NO_3)_3 + 4\frac{1}{2}H_2O$

Very deliquescent Easily sol in  $H_2O$  and absolute alcohol (Winkler)

+1 $\frac{1}{2}$ H O

**Iron (ferrous) nitrate**,  $Fe(NO_3)_2 + 6H_2O$

100 pts of crystals dissolve in 50 pts  $H_2O$  at  $0^\circ$ , sp gr of solution = 1 44, 40 8 pts  $H_2O$  at  $15^\circ$ , sp gr of solution = 1 48, 33 3 pts  $H_2O$  at  $25^\circ$ , sp gr of solution = 1 50 (Ordway, Sill Am J (2) 40 325)

Sat solution contains at

$-9^\circ$   $0^\circ$   $+18^\circ$   $24^\circ$   $60.5^\circ$  Mpt  
39 68 41 53 45 14 46 51 62 50%  $Fe(NO_3)_2$   
(Funk, Z anorg 1899, 20 406)

Sat solution of  $Fe(NO_3)_2 + 6H_2O$  in  $H_2O$  contains 41 5%  $Fe(NO_3)_2$  at  $0^\circ$ , 45 1% at  $18^\circ$  (Mylus, Z anorg 1912, 74 411)

+9H<sub>2</sub>O Solubility in H<sub>2</sub>O  
Sat solution contains at  
-27° -21 5° -19° -15 5°  
35 66 36 10 36 56 37 17% Fe(NO<sub>3</sub>)<sub>2</sub>  
Cryohydrate is formed at -28° (Funk,  
Z anorg 1899, 20 407)  
Fe(NO<sub>3</sub>)<sub>2</sub>+Aq decomposes on heating, less  
rapidly when dil, more readily in presence of  
excess of acid (Ordway)

**Iron (ferric) nitrate, basic, 36Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+48H<sub>2</sub>O (?)**

Easily sol in H<sub>2</sub>O Sl sol in dil HNO<sub>3</sub>+Aq, very sl sol in alcohol (Hausmann, A 89 111)

8Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+12H<sub>2</sub>O Sl sol in H<sub>2</sub>O, very sl sol in cold or warm dil HNO<sub>3</sub>+Aq, more easily sol in hot HCl+Aq (Hausmann)

+xH<sub>2</sub>O Sol in H<sub>2</sub>O, completely pptd from aqueous solution by NaCl, NH<sub>4</sub>Cl, KI, KClO<sub>3</sub>, Na<sub>2</sub>SO<sub>4</sub>, CaSO<sub>4</sub>, ZnSO<sub>4</sub>, CuSO<sub>4</sub>, KNO<sub>3</sub>, NaNO<sub>3</sub>, Ba(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>, or Zn(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>+Aq. More slowly pptd by NH<sub>4</sub>NO<sub>3</sub>, Mg(NO<sub>3</sub>)<sub>2</sub>, Ba(NO<sub>3</sub>)<sub>2</sub>, or Pb(NO<sub>3</sub>)<sub>2</sub>+Aq. Not pptd by alcohol, Pb(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>, Cu(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>, Hg(CN)<sub>2</sub>, AgNO<sub>3</sub>, or As<sub>2</sub>O<sub>3</sub>+Aq (Ordway, Sill Am J (2) 9 30)

4Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+1½H<sub>2</sub>O Easily sol in H<sub>2</sub>O, sl sol in dil HNO<sub>3</sub>+Aq, and in alcohol (Hausmann)

+3H<sub>2</sub>O Insol in H<sub>2</sub>O or HNO<sub>3</sub>+Aq, sol in HCl+Aq (Scheurer-Kestner, C R 87 927)

+9H<sub>2</sub>O Not deliquescent, easily sol in H<sub>2</sub>O (Ordway)

3Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+2H<sub>2</sub>O Insol in H<sub>2</sub>O (Scheurer-Kestner)

2Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+H<sub>2</sub>O Decomp by H<sub>2</sub>O (Scheurer-Kestner)

+8H<sub>2</sub>O (S-K)

Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub> Decomp by H<sub>2</sub>O (S-K)

Fe<sub>2</sub>O<sub>3</sub>, 2N<sub>2</sub>O<sub>5</sub> Sol in H<sub>2</sub>O or alcohol in all proportions Insol in HNO<sub>3</sub>+Aq

N<sub>2</sub>O<sub>5</sub> with 1, 2, 3, 4, 5, 6, and 8Fe<sub>2</sub>O<sub>3</sub> forms compounds, sol in H<sub>2</sub>O (Ordway)

Solubility determinations show that there are no definite basic nitrates of iron formed from solutions at 25°, and that the solid phase under these conditions is a solid solution of Fe<sub>2</sub>O<sub>3</sub>, HNO<sub>3</sub> and H<sub>2</sub>O. The normal salt, Fe<sub>2</sub>O<sub>3</sub>, 3N<sub>2</sub>O<sub>5</sub>, 18H<sub>2</sub>O is stable in solutions containing about 30-45% N<sub>2</sub>O<sub>5</sub>. In higher concentrations of nitric acid it appears to be metastable and a new salt, Fe<sub>2</sub>O<sub>3</sub>, 4N<sub>2</sub>O<sub>5</sub>, 18(?)H<sub>2</sub>O is the stable form (Cameron, J phys Chem 1909, 13 252)

**Iron (ferric) nitrate, Fe(NO<sub>3</sub>)<sub>3</sub>**

+H<sub>2</sub>O (Scheurer-Kestner, A ch (3) 65 113)

+6H<sub>2</sub>O Deliquescent, and sol in any amount of H<sub>2</sub>O (Schonbein, Pogg 39 141)

Sol in acetone (Naumann, B 1904, 37 4328)

+9H<sub>2</sub>O Deliquescent Sol in H<sub>2</sub>O as alcohol Sl sol in HNO<sub>3</sub>+Aq 2 pts sa with 1 pt H<sub>2</sub>O lower the temperature 18 5 (Scheurer-Kestner)

Sp gr of solution at 17 5° containing  
5 10 15 20 25% Fe(NO<sub>3</sub>)<sub>3</sub>  
1 0398 1 0770 1 1182 1 1612 1 2110

30 35 40 45 50% Fe(NO<sub>3</sub>)<sub>3</sub>  
1 2622 1 3164 1 3746 1 4338 1 4972  
55 60 65% Fe(NO<sub>3</sub>)<sub>3</sub>  
1 5722 1 6572 1 7532

(Franz, J pr (2) 5 274)

Nearly insol in conc HNO<sub>3</sub>+Aq at tem below 15 5°

Easily sol in alcohol

Melts in crystal H<sub>2</sub>O at 47 2° (Ordway)

Sat Fe(NO<sub>3</sub>)<sub>3</sub>+Aq boils at 125° (Ordway)

**Lanthanum nitrate, La(NO<sub>3</sub>)<sub>3</sub>+6H<sub>2</sub>O**

Very deliquescent, easily sol in H<sub>2</sub>O as alcohol (Mosander) Melts in its cryst H<sub>2</sub>O at 40°, boils at 124 5° (Ordway)

La(NO<sub>3</sub>)<sub>3</sub>+Aq sat at 25% contains 60 17

La(NO<sub>3</sub>)<sub>3</sub>, or 100 g H<sub>2</sub>O dissolve 151 1

La(NO<sub>3</sub>)<sub>3</sub> at 25° (James and Whittemor

J Am Chem Soc 1912, 34 1169)

Sol in acetone (Naumann, B 1904, 3 4328, Eidmann, C C 1899, II 1014)

**Lanthanum magnesium nitrate, 2La(NO<sub>3</sub>)<sub>3</sub>, 3Mg(NO<sub>3</sub>)<sub>2</sub>+24H<sub>2</sub>O**

Deliquescent in moist air (Holzmunn, pr 75 350)

1 l sat solution in HNO<sub>3</sub>+Aq (sp gr 1 325) contains 63 8 g hydrous salt at 16° (Jantsch, Z anorg 1912, 76 321)

**Lanthanum manganous nitrate, 2La(NO<sub>3</sub>)<sub>3</sub>, 3Mn(NO<sub>3</sub>)<sub>2</sub>+24H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Damour and Deville)

1 l sat solution in HNO<sub>3</sub>+Aq (sp gr 1 325) contains 193 1 g hydrous salt at 16° (Jantsch)

**Lanthanum nickel nitrate, 2La(NO<sub>3</sub>)<sub>3</sub>, 3Ni(NO<sub>3</sub>)<sub>2</sub>+36H<sub>2</sub>O**

Very sol in H<sub>2</sub>O (French and Smith, 191 355)

+24H<sub>2</sub>O 1 l sat solution in HNO<sub>3</sub>, Aq (sp gr 1 325) contains 90 3 g hydrous salt at 16° (Jantsch)

**Lanthanum rubidium hydrogen nitrate, [La(NO<sub>3</sub>)<sub>4</sub>]Rb, HNO<sub>3</sub>+6H<sub>2</sub>O**

Sol in H<sub>2</sub>O and HNO<sub>3</sub> (Jantsch, Z anorg 1911, 69 225)

**Lanthanum thallous nitrate, [La(NO<sub>3</sub>)<sub>3</sub>]Tl<sub>2</sub>, 4H<sub>2</sub>O**

Hygroscopic (Jantsch, Z anorg 1911, 6 228)

**Lanthanum zinc nitrate**,  $2\text{La}(\text{NO}_3)_3 \cdot 3\text{Zn}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Damour and Deville, J B 1858 135)

1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1.325) contains 124.1 g hydrous salt at  $16^\circ$  (Jantsch, Z anorg 1912, 76 321)  
 $+69\text{H}_2\text{O}$  (Frerichs and Smith, A 191 355)

**Lead nitrate, basic**,  $2\text{PbO} \cdot \text{N}_2\text{O}_5 + \text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$

Sol in 5 15 pts  $\text{H}_2\text{O}$  at  $19.2^\circ$  (Pohl, W A B 6 597) Very sl sol in cold, much more in hot  $\text{H}_2\text{O}$  (Berzelius) Sol in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  (Guignet, C R 56 358)

Insol in  $\text{H}_2\text{O}$ , sol in acids (Athanescio, Bull Soc 1895, (3) 13 178)

$+2\text{H}_2\text{O}$  (André, C R 100 639)  
 $3\text{PbO} \cdot \text{N}_2\text{O}_5 + 1\frac{1}{2}\text{H}_2\text{O}$  Sl sol in pure  $\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  containing  $\text{HCl}$  (Berzelius)

$+3\text{H}_2\text{O}$  Sol in 119.2 pts cold, and 10.5 pts boiling  $\text{H}_2\text{O}$  Sol in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ , but sl sol in  $\text{KNO}_3 + \text{Aq}$  (Vogel, jr A 94 97)

$=10\text{PbO} \cdot 3\text{N}_2\text{O}_5 + 5\text{H}_2\text{O}$  (Wakemann and Wells, Am Ch J 9 299)

$+4\text{H}_2\text{O}$  (André, C R 100 639)

$6\text{PbO} \cdot \text{N}_2\text{O}_5 + \text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$  (Lowe, J pr 98 385)

$10\text{PbO} \cdot 3\text{N}_2\text{O}_5 + 4\text{H}_2\text{O}$  Less sol in  $\text{H}_2\text{O}$  than  $\text{Pb}(\text{NO}_3)\text{OH}$ , and not decomp by boiling  $\text{H}_2\text{O}$  (Wakemann and Wells, Am Ch J 9 299)

**Lead nitrate**,  $\text{Pb}(\text{NO}_3)_2$

Sol in  $\text{H}_2\text{O}$  with absorption of much heat (Rose)

1 pt  $\text{Pb}(\text{NO}_3)_2$  dissolves in  $7\frac{1}{2}$  pts cold  $\text{H}_2\text{O}$  (Mitscherlich)

1 pt  $\text{Pb}(\text{NO}_3)_2$  dissolves in 1989 pts  $\text{H}_2\text{O}$  at  $17^\circ$  and forms a liquid of 1.3978 sp gr (Karsten)

1 pt  $\text{Pb}(\text{NO}_3)_2$  dissolves in 1707 pts  $\text{H}_2\text{O}$  at  $22.3^\circ$  in 1585 pts  $\text{H}_2\text{O}$  at  $24.7^\circ$  (Kopp)

Sol in 187 pts  $\text{H}_2\text{O}$  at  $17.5^\circ$  (Schiff A 109 326)

100 pts  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat at  $102.2^\circ$  contain 52.5 g  $\text{Pb}(\text{NO}_3)_2$  100 pt  $\text{H}_2\text{O}$  dissolve 110.526 pts  $\text{Pb}(\text{NO}_3)_2$  (C ruffins)

cold  $\text{H}_2\text{O}$  and much less hot  $\text{H}_2\text{O}$  (Wittstein)

100 pts boiling  $\text{H}_2\text{O}$  dissolve 13 pts  $\text{Pb}(\text{NO}_3)_2$  (Ure s Diet)

100 pts  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat at  $19-20^\circ$  contain 35.80 pts salt (v Hauer, W A B 53, 2 221)

1 pt dissolves  
 at  $0^\circ$   $10^\circ$   $25^\circ$   $45^\circ$   $65^\circ$   $85^\circ$   $100^\circ$   
 in 258 207 165 125 099 083 072 pts  $\text{H}_2\text{O}$

(Kremers, Pogg 92 497)

1 l  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat at  $15^\circ$  contains 461.49 g  $\text{Pb}(\text{NO}_3)_2$  and 928.58 g  $\text{H}_2\text{O}$ , and has sp gr 1.39 (Michel and Krafft, A ch (3) 41 471)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{Pb}(\text{NO}_3)_2$	$t^\circ$	Pts $\text{Pb}(\text{NO}_3)_2$	$t^\circ$	Pts $\text{Pb}(\text{NO}_3)_2$
0	36 5	36	65 9	72	99 7
1	37 4	37	66 7	73	100 7
2	38 3	38	67 6	74	101 7
3	39 1	39	68 5	75	102 6
4	39 8	40	69 4	76	103 6
5	40 5	41	70 3	77	104 6
6	41 2	42	71 2	78	105 6
7	42 0	43	72 1	79	106 6
8	42 8	44	73 0	80	107 6
9	43 6	45	74 0	81	108 6
10	44 4	46	74 9	82	109 6
11	45 2	47	75 9	83	110 6
12	46 0	48	76 8	84	111 5
13	46 8	49	77 7	85	112 5
14	47 5	50	78 7	86	113 5
15	48 3	51	79 6	87	114 5
16	49 1	52	80 5	88	115 4
17	49 9	53	81 5	89	116 4
18	50 7	54	82 4	90	117 4
19	51 5	55	83 3	91	118 4
20	52 3	56	84 3	92	119 4
21	53 1	57	85 2	93	120 3
22	53 9	58	86 1	94	121 3
23	54 7	59	87 1	95	122 3
24	55 6	60	88 0	96	123 2
25	56 4	61	89 0	97	124 2
26	57 3	62	90 0	98	125 2
27	58 1	63	90 9	99	126 1
28	59 0	64	91 9	100	127 0
29	59 8	65	92 8	101	128 0
30	60 7	66	93 8	102	128 9
31	61 6	67	94 8	103	129 9
32	62 4	68	95 7	104	130 9
33	63 3	69	96 7	104 7	131 5
34	64 1	70	97 7		
35	65 0	71	98 7		

(Mulder, Scheik Verhandel 1864 66)

100 g  $\text{H}_2\text{O}$  dissolve 52.76 g  $\text{Pb}(\text{NO}_3)_2$  at  $17^\circ$  (Euler, Z phys Ch 1904, 49 315)

Solubility of  $\text{Pb}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$  at  $20^\circ = 152$  g mol per l Sp gr of sat solution = 1.419 (Fedotieff, Z anorg 1911, 73 178)

Sat  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at  $0^\circ$  contains 26.7%  $\text{Pb}(\text{NO}_3)_2$ , at  $18^\circ$ , 29.1%  $\text{Pb}(\text{NO}_3)_2$ . (Myhus, Z anorg 1912, 74 411)

Sp gr of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at  $19.5^\circ$

$\text{Pb}(\text{NO}_3)_2$	Sp gr	$\text{Pb}(\text{NO}_3)_2$	Sp gr
5	1.045	25	1.266
10	1.093	30	1.334
15	1.144	35	1.414
20	1.203		

(Kremers, calculated by Gerlach, Z anal 8 286)



Sp gr of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at 17.5°			
$\text{Pb}(\text{NO}_3)_2$	Sp gr	$\text{Pb}(\text{NO}_3)_2$	Sp gr
5	1.044	25	1.263
10	1.092	30	1.333
15	1.144	35	1.409
20	1.200	sat sol	1.433

(Gerlach, Z anal 27 283)

Sp gr of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat at 8° = 1.372 (Anthon)

Sp gr of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at 17.5°			
$\text{Pb}(\text{NO}_3)_2$	Sp gr	$\text{Pb}(\text{NO}_3)_2$	Sp gr
1	1.0080	20	1.1902
2	1.0163	21	1.2016
3	1.0247	22	1.2132
4	1.0331	23	1.2251
5	1.0416	24	1.2372
6	1.0502	25	1.2495
7	1.0591	26	1.2620
8	1.0682	27	1.2747
9	1.0775	28	1.2876
10	1.0869	29	1.2907
11	1.0963	30	1.3140
12	1.1059	31	1.3276
13	1.1157	32	1.3416
14	1.1257	33	1.3558
15	1.1359	34	1.3702
16	1.1463	35	1.3848
17	1.1569	36	1.3996
18	1.1677	37	1.4146
19	1.1788		

(Schriff, calculated by Gerlach, Z anal 8 286)

Sp gr of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at t°		
t°	% $\text{Pb}(\text{NO}_3)_2$	Sp gr
14	5	1.0451
14	10	1.0939
14.5	15	1.1468
14.3	20	1.2045
15	25	1.2678
15	32.28	1.3716

(Long, W Ann 1880, 11 40)

Sp gr of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at room temp containing17.93 32.22%  $\text{Pb}(\text{NO}_3)_2$   
1.1786 1.3619

(Wagner, W Ann 1883, 18 267)

Sp gr of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at 25°	
Concentration of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$	Sp gr
1-normal	1.1380
1/2- "	1.0699
1/4- "	1.0351
1/8- "	1.0175

(Wagner, Z phys Ch 1890, 5 36)

$\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  containing 15.93%  $\text{Pb}(\text{NO}_3)_2$   
has sp gr 20°/20° = 1.1558  
 $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  containing 30.57%  $\text{Pb}(\text{NO}_3)_2$   
has sp gr 20°/20° = 1.3436  
 $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  containing 30.69%  $\text{Pb}(\text{NO}_3)_2$   
has sp gr 20°/20° = 1.3465  
 (Le Blanc and Rohland, Z phys Ch 1896, 19 279)

Sat  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  boils at 103.5° (Kremers)Sat  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  boils at 102.2°, and contains 140 pts  $\text{Pb}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$  (Griffiths)Sat  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  boils at 103.5° (Gerlach, Z anal 26 427)B-pt of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  containing pts  $\text{Pb}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$ , according to Gerlach (Z anal 26 449)

B-pt	Pts $\text{Pb}(\text{NO}_3)_2$	B-pt	Pts $\text{Pb}(\text{NO}_3)_2$
100.5°	11	102.5°	87
101	26	103	111
101.5	44	103.5	137
102	65		

Insol in conc  $\text{HNO}_3 + \text{Aq}$ Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{Ba}(\text{NO}_3)_2$ See under  $\text{Ba}(\text{NO}_3)_2$ Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{Cu}(\text{NO}_3)_2$ See under  $\text{Cu}(\text{NO}_3)_2$ Sol in sat  $\text{KNO}_3 + \text{Aq}$  without pptn, 100 pts  $\text{H}_2\text{O}$  at 18.75° dissolving 114 pts mixed salt, viz 84.1 pts  $\text{Pb}(\text{NO}_3)_2$  and 29.9 pts  $\text{KNO}_3$  (Karsten)100 pts  $\text{H}_2\text{O}$  dissolve 119.6 pts  $\text{Pb}(\text{NO}_3)_2$  and 67.1 pts  $\text{KNO}_3$  at 21.2° (Rudorff, B 6 484)100 g  $\text{H}_2\text{O}$  dissolve 95.39 g  $\text{Pb}(\text{NO}_3)_2$  and 61.05 g  $\text{KNO}_3$  at 20° (Le Blanc and Noyes Z phys Ch 1890, 6 386)Sol in sat  $\text{NaNO}_3 + \text{Aq}$  without pptn, 100 pts  $\text{H}_2\text{O}$  at 18.75° dissolving 121.9 pts mixed salt, viz 87.8 pts  $\text{Pb}(\text{NO}_3)_2$  and 34.1 pts  $\text{NaNO}_3$  (Karsten)Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{NaNO}_3$ Solid phase =  $\text{Pb}(\text{NO}_3)_2$ 

t° of saturation	% $\text{NaNO}_3$	% $\text{Pb}(\text{NO}_3)_2$
32	34.42	19.69
35.5	34.15	20.33
39.5	33.71	21.35
44	33.35	22.19
49.1	32.94	23.15
55	32.60	23.93
58	32.47	24.24
62	32.33	24.57
65	32.14	24.89

Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{NaNO}_3$ —Continued

Solid phase = $\text{NaNO}_3$		
t° or saturation	% $\text{NaNO}_3$	% $\text{Pb}(\text{NO}_3)_2$
21	40 97	13 62
26 5	42 04	13 38
31	43 18	12 88
38 8	44 63	12 78
41	45 11	12 94
44 25	46 03	12 45
51	47 28	12 50
58	49 03	11 76
64	49 92	11 56

(Isaac, Chem Soc 1908, 93 398)

Also sol in  $\text{KNO}_3 + \text{NaNO}_3 + \text{Aq}$   
 100 pts sat  $\text{Pb}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2 + \text{Aq}$   
 contain 45 98 pts of the two salts at 19 20°  
 (v Hauer, J pr 98 137)

Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2$  at 25°

G per 100 cc		Mol per cent in solid phase	
$\text{Pb}(\text{NO}_3)_2$	$\text{Sr}(\text{NO}_3)_2$	$\text{Pb}(\text{NO}_3)_2$	$\text{Sr}(\text{NO}_3)_2$
46 31	0	100	0
50 47	4 56	99 05	0 95
53 92	8 14	98 11	1 89
45 34	17 81	97 02	2 98
44 48	18 74	96 06	3 94
25 23	35 03	83 84	16 16
19 13	37 54	32 88	67 12
0	71 04	0	100

(Fock, Z Kryst Min 1897, 28 365)

Very easily sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

100 pts alcohol of 0 9252 sp gr dissolve

at 4° 8° 22° 40° 50°

4 96 5 82 8 77 12 8 14 9 pts  $\text{Pb}(\text{NO}_3)_2$   
 (Gerardin, A ch (4), 5 129)

100 pts absolute methyl alcohol dissolve  
 1 37 pts at 20 5°

100 pts absolute ethyl alcohol dissolve 0 04  
 pt at 20 5° (de Bruyn Z phys Ch 10 783)

Very sl sol in acetone (Krug and M'Elroy, J Anal Ch 6 184)

Insol in cold, sl sol in hot  $\text{CS}_2$  (Arcetow sk, Z anorg 1894, 6 257)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Mol weight determined in pyridine (Werner, Z anorg 1897, 15 21)

Solubility of  $\text{Pb}(\text{NO}_3)_2$  in pyridine at t°

t°	G $\text{Pb}(\text{NO}_3)_2$ per 100 g $\text{C}_5\text{H}_5\text{N}$	Solid phase
—19 4	2 93	$\text{Pb}(\text{NO}_3)_2, 4\text{C}_5\text{H}_5\text{N}$
—14 5	2 14	"
—10	1 90	"
0	3 54	"
5 4	3 93	"
8 7	5 39	"
14 72	6 13	"
19 97	6 78	"
24 75	8 56	"
30 03	10 98	"
34 97	13 20	"
40 03	16 94	"
45	22 03	"
49 97	29 37	"
51 tr pt		" + $\text{Pb}(\text{NO}_3)_2, 3\text{C}_5\text{H}_5\text{N}$
59 52	36 70	$\text{Pb}(\text{NO}_3)_2, 3\text{C}_5\text{H}_5\text{N}$
70	47 29	"
80	61 60	"
89 93	90 21	"
94 94	128 06	"
96 tr pt		" + $\text{Pb}(\text{NO}_3)_2, 2\text{C}_5\text{H}_5\text{N}$
99 89	143 36	$\text{Pb}(\text{NO}_3)_2, 2\text{C}_5\text{H}_5\text{N}$
104 90	152	"
109 90	163 80	"

(Walton and Judd, J Am Chem Soc 1911, 33 1036)

Lead mercurous nitrate,  $2\text{PbO}, 2\text{Hg}_2\text{O}, 3\text{N}_2\text{O}_5$ 

Decomp by  $\text{H}_2\text{O}$  Sol in warm dil  $\text{HNO}_3$ ,  
 or  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$  without decomp (Stadler, A 87 129)

Lead silver nitrate,  $\text{Pb}(\text{NO}_3)_2, 2\text{AgNO}_3$ 

Sol in  $\text{H}_2\text{O}$  (Sturenberg, Pogg 74 115)

Lead silver nitrate iodide,  $\text{Pb}(\text{NO}_3)_2, 8\text{AgNO}_3, 4\text{AgI}$ 

Decomp by  $\text{H}_2\text{O}$  (Sturenberg)

$\text{Pb}(\text{NO}_3)_2, 2\text{AgNO}_3, 2\text{AgI}$  Decomp by  
 $\text{H}_2\text{O}$  (Sturenberg)

Lead nitrate nitrite, basic,  $4\text{PbO}, \text{N}_2\text{O}_5, \text{N}_2\text{O}$   
 $+ 2\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3, \text{Pb}(\text{OH})\text{NO}$ 

Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  Sol in  
 80 pts  $\text{H}_2\text{O}$  at 23° (Chevreul), 85 pts at ord  
 temp (Bromeis, A 72 38), 10 6 pts at 100°  
 (Chevreul)

$+ 2\text{H}_2\text{O}$

## Solubility in acetic acid

Normality of acid	% $\text{PbO}$ per 100 cc at solution	Normality of acid	% $\text{PbO}$ per 100 cc at solution
0	0 601	0 25	5 450
0 05	1 323	0 50	9 690
0 10	2 185	0 75	15 874

(Chilesotti, Att Acad Linc 1908, (5) 17, II 475)

Formula is  $3\text{Pb}(\text{OH})\text{NO}_3$ ,  $5\text{Pb}(\text{OH})\text{NO}_2 + \text{H}_2\text{O}$  (v Lorenz, W A B 84, 2 1133)  
 $+3\text{H}_2\text{O}$  (v Lorenz)  
 $4\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $3\text{N}_2\text{O}_3 + 4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Bromeis)  
 $6\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $2\text{N}_2\text{O}_3 + 3\frac{1}{2}\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  
 $2\text{Pb}(\text{OH})\text{NO}_2 + \frac{1}{2}\text{H}_2\text{O}$  (v Lorenz)  
 $6\text{PbO}$ ,  $2\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_3 + 3\frac{1}{2}\text{H}_2\text{O} =$   
 $2\text{Pb}(\text{OH})\text{NO}_3$ ,  $\text{Pb}(\text{OH})\text{NO}_2 + \frac{1}{2}\text{H}_2\text{O}$  (v Lorenz)  
 $7\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_3 + 3\text{H}_2\text{O}$  Less sol in  
 $\text{H}_2\text{O}$  than  $4\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_3 + 2\text{H}_2\text{O}$ , sol in  
 cold conc  $\text{HNO}_3 + \text{Aq}$  (Peligot, A 39 338)  
 $8\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $3\text{N}_2\text{O}_3 + 4\frac{1}{2}\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  
 $3\text{Pb}(\text{OH})\text{NO}_2 + \frac{1}{2}\text{H}_2\text{O}$  (v Lorenz)  
 $10\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $4\text{N}_2\text{O}_3 + 5\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  
 $4\text{Pb}(\text{OH})\text{NO}_2$  (v Lorenz)  
 $12\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $5\text{N}_2\text{O}_3 + 6\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  
 $5\text{Pb}(\text{OH})\text{NO}_2$  (v Lorenz)  
 $10\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $2\text{N}_2\text{O}_3 + 4\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  
 $2\text{Pb}(\text{OH})\text{NO}_2$ ,  $2\text{PbO} + \frac{1}{2}\text{H}_2\text{O}$  (v Lorenz)  
 $14\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $3\text{N}_2\text{O}_3 + 6\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  
 $3\text{Pb}(\text{OH})\text{NO}_2$ ,  $3\text{PbO} + \text{H}_2\text{O}$  (Bromeis)  
 $14\text{PbO}$ ,  $3\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_3 + 6\text{H}_2\text{O} =$   
 $3\text{Pb}(\text{OH})\text{NO}_3$ ,  $\text{Pb}(\text{OH})\text{NO}_2$ ,  $3\text{PbO} + \text{H}_2\text{O}$   
 (Bromeis)  
 $16\text{PbO}$ ,  $2\text{N}_2\text{O}_5$ ,  $3\text{N}_2\text{O}_3 + 6\text{H}_2\text{O} =$   
 $4\text{Pb}(\text{OH})\text{NO}_3$ ,  $6\text{Pb}(\text{OH})\text{NO}_2$ ,  $5\text{PbO}$ ,  $\text{Pb}(\text{OH})_2$   
 (v Lorenz)  
 $16\text{PbO}$ ,  $3\text{N}_2\text{O}_5$ ,  $5\text{N}_2\text{O}_3 + 10\text{H}_2\text{O} =$   
 $3\text{Pb}(\text{OH})\text{NO}_3$ ,  $5\text{Pb}(\text{OH})\text{NO}_2 + \text{H}_2\text{O}$  (v  
 Lorenz)  
 $26\text{PbO}$ ,  $6\text{N}_2\text{O}_5$ ,  $7\text{N}_2\text{O}_3 + 21\text{H}_2\text{O} =$   
 $6\text{Pb}(\text{OH})\text{NO}_3$ ,  $7\text{Pb}(\text{OH})\text{NO}_2 + 4\text{H}_2\text{O}$  (v  
 Lorenz)

**Lead nitrate phosphate**,  $\text{Pb}(\text{NO}_3)_2$ ,  $\text{Pb}_3(\text{PO}_4)_2$   
 $+ 2\text{H}_2\text{O}$

Completely insol in cold  $\text{H}_2\text{O}$  Decomp by  
 boiling  $\text{H}_2\text{O}$  into its constituents Sol in a  
 little conc  $\text{HNO}_3 + \text{Aq}$  without decomp  
 (Gerhardt, A 72 83)

**Lead nitrate phosphite**,  $\text{Pb}(\text{NO}_3)_2$ ,  $\text{PbHPO}_3$

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$   
 $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  (33.3 g per litre) dissolves 1  
 g salt at  $15^\circ$  If less than 31 g per litre of  
 $\text{Pb}(\text{NO}_3)_2$  are present the salt is decomp  
 (Amat, A ch (6) 24 317)

**Lead nitrate potassium nitrite**,  $\text{Pb}(\text{NO}_3)_2$ ,  
 $2\text{KNO}_2 + \text{H}_2\text{O}$

Difficultly sol in  $\text{H}_2\text{O}$  (Lang, J B 1862  
 102)

$3\text{PbO}$ ,  $3\text{K}_2\text{O}$ ,  $4\text{N}_2\text{O}_3$ ,  $2\text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$  Sol  
 in  $\text{H}_2\text{O}$  (Hayes, Sill Am J (2) 31 226)

**Lithium nitrate**,  $\text{LiNO}_3$

Very deliquescent, and sol in  $\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve

at  $0^\circ$   $20^\circ$   $40^\circ$   $70^\circ$   $100^\circ$   $110^\circ$

48 3 75 7 169 4 196 1 227 3 256 4 pts  $\text{LiNO}_3$

(Kremers, Pogg 99 47)

Forms supersaturated solutions with e e,  
 which crystallize when temp is lowered to  
 $+1^\circ$  (Kremers, Pogg 92 520)

Sat solution boils at over  $200^\circ$  (Krem  
 s, Pogg 99 43)

1 pt  $\text{LiNO}_3$  dissolves in 200 pts  $\text{HN}$   
 (Schultz, Zeit Ch (2) 5 531)

100 pts of the sat solution contain at

$64.2^\circ$   $70.9^\circ$

64.9 66.1 pts anhydrous salt

(Donnan and Burt, Chem Soc 1903, 3  
 339)

See  $+\frac{1}{2}\text{H}_2\text{O}$ , and  $3\text{H}_2\text{O}$

Sp gr of  $\text{LiNO}_3 + \text{Aq}$  at  $19.5^\circ$  contain g  
 pts  $\text{LiNO}_3$  in 100 pts  $\text{H}_2\text{O}$

12.7	14.2	26.4	41.8 pts $\text{LiN}$
1.069	1.077	1.134	1.197

54.8	57.5	77.4	79.4 pts $\text{LiN}$
1.245	1.255	1.315	1.319

(Kremers, Pogg 114 45)

Sp gr of  $\text{LiNO}_3 + \text{Aq}$

g $\text{LiNO}_3$ in 1000 g of solution	Sp gr $16/16^\circ$
0	1.000000
4.8526	1.002469
10.9128	1.0055495
17.9016	1.009113

(Dijken, Z phys Ch 1897, 24 109)

Sp gr  $20^\circ/4^\circ$  of a normal solution of  $\text{LiNO}_3$   
 $= 1.03803$ , of a 0.5-normal solution  $= 1.0183$   
 (Haigh, J Am Chem Soc 1912, 34 1151)

Very easily sol in liquid  $\text{NH}_3$  (Frankl  
 Am Ch J 1898, 20 828)

Sol in strong alcohol

Sol in acetone (Eidmann, C C 189  
 II 1014, Naumann, B 1904, 37 4328)

Solubility in acetone  $= 0.343$  g mol per  
 at  $18^\circ$  (Roshdestwensky and McBrid  
 Chem Soc 1911, 99 2140)

Insol in benzonitrile (Naumann, I  
 1914, 47 1370)

Difficultly sol in ethyl acetate (Na  
 mann, B 1910, 43 314)

$+\frac{1}{2}\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

100 pts of the sat solution contain at

$43.6^\circ$   $50.5^\circ$   $55.0^\circ$   $60.0^\circ$

60.8 61.3 63.0 63.6 pts anhydrous salt

$61.1^\circ$  is the temp at which  $\text{LiNO}_3 + \frac{1}{2}\text{H}_2\text{O}$   
 goes over into  $\text{LiNO}_3$  (Donnan and Burt  
 Chem Soc 1903, 83 339)

Solubility in  $\text{H}_2\text{O}$ 

100 pts of the sat solution contain pts anhydrous salt at  $t^\circ$

t	Pts anhydrous salt
0 10	34 8
10 50	37 9
12 10	38 2
13 75	39 3
19 05	40 4
22 10	42 9
27 55	47 3
29 47	53 67
29 78	55 09
29 87	56 42
29 86	56 68
29 64	57 48
29 55	58 03

Mpt of  $\text{LiNO}_3 + 3\text{H}_2\text{O}$  is 29 88°

(Donnan and Burt, Chem Soc 1903, 83 337)

**Magnesium nitrate, basic,  $\text{Mg}_3\text{N}_2\text{O}_8$** 

Insol in  $\text{H}_2\text{O}$  and alcohol Sol in acids (Chodnew, A 71 241)

$+5\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Didier, C R 1896, 122 936)

**Magnesium nitrate,  $\text{Mg}(\text{NO}_3)_2$** 

Anhydrous Deliquescent

Sol in 1 pt  $\text{H}_2\text{O}$  at 15 6° Sol in 4 pts abs alcohol at 15 6 and 2 pts at boiling temp Moresol in alcohol of 0 817 sp gr than in that of 0 900 (Kirwan)  
Sol in 0 3458 pt strong alcohol at 82 5° (Wenzel)  
Sol in 10 pts strong alcohol at 15° (Bergmann)  
Sol in 9 pts strong alcohol on heating (Bergmann)

Solubility in  $\text{H}_2\text{O}$  in presence of the anhydrous salt

Sat solution contains at

89° 77 5° 67°  
63 14 65 67 67 55%  $\text{Mg}(\text{NO}_3)_2$

(Funk, Z anorg 1899, 20 396)

See +6, and  $9\text{H}_2\text{O}$

Sp gr of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at 14°

% $\text{Mg}(\text{NO}_3)_2$ $6\text{H}_2\text{O}$	Sp gr	% $\text{Mg}(\text{NO}_3)_2$ $6\text{H}_2\text{O}$	Sp gr
1	1 0034	30	1 1347
5	1 0202	35	1 1649
10	1 0418	40	1 1909
15	1 0639	45	1 2176
20	1 0869	49	1 2397
25	1 1103		

(Oudemans, Z anal 7 419)

Sp gr of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at 21°

% $\text{Mg}(\text{NO}_3)_2$ $+6\text{H}_2\text{O}$	Sp gr	% $\text{Mg}(\text{NO}_3)_2$ $+6\text{H}_2\text{O}$	Sp gr
2	1 0078	28	1 1216
4	1 0158	30	1 1312
6	1 0239	32	1 1410
8	1 0321	34	1 1508
10	1 0405	36	1 1608
12	1 0490	38	1 1709
14	1 0577	40	1 1811
16	1 0663	42	1 1914
18	1 0752	44	1 2019
20	1 0843	46	1 2124
22	1 0934	48	1 2231
24	1 1026	50	1 2340
26	1 1120		

(Schriff, calculated by Gerlach, Z anal 8 286)

Sp gr of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at 18°

% $\text{Mg}(\text{NO}_3)_2$	Sp gr	% $\text{Mg}(\text{NO}_3)_2$	Sp gr
5	1 0378	15	1 1181
10	1 0763	17	1 1372

(Kohlrausch, W Ann 1879 1)

Sp gr of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at room temp containing

18 62 34 19 39 77%  $\text{Mg}(\text{NO}_3)_2$   
1 1025 1 2000 1 4298

(Wagner, W Ann 1883, 18 273)

Sp gr of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at 25°

Concentration of $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$	Sp gr
1-normal	1 0512
$\frac{1}{2}$ - "	1 0259
$\frac{1}{4}$ - "	1 0130
$\frac{1}{8}$ - "	1 0066

(Wagner, Z phys Ch 1890, 5 38)

Sp gr of solution sat at 18° = 1 384, containing 43 1%  $\text{Mg}(\text{NO}_3)_2$  (Mylhus, B 1897, 30 1718)

Sp gr of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$ 

$\frac{1}{2}$ $\text{Mg}(\text{NO}_3)_2$ g in 1000 g of solution	Sp gr 16°/16°
0	1 000000
0 8099	1 000660
1 5621	1 001253
3 3398	1 002539
7 4410	1 005523
15 161	1 011151
29 356	1 021580
58 353	1 043329
81 025	1 060773

(Dijken, Z phys Ch 1897, 24 107)

Sp gr of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at  $20^\circ$   
 $p$  = per cent strength of solution,  $d$  = observed density,  $w$  = volume concentration in grams per cc ( $\frac{pd}{100} = w$ )

$p$	$d$	$w$
35 02	1 3110	0 46695
31 15	1 2655	0 39420
25 03	1 2057	0 30172
19 55	1 1551	0 22585
13 43	1 1023	0 14815
10 09	1 0753	0 10850
6 650	1 0480	0 06968
4 672	1 0330	0 04826
4 001	1 0276	0 04112
1 372	1 0085	0 01383

(Barnes J phys Chem 1898, 2 545)

Sp gr of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at  $20^\circ$  containing  
 M g mols of salt per liter  
 M 0 02 0 05 0 10 0 15  
 Sp gr 1 00224 1 005626 1 011118 1 016557

M 0 20 0 50 1 00 1 274  
 Sp gr 1 022026 1 054804 1 107865 1 136615  
 (Jones and Pearce, Am Ch J 1907, 38 707)

Less sol in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Dijonval)

Very easily sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 823)  
 $+2\text{H}_2\text{O}$  Mpt  $127^\circ$  (Wasiljew, C C 1909, II 1966)

$+4\text{H}_2\text{O}$  Mpt  $45.5^\circ$  (W)  
 $+6\text{H}_2\text{O}$  Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol Sol in 0.5 pt cold  $\text{H}_2\text{O}$ , and 9 pts cold alcohol of 0.84 sp gr, very sl sol in abs alcohol (Graham)

Melts in its crystal  $\text{H}_2\text{O}$  at  $90^\circ$ , and the resulting liquid boils at  $143.4^\circ$  (Ordway, Sil Am J (2) 27 14)

Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

$-18^\circ$   $-4.5^\circ$   $0^\circ$   $18^\circ$   
 38 03 39 50 39 96 42 33%  $\text{Mg}(\text{NO}_3)_2$ ,  
 $40^\circ$   $80^\circ$   $90^\circ$  (mpt)  
 45 87 53 69 57 81%  $\text{Mg}(\text{NO}_3)_2$

(Funk, Z anorg 1899, 20 395)

$+9\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

$-23^\circ$   $-20.5^\circ$   $-18^\circ$   
 35 44 36 19 38 03%  $\text{Mg}(\text{NO}_3)_2$

Cryohydrate is formed at  $-29^\circ$  (Funk, Z anorg 1899, 20 398)

**Magnesium neodymium nitrate**,  $3\text{Mg}(\text{NO}_3)_2$ ,  $2\text{Nd}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1 325) contains 97.7 g hydrous salt at  $16^\circ$  (Jantsch, Z anorg 1912, 76 303)

**Magnesium praseodymium nitrate**,  $3\text{Mg}(\text{NO}_3)_2$ ,  $2\text{Pr}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1 325) contains 77.0 g hydrous salt at  $16^\circ$  (Jantsch)

**Magnesium samarium nitrate**,  $3\text{Mg}(\text{NO}_3)_2$ ,  $\text{Sm}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$

(Demaray, C R 1900, 130 1187)  
 1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1 325) contains 24.55 g hydrous salt at  $16^\circ$  (Jantsch)

**Magnesium thorium nitrate**,  $\text{MgTh}(\text{NO}_3)_6 + \text{H}_2\text{O}$

Hydroscopic, sol in  $\text{HNO}_3$  (Meyer, Z anorg 1901, 27 385)

**Magnesium nitrate ammonia**,  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{NH}_3$

Sl sol in liquid  $\text{NH}_3$  (Franklin, J A Chem Soc 1913, 35 1459)

**Manganous nitrate, basic**,  $2\text{MnO}$ ,  $\text{N}_2\text{O}$   $+ 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Gorgeu)

**Manganous nitrate**,  $\text{Mn}(\text{NO}_3)_2$

Deliquescent Easily sol in  $\text{H}_2\text{O}$  & c alcohol

See +3, and  $6\text{H}_2\text{O}$

Sp gr of  $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$  at  $8^\circ$

% $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$	Sp gr	% $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$	Sp gr
5	1 0253	45	1 270
10	1 0517	50	1 304
15	1 0792	55	1 345
20	1 1078	60	1 386
25	1 1137	65	1 428
30	1 1688	70	1 472
35	1 2012	71	1 481
40	1 2352		

(Oudemans, Z anal 7 421)

Sp gr of aqueous solutions containing

10 20 30 %  $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$   
 6 237 12 474 18 711%  $\text{Mn}(\text{NO}_3)_2$ ,  
 1 052 1 107 1 165

40 50 60 %  $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$   
 24 948 31 185 37 422%  $\text{Mn}(\text{NO}_3)_2$ ,  
 1 230 1 302 1 381

70 80 %  $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$   
 43 659 49 896%  $\text{Mn}(\text{NO}_3)_2$ ,  
 1 466 1 558

(Gerlach, Z anal 28 477)

Sp gr of  $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$  at room temperature containing

18 309 29 602 49 309%  $\text{Mn}(\text{NO}_3)_2$   
 1 1482 1 3227 1 5056

(Wagner, W Ann 1883, 18 271)

Sp gr of $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$ at $25^\circ$	
Concentration of $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$	Sp gr
1-normal	1 0690
$\frac{1}{2}$ - " "	1 0349
$\frac{1}{4}$ - " "	1 0174
$\frac{1}{8}$ - " "	1 0093

(Wagner, Z phys Ch 1890, 5 39)

Sol in liquid  $\text{NH}_3$  (Guntz, Bull Soc 1909, (4) 5 1006)Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)+  $\text{H}_2\text{O}$  Deliquescent (Guntz, Bull Soc 1909 (4) 5 1005)+  $3\text{H}_2\text{O}$  From solution in  $\text{HNO}_3$  (Schultz-Sellaack, Zeit Ch 1870 646)Solubility in  $\text{H}_2\text{O}$ 

Sat solution contains at

$27^\circ$	$29^\circ$	$30^\circ$	$34^\circ$	$35^\circ$	mpt
65 66	66 99	67 38	71 31	76 82%	$\text{Mn}(\text{NO}_3)_2$

(Funk, Z anorg 1899, 20 403)

+  $6\text{H}_2\text{O}$  Melts in its crystal  $\text{H}_2\text{O}$  at  $25.8^\circ$  and boils at  $129.4^\circ$  (Ordway)Solubility in  $\text{H}_2\text{O}$ 

Sat solution contains at

$-29^\circ$	$-26^\circ$	$-21^\circ$	$-16^\circ$	$-5^\circ$
42 29	43 15	44 30	45 52	48 88%

 $\text{Mn}(\text{NO}_3)_2$ 

$0^\circ$	$+11^\circ$	$18^\circ$	$25.8^\circ$	mpt
50 49	54 50	57 33	62 37%	$\text{Mn}(\text{NO}_3)_2$

Cryohydrate is formed at  $-36^\circ$  (Funk, Z anorg 1899, 20 403)**Manganous neodymium nitrate,  $3\text{Mn}(\text{NO}_3)_2, 2\text{Nd}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$** 1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1 325) contains 296 g hydrous salt at  $16^\circ$  (Jantsch, Z anorg 1912, 76 303)**Manganous praseodymium nitrate,  $3\text{Mn}(\text{NO}_3)_2, 2\text{Pr}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$** 1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1 325) contains 234 g hydrous salt at  $16^\circ$  (Jantsch)**Manganous samarium nitrate,  $3\text{Mn}(\text{NO}_3)_2, 2\text{Sm}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$** 1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1 325) contains 50.04 g hydrous salt at  $16^\circ$  (Jantsch)**Manganous thorium nitrate,  $\text{MnTh}(\text{NO}_3)_6 + 8\text{H}_2\text{O}$** 

Ppt (Meyer, Z anorg 1901, 27 388)

**Manganous nitrate cupric oxide,  $\text{Mn}(\text{NO}_3)_2, 3\text{CuO} + 3\text{H}_2\text{O}$** 

Ppt (Mailhe, C R 1902, 134 234)

**Manganous nitrate hydrazine,  $\text{Mn}(\text{NO}_3)_2, 2\text{N}_2\text{H}_4$** Not decomp by  $\text{H}_2\text{O}$  (Franzen, Z anorg 1908, 60 286)**Mercurous nitrate, basic,  $2\text{Hg}_2\text{O}, \text{N}_2\text{O}_5 + \text{H}_2\text{O}$** Ppt Decomp by boiling with  $\text{H}_2\text{O}$  (Marignac, A ch (3) 27 332)Slowly sol in cold, rapidly in hot  $\text{HCl} + \text{Aq}$ , insol in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{NO}_3 + \text{Aq}$ +  $10\text{H}_2\text{O}$  Slowly sol in normal  $\text{HNO}_3$  (Reuss, Dissert 1886)+  $4\text{Hg}_2\text{O}, 3\text{N}_2\text{O}_5 + \text{H}_2\text{O}$  Sol in a small quantity of  $\text{H}_2\text{O}$ , decomp by a large amt of  $\text{H}_2\text{O}$  or by warm  $\text{H}_2\text{O}$  (Rose, Pogg 83 154)Is  $3\text{Hg}_2\text{O}, 2\text{N}_2\text{O}_5 + \text{H}_2\text{O}$  according to Gerhardt+  $5\text{H}_2\text{O}$  (Reuss, Dissert 1886)+  $5\text{Hg}_2\text{O}, 3\text{N}_2\text{O}_5 + 2\text{H}_2\text{O}$  (Marignac) Is  $2\text{Hg}_2\text{O}, \text{N}_2\text{O}_5 + \text{H}_2\text{O}$  (Lefort, A 56 247)Sol in boiling, less sol in cold  $\text{H}_2\text{O}$  (Marignac, l c)+  $4\text{H}_2\text{O}$ , and +  $6\text{H}_2\text{O}$  (Reuss, Dissert 1886)+  $8\text{Hg}_2\text{O}, 5\text{N}_2\text{O}_5 + 5\text{H}_2\text{O}$ , and +  $11\text{H}_2\text{O}$ 

(Reuss)

+  $11\text{Hg}_2\text{O}, 6\text{N}_2\text{O}_5 + 25\text{H}_2\text{O}$  (Reuss)+  $16\text{Hg}_2\text{O}, 9\text{N}_2\text{O}_5 + 19\text{H}_2\text{O}$ , +  $23\text{H}_2\text{O}$ , and +  $31\text{H}_2\text{O}$  (Reuss)+  $3\text{Hg}_2\text{O}, \text{N}_2\text{O}_5 + 2\text{H}_2\text{O}$  (Cox, Z anorg 1904, 40 177)**Mercurous nitrate,  $\text{Hg}_2\text{NO}_3$** Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)Fairly sol in boiling  $\text{CS}_2$  (Arcetowski, Z anorg 1894, 6 257)

Sl sol in benzonitrile (Naumann, B 1914, 47 1369)

Sol in methylamine (Franklin, J Am Chem Soc 1906, 28 1419)

+  $\text{H}_2\text{O}$  Completely sol in a little warm  $\text{H}_2\text{O}$ , but decomp by more  $\text{H}_2\text{O}$  Completely sol as acid salt in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$  (Marignac, A ch (3) 27 332)

Sol in methyl acetate (Naumann, B 1909, 42 3790)

+  $1\frac{1}{4}\text{H}_2\text{O}$ , +  $1\frac{1}{2}\text{H}_2\text{O}$ , +  $1\frac{1}{2}\text{H}_2\text{O}$ , etc (Reuss, Dissert 1896)**Mercuric nitrate, basic,  $6\text{HgO}, \text{N}_2\text{O}_5 (?)$** Insol in hot  $\text{H}_2\text{O}$  (Kune)+  $3\text{HgO}, \text{N}_2\text{O}_5 + \text{H}_2\text{O}$  Decomp to oxide by washing with cold  $\text{H}_2\text{O}$  Sol in dil  $\text{HNO}_3 + \text{Aq}$  (Millon, A ch (3) 18 361)+  $2\text{HgO}, \text{N}_2\text{O}_5 + \text{H}_2\text{O}$  Sl deliquescent Decomp by  $\text{H}_2\text{O}$ , sol in dil  $\text{HNO}_3 + \text{Aq}$  (Millon)+  $2\text{H}_2\text{O}$  Decomp by cold  $\text{H}_2\text{O}$  Deliquescent Sol in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$  (Marignac)+  $3\text{H}_2\text{O}$  (Ditte, J B 1854 366)**Mercuric nitrate,  $\text{Hg}(\text{NO}_3)_2$** Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Neither dissolved nor attacked by liquid  $\text{NO}_2$  (Frankland, Chem Soc 1901, **79** 1361)

Sol in benzonitrile (Naumann, B 1914, **47** 1369)

Sol in acetone (Naumann, B 1904, **37** 4328)

Difficultly sol in ethyl acetate (Naumann, B 1910, **43** 314)

Sol in methylal (Eidmann, C C 1899 II, 1014)

+ $\frac{1}{2}\text{H}_2\text{O}$  Deliquescent Very sol in a little  $\text{H}_2\text{O}$   $\text{H}_2\text{O}$  precipitates basic salt from conc  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$  Insol in alcohol Decomposed by ether (Millon)

+ $\text{H}_2\text{O}$  Extraordinarily sol in  $\text{H}_2\text{O}$  (Cox, Z anorg 1904, **40** 159)

+ $8\text{H}_2\text{O}$  Melts at  $6^\circ$  in crystal  $\text{H}_2\text{O}$  (Ditte)

**Mercuriomercuric nitrate**,  $\text{Hg}_2\text{O}$ ,  $2\text{HgO}$ ,  $\text{N}_2\text{O}_5$

Boiling  $\text{H}_2\text{O}$  gradually dissolves out  $\text{Hg}_2(\text{NO}_3)_2$ , and leaves residue of  $\text{HgO}$  and  $\text{Hg}$  (Brooks, Pogg **66** 63)

$2\text{Hg}_2\text{O}$ ,  $\text{HgO}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O}$  (Rây, Chem Soc 1905, **87** 175)

$\text{Hg}_2\text{O}$ ,  $2\text{HgO}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O}$  (Rây)

**Mercurous hydrogen nitrate**,  $4\text{HgNO}_3$ ,  $\text{HNO}_3$ , + $8\text{H}_2\text{O}$

(Reuss, Dissert 1886)

$5\text{HgNO}_3$ ,  $3\text{HNO}_3 + 26\text{H}_2\text{O}$  (Reuss)

**Mercuric silver nitrate**,  $\text{Hg}(\text{NO}_3)_2$ ,  $2\text{AgNO}_3$

Easily sol in  $\text{H}_2\text{O}$  without decomp (Berzelius)

**Mercurous strontium nitrate**,  $2\text{SrO}$ ,  $2\text{Hg}_2\text{O}$ ,  $3\text{N}_2\text{O}_5$

Decomp by  $\text{H}_2\text{O}$  Much more sol in  $\text{H}_2\text{O}$  than the corresponding Ba compound

Readily sol in warm dil  $\text{HNO}_3 + \text{Aq}$  or  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$  without decomposition (Stadeler, A **87** 131)

**Mercurous thallous nitrate**,  $\text{HgNO}_3$ ,  $\text{TlNO}_3$

Miscible with  $\text{H}_2\text{O}$  (Retgers, N Jahrb Miner, 1896 II, 183)

**Mercuric nitrate bromide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{HgBr}_2$   
(Morse, Z phys Ch 1902, **41** 733)

**Mercuric nitrate cadmium oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{CdO} + 2\text{H}_2\text{O}$

Ppt (Mailhe, Bull Soc 1901, (3) **25** 788)

+ $3\text{H}_2\text{O}$  Decomposed by  $\text{H}_2\text{O}$  (Mailhe)

**Mercuric nitrate cobaltous oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{CoO} + 3\text{H}_2\text{O}$

Ppt (Mailhe, C R 1901, **132** 1275)

+ $4\text{H}_2\text{O}$  Decomposed by  $\text{H}_2\text{O}$  (Mailhe, A ch 1902, (7) **27** 369)

**Mercuric nitrate cupric oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{CuO} + 2\text{H}_2\text{O}$ , and + $4\text{H}_2\text{O}$

(Mailhe, Bull Soc 1901, (3) **25** 791)

+ $5\text{H}_2\text{O}$  Decomposed by  $\text{H}_2\text{O}$  (Mailhe, A ch 1902, (7) **27** 365)

**Mercuric nitrate cyanide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{Hg}(\text{CN})_2$

Very sol in  $\text{H}_2\text{O}$  Very sol in methyl alcohol and solution is not decomposed at bp Ethyl alcohol apparently decomposed it (Prussia, Gazz ch it 1898, **23** (2) 115)

**Mercurous nitrate hydrazine**,  $2\text{HgNO}_3$ ,  $\text{N}_2\text{H}_4$

Decomposed by  $\text{H}_2\text{O}$  Stable in dil  $\text{HNO}_3$  Aqueous solution (Hofmann and Marburg, A 1899, **305** 215)

Ppt, very unstable (Hofmann, B 1897, **30** 2021)

$\text{Hg}(\text{NO}_3)_2$ ,  $\text{N}_2\text{H}_4$  Sol in dil  $\text{HCl}$  and  $\text{HNO}_3$  (Hofmann and Marburg, A 1897, **305** 215)

Ppt, sol in acids, decomposed by alkali (Hofmann, B 1897, **30** 2021)

**Mercuric nitrate iodide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $2\text{HgI}_2$

Decomposed by long boiling with  $\text{H}_2\text{O}$  (Riegel, Jahrb Pharm **11** 396)

$2\text{Hg}(\text{NO}_3)_2$ ,  $3\text{HgI}_2$  Easily decomposed by  $\text{H}_2\text{O}$ , less easily by alcohol or ether (Riegel,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{HgI}_2$  Decomposed very quickly by  $\text{HNO}_3 + \text{Aq}$  or alcohol of 0.814 sp g (Souville, J Pharm **26** 474)

**Mercuric nitrate manganous oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{MnO} + 2\text{H}_2\text{O}$

Decomposed by  $\text{H}_2\text{O}$  (Mailhe, Bull Soc 1901, (3) **25** 790)

+ $3\text{H}_2\text{O}$  (Mailhe)

+ $4\text{H}_2\text{O}$  (Mailhe, A ch 1902, (7) **27** 370)

**Mercuric nitrate nickel oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{NiO} + 2\text{H}_2\text{O}$

(Mailhe, Bull Soc 1901, (3) **25** 788)

+ $4\text{H}_2\text{O}$  Decomposed by  $\text{H}_2\text{O}$  (Mailhe, A ch 1902, (7) **27** 369)

**Mercurous nitrate phosphate**,  $\text{HgNO}_3$ ,  $\text{Hg}_3\text{PO}_4 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , but decomposed by boiling with Insol in  $\text{H}_3\text{PO}_4 + \text{Aq}$  or alcohol Completely sol in hot  $\text{NH}_4\text{Cl} + \text{Aq}$  Decomposed by cold  $\text{KOH} + \text{Aq}$ , and warm  $\text{K}_2\text{CO}_3 + \text{Aq}$  (Wittstein)

$2\text{HgNO}_3$ ,  $\text{Hg}_2\text{O}$ ,  $5\text{Hg}_3\text{PO}_4 + \text{H}_2\text{O}$  (Haas, A **262** 192)

**Mercuric nitrate silver bromide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{AgBr}$

(Morse, Z phys Ch 1902, **41** 733)

**Mercuric nitrate silver cyanide, basic,**  
 $\text{Hg}(\text{OH})\text{NO}_3, \text{AgCN}+2\text{H}_2\text{O}$   
 (Schmidt, Z anorg 1895, 9 431)  
 $\text{Hg}(\text{OH})\text{NO}_3, 5\text{Ag}_2\text{O}, 20\text{AgCN}+7\text{H}_2\text{O}$   
 (Schmidt)

**Mercuric nitrate silver iodide,  $\text{Hg}(\text{NO}_3)_2$ ,**  
 $2\text{AgI}+\frac{1}{2}\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Preuss, A 29 328)

**Mercuric nitrate sulphide,  $\text{Hg}(\text{NO}_3)_2, 2\text{HgS}$**   
 Very sl sol in hot  $\text{H}_2\text{O}$  Insol in  $\text{HNO}_3$ +  
 Aq Decomp by hot  $\text{H}_2\text{SO}_4$  or aqua regia,  
 also by hot  $\text{HCl}$ +Aq (Barfoed, J pr 93  
 230)

Sol in aqua regia (Denigès, Bull Soc  
 1915, (4) 17 355)

$2\text{Hg}(\text{NO}_3)_2, \text{HgO}, 6\text{HgS}+12\text{H}_2\text{O}$  Insol  
 in  $\text{H}_2\text{O}$ , and  $\text{HNO}_3$ +Aq of 1 2 sp gr (Gramp,  
 J pr (2) 14 299)

**Mercuric nitrate zinc oxide,  $\text{Hg}(\text{NO}_3)_2, \text{ZnO}+$**   
 $\text{H}_2\text{O}$

Ppt Decomp by  $\text{H}_2\text{O}$  (Mailhe, C R  
 1901, 132 1274)

**Molybdenum nitrate,  $\text{Mo}_2\text{O}_5, \text{N}_2\text{O}_5$  (?)**

Sol in dil  $\text{HNO}_3$ +Aq (Berzelius)  
 $\text{MoO}_2, 2\text{N}_2\text{O}_5$  (?) Sol in dil  $\text{HNO}_3$ +Aq  
 (Berzelius)

**Neodymium nickel nitrate,  $2\text{Nd}(\text{NO}_3)_3$ ,**  
 $3\text{Ni}(\text{NO}_3)_2+24\text{H}_2\text{O}$

1 l sat solution in  $\text{HNO}_3$ +Aq (sp gr  
 1 325) contains 116 6 g hydrous salt at  $16^\circ$   
 (Jantsch, Z anorg 1912, 76 303)

**Neodymium rubidium nitrate,  $[\text{Nd}(\text{NO}_3)_3]\text{Rb}_2$**   
 $+4\text{H}_2\text{O}$

Hydroscopic (Jantsch, Z anorg 1911,  
 69 230)

**Neodymium zinc nitrate,  $2\text{Nd}(\text{NO}_3)_3$ ,**  
 $3\text{Zn}(\text{NO}_3)_2+24\text{H}_2\text{O}$

1 l sat solution in  $\text{HNO}_3$ +Aq (sp gr  
 1 325) contains 177 g hydrous salt at  $16^\circ$   
 (Jantsch)

**Nickel nitrate, basic**

Insol in  $\text{H}_2\text{O}$  (Proust)  
 $3\text{NiO}, 2\text{N}_2\text{O}_5+5\text{H}_2\text{O}$  Insol in cold or hot  
 $\text{H}_2\text{O}$  (Habermann, M 5 432)

$5\text{NiO}, \text{N}_2\text{O}_5+4\text{H}_2\text{O}$  Not decomp by boil-  
 ing  $\text{H}_2\text{O}$  (Roussseau and Tite, C R 114  
 1184)

**Nickel nitrate,  $\text{Ni}(\text{NO}_3)_2$**

Solubility in  $\text{H}_2\text{O}$  See +3, 6, and  $9\text{H}_2\text{O}$   
 Sp gr of aqueous solution at  $17.5^\circ$  contain-  
 ing

5	10	15	20	% $\text{Ni}(\text{NO}_3)_2$
1 0463	1 0903	1 1375	1 1935	
25	30	35	40	% $\text{Ni}(\text{NO}_3)_2$
1 2534	1 3193	1 3896	1 4667	

(Franz, J pr (2) 5 295)

Sp gr of  $\text{Ni}(\text{NO}_3)_2$ +Aq containing g  
 $\text{Ni}(\text{NO}_3)_2$  (anhydrous) in 1000 g  $\text{H}_2\text{O}$  at  
 $24.4^\circ$

91 5 g (=  $\frac{1}{2}$  mol) 183 274 5 369 460 5 549  
 1 078 1 141 1 205 1 266 1 324 1 378

(Gerlach, Z anal 28 468)

Sp gr of  $\text{Ni}(\text{NO}_3)_2$ +Aq at room temp  
 containing

16 493 30 006 40 953%  $\text{Ni}(\text{NO}_3)_2$   
 1 1363 1 2776 1 3879

(Wagner, W Ann 1883, 18 269)

Sp gr of  $\text{Ni}(\text{NO}_3)_2$ +Aq at  $25^\circ$

Concentration of $\text{Ni}(\text{NO}_3)_2$ +Aq	Sp gr
1-normal	1 0755
$\frac{1}{2}$ -"	1 0381
$\frac{1}{4}$ -"	1 0192
$\frac{1}{8}$ -"	1 0096

(Wagner, Z phys Ch 1890, 5 39)

Sp gr at  $20^\circ$  of  $\text{Ni}(\text{NO}_3)_2$ +Aq containing  
 M g mols of salt per liter

M 0 01 0 025 0 05 0 075  
 Sp gr 1 001521 1 003882 1 007792 1 011541

M 0 1 0 25 0 5 0 75  
 Sp gr 1 015307 1 03837 1 07611 1 11310

M 1 0 1 5 2 0  
 Sp gr 1 14562 1 22134 1 29459

(Jones and Pearce, Am Ch J 1907, 38 720)

Sol in liquid  $\text{NH}_3$  (Guntz, Bull Soc  
 1909 (4) 5 1008)

Moderately sol in liquid  $\text{NH}_3$  (Franklin,  
 Am Ch J 1898, 20 828)

Solubility in glycol=7 5% (de Coninck,  
 C C 1905, II 1234)

Insol in benzonitrile (Naumann, B 1914,  
 47 1370)

+ $3\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

$58^\circ$   $60^\circ$   $64^\circ$   $70^\circ$   
 61 61 61 99 62 76 63 95%  $\text{Ni}(\text{NO}_3)_2$ ,

$90^\circ$   $95^\circ$  mpt

70 16 77 12%  $\text{Ni}(\text{NO}_3)_2$

(Funk, Z anorg 1899, 20 411)

+ $6\text{H}_2\text{O}$  Not deliquescent in dry air Sol  
 in 2 pts cold  $\text{H}_2\text{O}$  and in alcohol (Tupputi)  
 Mpt of  $\text{Ni}(\text{NO}_3)_2+6\text{H}_2\text{O}=56.7^\circ$  (Ord-  
 way, Tilden, Chem Soc 45 409)

Sat solution boils at  $136.7^\circ$  (Ordway)

Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

$-21^\circ$   $-12.5^\circ$   $-10^\circ$   $-6^\circ$   
 39 94 41 59 42 11 43 00%  $\text{Ni}(\text{NO}_3)_2$ ,

$0^\circ$   $+20^\circ$   $41^\circ$   $56.7^\circ$  mpt  
 44 32 49 06 55 22 62 76%  $\text{Ni}(\text{NO}_3)_2$

(Funk, Z anorg 1899, 20 410)



Sat solution of  $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  contains 44.3%  $\text{Ni}(\text{NO}_3)_2$  at  $0^\circ$ , and 48.7%  $\text{Ni}(\text{NO}_3)_2$  at  $18^\circ$  (Mylius, Z anorg 1912, 74 411)  
 Sp gr of  $\text{Ni}(\text{NO}_3)_2 \cdot \text{Aq}$  containing in 1000 g  $\text{H}_2\text{O}$  at  $24.4^\circ$ , g  $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$   
 145.5 g (=  $\frac{1}{2}$  mol) 291 436.5 582  
 1 069 1 128 1 179 1 224

727.5 873 1018.5 1164  
 1 264 1 299 1 329 1 357  
 (Gerlach, Z anal 28 468)

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
 Insol in absolute alcohol  
 Sl sol in acetone (Krug and M'Elroy)  
 Difficultly sol in methyl acetate (Naumann, B 1909, 42 3790)  
 Insol in ethyl acetate (Naumann, B 1910, 43 314)  
 +  $9\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$   
 Sat solution contains at  
 $-23^\circ$   $-21^\circ$   $-10.5^\circ$   
 39.02 39.48 44.13%  $\text{Ni}(\text{NO}_3)_2$   
 Cryohydrate is formed at  $-27^\circ$  (Funk, Z anorg 1899, 20 411)

**Nickel praseodymium nitrate**,  $3\text{Ni}(\text{NO}_3)_2 \cdot 3\text{Pr}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$   
 solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr contains 9.28 g hydrous salt at  $16^\circ$ )  
 (Funk, Z anorg 1912, 76 303)

**Nickel samarium nitrate**,  $3\text{Ni}(\text{NO}_3)_2 \cdot 2\text{Sm}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$   
 1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1.325) contains 29.11 g hydrous salt at  $16^\circ$  (Jantsch)

**Nickel thorium nitrate**,  $\text{NiTh}(\text{NO}_3)_6 + 8\text{H}_2\text{O}$   
 Sol in  $\text{HNO}_3 + \text{Aq}$  (Meyer, Z anorg 1901, 27 387)

**Nickel uranyl nitrate**,  $10\text{Ni}(\text{NO}_3)_2 \cdot 3(\text{UO}_2)(\text{NO}_3)_2$   
 Sol in  $\text{H}_2\text{O}$  and acids, insol in aq alkali (Lancien, C C 1912, I 208)

**Nickel nitrate ammonia**,  $\text{Ni}(\text{NO}_3)_2 \cdot 4\text{NH}_3 + 2\text{H}_2\text{O}$   
 Efflorescent Easily sol in cold  $\text{H}_2\text{O}$ , decomp by boiling Insol in alcohol (Erdmann, J pr 97 395, Ephraim, B 1913, 46 3106)  
 +  $1\frac{1}{2}\text{H}_2\text{O}$  (André, C R 106 936)

**Nickel nitrate chloride ammonia**,  $6\text{Ni}(\text{NO}_3)_2 \cdot \text{NiCl}_2 \cdot 30\text{NH}_3 + 16\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  with decomp (Schwarz, W A B 1850 272)

**Nickel nitrate cupric oxide**,  $\text{Ni}(\text{NO}_3)_2 \cdot 3\text{CuO} + 3\text{H}_2\text{O}$   
 Ppt (Mahle, C R 1902, 134 234)

**Nickel nitrate hydrazine**,  $\text{Ni}(\text{NO}_3)_2 \cdot 3\text{N}_2\text{H}_4$   
 Insol in  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$   
 Easily sol in dil acids (Franzen, Z anorg 1908, 60 267)

**Palladium nitrate, basic**,  $\text{Pd}(\text{NO}_3)_2 \cdot 3\text{F} + 4\text{H}_2\text{O}$   
 Ppt Insol in  $\text{H}_2\text{O}$  (Kane)

**Palladium nitrate**,  $\text{Pd}(\text{NO}_3)_2 + x\text{H}_2\text{O}$   
 Very deliquescent, and sol in  $\text{H}_2\text{O}$  decomp by much  $\text{H}_2\text{O}$  or alcohol (Kane)  
 Decomp by cold or hot  $\text{H}_2\text{O}$  (Rose, A 3 143)

**Platinic nitrate**,  $\text{Pt}(\text{NO}_3)_4$  (?)  
 Known only in solution, which is decomposed on evaporating (Berzelius)  
 $\text{Pt}(\text{NO}_3)_2 \cdot 3\text{PtO}_2 + 5\text{H}_2\text{O}$  Insol in F (Prost, Bull Soc (2) 46 156)

**Platinum nitrate sulphocarbamide**,  $\text{Pt}(\text{NO}_3)_2 \cdot 4\text{CS}(\text{NH}_2)_2$   
 Very sol in  $\text{H}_2\text{O}$  Unstable (Kurnok, J pr 1894, (2) 50 490)

**Potassium nitrate**,  $\text{KNO}_3$   
 Not deliquescent, but, according to Mulder, 100 pts  $\text{KNO}_3$  under a bell jar with  $\text{H}_2\text{O}$  take up 339 pts  $\text{H}_2\text{O}$  in 22 days, and small amount finally deliquesce completely  
 Sol in  $\text{H}_2\text{O}$  with absorption of heat  
 16 pts  $\text{KNO}_3 + 100$  pts  $\text{H}_2\text{O}$  at  $13.2^\circ$  lower the temperature  $10.2^\circ$  If the initial temp is  $23^\circ$  it falls to  $12.8^\circ$ , if  $0^\circ$  it does not fall below  $-2.7^\circ$ , which is the freezing-point of the mixture (Rudorff, Pogg 136 276)

$\text{KNO}_3 + \text{Aq}$  sat at  $18.1^\circ$  has 1.1601 sp gr and contains 22.72%  $\text{KNO}_3$  or 100 pts  $\text{H}_2\text{O}$  at  $18.1^\circ$  dissolve 29.45 pts  $\text{KNO}_3$  (Karsten 1840)

Sol in 3.745 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach)  
 Sol in 3 pts  $\text{H}_2\text{O}$  at  $21^\circ$  (Schiff A 109 326) and solution has 1.1683 sp gr  
 Sol in 3 pts cold and 0.5 pt boiling  $\text{H}_2\text{O}$  (Cory)

$\text{KNO}_3 + \text{Aq}$  sat at  $18^\circ$  has sp gr 1.161 and contains 21.63%  $\text{KNO}_3$  or 100 pts  $\text{H}_2\text{O}$  dissolve 27.6 pts  $\text{KNO}_3$  at  $18^\circ$   
 Sol in 4 pts  $\text{H}_2\text{O}$  at  $16^\circ$  and 0.2 pt at b pt (Rifault)

100 pts  $\text{H}_2\text{O}$  at  $114^\circ$  dissolve 284.61 pts (Cory)  
 Sol in 7 pts cold and 1 pt boiling  $\text{H}_2\text{O}$  (Erdmann)

Sol in 6.15 pts cold  $\text{H}_2\text{O}$  at  $18.7^\circ$  (Abel)  
 100 pts  $\text{H}_2\text{O}$  at  $15^\circ$  dissolve 26.6 pts at  $10^\circ$  (Ure's Dictionary)

$\text{KNO}_3 + \text{Aq}$  sat at  $10^\circ$  contains 33.3% (Dill)  
 $\text{KNO}_3 + \text{Aq}$  sat in the cold contains 22% (Cory)

$\text{KNO}_3 + \text{Aq}$  sat at  $12.5^\circ$  contains 24.8% (Hsenfratz)

Solubility of  $\text{KNO}_3$  in 100 pts  $\text{H}_2\text{O}$   $t^\circ$

$t^\circ$	Pts $\text{KNO}_3$	$t$	1 ts 1 $\text{H}_2\text{O}$
0	13.2	45.10	7.7
5	16.7	54.72	9.1
11.67	22.2	65.45	12.5
17.91	29.3	79.72	16.2
24.94	38.4	97.66	23.4

(Gay-Lussac, A ch 11 314)

Solubility of  $\text{KNO}_3$  in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{KNO}_3$
16 0	26 7
29	43 5
44 2	71 4

(Nordenskjold, Pogg 136 312)

100 pts  $\text{H}_2\text{O}$  dissolve at  
 $10^\circ$  18° 27° 41° 53°  
 21 2 27 9 40 1 66 3 93 3 pts  $\text{KNO}_3$   
 (Gerardin, A ch (4) 5 150)

100 pts  $\text{KNO}_3 + \text{Aq}$  sat at  $14^\circ$  contain  
 16 34 pts  $\text{KNO}_3$ , at  $15^\circ$ , 18 81 pts  $\text{KNO}_3$   
 (v Hauer, J pr 98 177)

100 pts  $\text{H}_2\text{O}$  dissolve at  
 $4^\circ$  16 3° 68 3°  
 16 27 2 132 1 pts  $\text{KNO}_3$   
 (Andreae, J pr (2) 29 456)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{KNO}_3$	$t^\circ$	Pts $\text{KNO}_3$	$t^\circ$	Pts $\text{KNO}_3$
0	13 3	39	62	78	165
1	13 8	40	64	79	168
2	14 6	41	66	80	172
3	15 5	42	68	81	175
4	16 4	43	70	82	179
5	17 1	44	72	83	182
6	17 8	45	74	84	185
7	18 5	46	76	85	189
8	19 3	47	78	86	192
9	20 2	48	81	87	196
10	21 1	49	83	88	199
11	22 0	50	86	89	203
12	23 0	51	88	90	206
13	24 0	52	91	91	210
14	25 0	53	93	92	214
15	26 0	54	96	93	218
16	27 0	55	98	94	222
17	28 1	56	101	95	226
18	29 1	57	103	96	230
19	30 2	58	106	97	234
20	31 2	59	108	98	238
21	32 3	60	111	99	243
22	33 5	61	113	100	247
23	34 7	62	116	101	252
24	36 0	63	119	102	256
25	37 3	64	121	103	261
26	38 6	65	124	104	266
27	40 0	66	127	105	272
28	41 4	67	130	106	278
29	42 9	68	133	107	284
30	44 5	69	136	108	289
31	46 0	70	139	109	295
32	48	71	142	110	301
33	50	72	146	111	307
34	52	73	149	112	313
35	54	74	152	113	319
36	56	75	155	114	326
37	58	76	159	114 1	327 4
38	60	77	162		

(Mulder, Scheik Verhandel 1864 89)

100 pts  $\text{H}_2\text{O}$  dissolve 493 pts  $\text{KNO}_3$  at  
 $125^\circ$  (Tilden and Shenstone, Phil Trans  
 1884 23)

Rhombohedral  $\text{KNO}_3$  is more easily soluble  
 than the prismatic, and easily forms super-  
 saturated solutions (Frankenheim)

Sat  $\text{KNO}_3 + \text{Aq}$  contains at

$139^\circ$   $158^\circ$   $160^\circ$   $175^\circ$   $180^\circ$   
 79 8 83 7 83 9 84 0 84 2%  $\text{KNO}_3$

$190^\circ$   $215^\circ$   $225^\circ$   $258^\circ$   $283^\circ$   
 86 0 89 0 90 4 91 6 96 5%  $\text{KNO}_3$

(Étard, A ch 1894, (7) 2 526)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	G $\text{KNO}_3$	Sp gr $t^\circ/4^\circ$
0 40	13 43	1 0817
14 90	25 78	1 1389
30 80	47 52	1 2218
44 75	74 50	1 3043
60 05	111 18	1 3903
76	156 61	1 4700
91 65	210 20	1 5394
114*	311 64	1 6269

\* B-pt of sat solution

(Berkeley, Phil Trans 1904, 203, A 189)

100 g  $\text{H}_2\text{O}$  dissolve 37 79 g  $\text{KNO}_3$  at  $25^\circ$   
 100 g  $\text{H}_2\text{O}$  dissolve 3 08 g equiv  $\text{KNO}_3$

at  $20^\circ$ , 3 27 at  $21 5^\circ$  (Euler, Z phys Ch  
 1904, 49 312)

1 l  $\text{H}_2\text{O}$  dissolves 384 48 g  $\text{KNO}_3$  at  $25^\circ$   
 (Armstrong and Eyre, Proc Roy Soc 1910,  
 A, 84 123)

1 l sat  $\text{KNO}_3 + \text{Aq}$  contains 2 8 g mols  
 $\text{KNO}_3$  (Rosenheim and Weinheber, Z  
 anorg 1911, 69 263)

100 g  $\text{H}_2\text{O}$  dissolve 38 485 g  $\text{KNO}_3$  at  $25^\circ$   
 (Haigh, J Am Chem Soc 1912, 34 1148)

Sat  $\text{KNO}_3 + \text{Aq}$  contains at

$50^\circ$   $58^\circ$   $62^\circ$   $68^\circ$   
 46 39 51 55 53 64 57 04%  $\text{KNO}_3$   
 (Tschugaeff, Z anorg 1914, 86 160)

Solubility in  $\text{H}_2\text{O}$ 

100 g of the sat solution contain at

$9 1^\circ$   $21 1^\circ$   $35^\circ$   
 16 76 24 77 35 01 g  $\text{KNO}_3$

(Fmdlay, Chem Soc 1914, 105 780)

Sp gr of solution sat at  $15^\circ = 1 134$   
 (Michel and Kraft)

Sp gr of solution sat at  $16^\circ = 1 138$   
 (Stolba, J pr 97 503)

Sp gr of solution sat at  $18^\circ = 1 1601$ , and  
 contains 29 45%  $\text{KNO}_3$  (Karsten)

Sp gr of  $\text{KNO}_3 + \text{Aq}$  at  $19 5^\circ$ 

% $\text{KNO}_3$	Sp gr	% $\text{KNO}_3$	Sp gr
4 871	1 0307	17 965	1 1198
9 618	1 0618	21 488	1 1457
14 044	1 0920		

(Kremers, Pogg 95 120)

Sp gr of  $\text{KNO}_3 + \text{Aq}$  at  $21^\circ$ 

% $\text{KNO}_3$	Sp gr	% $\text{KNO}_3$	Sp gr
1	1 0058	13	1 0819
2	1 0118	14	1 0887
3	1 0178	15	1 0956
4	1 0239	16	1 1026
5	1 0300	17	1 1097
6	1 0363	18	1 1169
7	1 0425	19	1 1242
8	1 0490	20	1 1316
9	1 0555	21	1 1390
10	1 0621	22	1 1464
11	1 0686	23	1 1538
12	1 0752	24	1 1613

(Schiff, A 110 75)

Sp gr of  $\text{KNO}_3 + \text{Aq}$  at  $15^\circ$ 

% $\text{KNO}_3$	Sp gr	% $\text{KNO}_3$	Sp gr
1	1 00641	12	1 07905
2	1 01283	13	1 08596
3	1 01924	14	1 09286
4	1 02566	15	1 09977
5	1 03207	16	1 10701
6	1 03870	17	1 11426
7	1 04534	18	1 12150
8	1 05197	19	1 12875
9	1 05861	20	1 13599
10	1 06524	21	1 14361
11	1 07215		

(Gerlach, Z anal 8 286)

Sp gr of  $\text{KNO}_3 + \text{Aq}$  at  $17.5^\circ$ 

% $\text{KNO}_3$	Sp gr	% $\text{KNO}_3$	Sp gr	% $\text{KNO}_3$	Sp gr
1	1 006	8	1 051	15	1 099
2	1 012	9	1 058	16	1 106
3	1 019	10	1 065	17	1 113
4	1 025	11	1 072	18	1 120
5	1 032	12	1 078	19	1 127
6	1 038	13	1 085	20	1 134
7	1 045	14	1 092		

(Hager, Comm 1883)

Sp gr of  $\text{KNO}_3 + \text{Aq}$  at  $18^\circ$ 

% $\text{KNO}_3$	Sp gr	% $\text{KNO}_3$	Sp gr
5	1 0305	20	1 133
10	1 0632	22	1 148
15	1 097		

(Kohlrausch, W Ann 1879 1)

Sp gr of  $\text{KNO}_3 + \text{Aq}$  at  $20^\circ$ , containing mols  $\text{KNO}_3$  in 100 mols  $\text{H}_2\text{O}$ 

Mols $\text{KNO}_3$	Sp gr	Mols $\text{KNO}_3$	Sp gr
0.5	1 01730	4	1 12264
1	1 03373	5	1 14888
2	1 06524		

(Nicol, Phil Mag (5) 16 122)

Sp gr of  $\text{KNO}_3 + \text{Aq}$  at  $25^\circ$ 

Concentration of $\text{KNO}_3 + \text{Aq}$	Sp gr
1-normal	1 0605
$\frac{1}{2}$ -"	1 0305
$\frac{1}{4}$ -"	1 0161
$\frac{1}{8}$ -"	1 0075

(Wagner, Z phys Ch 1890, 5 37)

Sp gr of  $\text{KNO}_3 + \text{Aq}$  at  $20.1^\circ$ 

p = per cent strength of solution, d = served density, w = volume conc in grams per cc ( $\frac{pd}{100} = w$ )

p	d	w
25.54	1 1783	0 30095
21.95	1 1510	0 25270
17.88	1 1200	0 20033
13.93	1 0913	0 15203
8.706	1 0553	0 09186
5.393	1 0331	0 05571
4.389	1 0264	0 04506
2.848	1 0165	0 02895
2.030	1 0113	0 02053
0.741	1 0030	0 00743

(Barnes, J Phys Chem 1898, 2 544)

Sp gr  $20^\circ/4^\circ$  of a normal solution of  $\text{KNO}_3$  = 1.05954, of a 0.5 normal solution = 1.029 (Haigh, J Am Chem Soc 1912, 34 1151)

Sp gr of sat  $\text{KNO}_3 + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	G $\text{KNO}_3$ sol in 100 g $\text{H}_2\text{O}$	Sp gr
0	13.27	1 054
10	20.89	1 120
20	31.59	1 161
30	45.85	1 212
40	63.90	1 282
50	85.51	1 339
60	109.00	1 403
70	138.00	1 446

(Tschernaj, J Russ Phys Chem Soc 1902, 44 1565)

The saturated solution boils at  $114.1^\circ$  (Muller),  $114.5^\circ$  (Griffiths),  $115.9^\circ$  (Legrand),  $117^\circ$  (Mardun),  $117^\circ$  (Mardun),  $118^\circ$  (Kremers),  $118^\circ$  (Le Page)

The saturated solution forms a crust at  $111^\circ$ , and boils at  $115^\circ$ , highest temperature served,  $115.3^\circ$  (Gerlach, Z anal 26 426)

B-pt of  $\text{KNO}_3 + \text{Aq}$  containing pts  $\text{KNO}_3$  to 100 pts  $\text{H}_2\text{O}$  G=according to Gerlach (Z anal 26 444), L=according to Legrand (A ch (2) 62 426)

B pt	G	L	B pt	G	L
100 5°	7 5		107°	120 5	119 0
101	15 2	12 2	108	141 5	140 6
101 5	23		109	164	163 0
102	31	26 4	110	188 5	185 9
102 5	39		111	215	209 2
103	47 5	42 2	112	243	233 0
103 5	56		113	274	257 6
104	64 5	59 6	114	306	283 3
104 5	73		115	338 5	310 2
105	82	78 3	115 9		335 1
106	101	98 2			

1 pt  $\text{KNO}_3$  dissolves in 14 pts  $\text{HNO}_3$ , at 20° in 38 pts, and at 123° in 1 pt  $\text{HNO}_3 + \text{Aq}$  of 1 423 sp gr (Composition  $2\text{HNO}_3, 3\text{H}_2\text{O}$ ) (Schultz, Zeit Ch (2) 5 531)

Solubility of  $\text{KNO}_3$  in  $\text{HNO}_3$  at 0°

G per 100 cc solution		Sp gr
$\text{KNO}_3$	$\text{HNO}_3$	
12 65	0 00	1 079
10 02	3 71	
8 38	8 38	1 093
7 49	13 58	1 117
7 49	19 47	1 144
7 68	30 04	1 202
10 42	42 86	1 289
28 64	75 95	1 498

(Engel, C R, 1887, 104 913)

Solubility in  $\text{HNO}_3 + \text{Aq}$

Solution temp	% by wt $\text{KNO}_3$	Solid phase
-6°	24 4	$\text{KNO}_3, 2\text{HNO}_3$ (solution in $\text{HNO}_3$ ) (stable)
+14 0	32 6	"
17 0	34 8	"
19 5	37 2	"
22 0	44 5	(mpt)
21 5	47 8	(Solution in $\text{KNO}_3$ ) (labile)
21 5	48 6	"
20 0	50 9	"
-4 0	37 2	$\text{KNO}_3, \text{HNO}_3$ (labile)
+16 5	44 5	"
22 5	47 2	(stable)
23 5	47 8	"
25 5	48 6	"
27 0	49 4	"
29 0	50 1	(labile)
30 5	50 9	"
21 0	49 4	$\text{KNO}_3$ (labile)
39 0	50 9	(stable)
50 0	51 7	"

(Groschuff, Z anorg 1904, 40 10)

Sol in sat  $\text{NH}_4\text{Cl} + \text{Aq}$  Solution thus obtained contains 43 07 pts mixed salts, or 100 pts  $\text{H}_2\text{O}$  dissolve 75 66 pts mixed salts, viz 38 62 pts  $\text{KNO}_3$  and 39 84 pts  $\text{NH}_4\text{Cl}$  (Karsten) See also under  $\text{NH}_4\text{Cl}$

Solubility of  $\text{KNO}_3 + \text{K}_2\text{CO}_3$  and  $\text{KHCO}_3$  in  $\text{H}_2\text{O}$ , see under  $\text{K}_2\text{CO}_3$  and  $\text{KHCO}_3$

Sol in sat  $\text{BaCl}_2 + \text{Aq}$  with pptn of  $\text{Ba}(\text{NO}_3)_2$

Sol in sat  $\text{NH}_4\text{NO}_3 + \text{Aq}$ , at first without pptn, but afterwards  $\text{NH}_4\text{NO}_3$  is pptd (Karsten)

Sol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  with pptn of  $\text{NH}_4\text{NO}_3$  (Rudorff, B 6 485)

See also under  $\text{NH}_4\text{NO}_3$

Sol in sat  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$ , but soon a double salt separates (Karsten)

See also under  $\text{Ba}(\text{NO}_3)_2$

Sol in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  (Longchamp)

See also under  $\text{Ca}(\text{NO}_3)_2$

Sol in sat  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  without pptn 100 pts  $\text{H}_2\text{O}$  dissolve 119 6 pts  $\text{Pb}(\text{NO}_3)_2$  and 67 1 pts  $\text{KNO}_3$  at 21 2° (Rudorff, B 6 484) See also under  $\text{Pb}(\text{NO}_3)_2$

Solubility in  $\text{AgNO}_3 + \text{Aq}$  at t°

t°	Sat solution contains		
	% $\text{KNO}_3$	% $\text{AgNO}_3$	% total salt
-7	10 5	39 4	49 9
-7 5	10 5	40 5	51 0
-4	11 3	42 5	53 8
+20	23 6	46 4	70 0
33	26 3	50 9	77 2
34	27 3	51 1	78 4
36	29 4	52 0	81 4
38			81 7
46			82 3
54	33 1	55 0	88 1
54		55 8	
61			89 5
68	34 3	54 6	88 9
96	37 8	57 4	93 2
105	38 5	55 6	94 1
142	41 5	55 8	97 3

(Étard, A ch 1894, (7) 3 286)

Solubility of mixed crystals of  $\text{KNO}_3$  and  $\text{AgNO}_3$  in  $\text{H}_2\text{O}$  at 25°

G per l		Mg mols per l		Mol % $\text{AgNO}_3$ in solution	Mol % $\text{AgNO}_3$ in solid phase
$\text{AgNO}_3$	$\text{KNO}_3$	$\text{AgNO}_3$	$\text{KNO}_3$		
45 9	321 8	270	3180	7 83	0 2896
110 7	322 6	6513	3184	16 96	0 6006
176 8	333 7	1040	3298	23 97	0 9040
259 6	364 0	1258	3597	29 81	1 054
365 6	456 4	2151	4511	32 28	1 604
507 9	387 2	2988	3816	43 85	2 439
745 9	398 6	4388	3960	57 70	8 294

(Herz, Z Kryst Min 1897, 23 405)

Solubility of  $\text{KNO}_3 + \text{AgNO}_3$  at  $30^\circ$ 

Composition of the solution		Solid phase
% $\text{KNO}_3$	% $\text{AgNO}_3$	
0	73 0	$\text{AgNO}_3$
5 53	71 65	"
11 22	69 01	$\text{AgNO}_3 + \text{AgNO}_3, \text{KNO}_3$
13 44	65 08	$\text{AgNO}_3, \text{KNO}_3$
17 38	57 85	"
25 05	46 32	$\text{KNO}_3 + \text{AgNO}_3, \text{KNO}_3$
25 00	46 45	"
26 58	39 09	$\text{KNO}_3$
29 22	23 59	"
30 45	11 51	"
31 30	0	"

(Schrenemakers, Z phys Ch 1909, 65 576)

 $\text{KNO}_3 + \text{NaNO}_3$ 

100 pts  $\text{H}_2\text{O}$  dissolve 34 53 pts  $\text{KNO}_3$  and 91 16 pts  $\text{NaNO}_3$  at  $15.6^\circ$ , and solution has sp gr = 1 478 (Page and Keightley)

100 pts  $\text{KNO}_3 + \text{NaNO}_3 + \text{Aq}$  sat at  $14^\circ$  contain 52 17 pts of the two salts, sat at  $13^\circ$  contain 53 15 pts of the two salts (v Hauer)

100 pts  $\text{H}_2\text{O}$  dissolve at  $18.75^\circ$  29 45 pts  $\text{KNO}_3$  and 89 53 pts  $\text{NaNO}_3$ , if sat  $\text{KNO}_3 + \text{Aq}$  is treated with  $\text{NaNO}_3$ , and 35 79 pts  $\text{KNO}_3$  and 88 00 pts  $\text{NaNO}_3$  by the opposite process 134 38 pts of the two salts are dissolved if a mixture of the salts is treated with  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Karsten)

100 pts  $\text{H}_2\text{O}$  dissolve 39 34 pts  $\text{KNO}_3$  and 94 60 pts  $\text{NaNO}_3$ , or 133 94 pts of the two salts at  $20^\circ$  (Nicol, Phil Mag (5) 13 385)

Solubility of mixtures of  $\text{KNO}_3$  and  $\text{NaNO}_3$ 

% $\text{NaNO}_3$ in mixture before solution	Total amt mixed salts dissolved in 100 pts $\text{H}_2\text{O}$ at $20^\circ$	Pts $\text{NaNO}_3$ dissolved	Pts $\text{KNO}_3$ dissolved	% $\text{NaNO}_3$ in mixture after solution and evap to dryness
100	86 8	86 8	0	100
90	109 6	96 4	13 2	88
80	136 5	98 0	38 5	71 8
70	136 3			
60	137 6	90 0	47 6	65 4
50	106 1	66 0	40 1	62 2
45 7*	88 0	53 3	34 7	60 6
40	81 1	45 6	35 6	56 2
30	73 5			
20	54 1	20 8	33 3	38 5
10	40 9	9 4	31 5	22 9
0	33 6	0	33 6	0

\*  $\text{NaNO}_3 + \text{KNO}_3$ 

(Carnelley and Thomson, Chem Soc 53 782)

Solubility of  $\text{KNO}_3 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at  $10^\circ$ 

In 1000 ccm $\text{H}_2\text{O}$		Solid phase
$\text{NaNO}_3$	$\text{KNO}_3$	
805 0		$\text{NaNO}_3$
848 3	301 9	$\text{NaNO}_3, \text{KNO}_3$
	208 9	$\text{KNO}_3$

(Kremann and Zitek, M 1909, 30 325)

Solubility of  $\text{KNO}_3 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at  $24.2^\circ$ 

In 1000 ccm $\text{H}_2\text{O}$		Solid phase
$\text{NaNO}_3$	$\text{KNO}_3$	
913 58		$\text{NaNO}_3$
910 60	123 60	"
1019 65	435 85	$\text{NaNO}_3, \text{KNO}_3$
1018 40	437 70	"
931 30	422 00	$\text{KNO}_3$
346 70	390 00	"
	377 35	"

(Kremann and Zitek)

Solubility of  $\text{KNO}_3 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at  $25^\circ$ 

% $\text{KNO}_3$	% $\text{NaNO}_3$	Solid phase
38 70	39 62	
41 60	66 31	$\text{KNO}_3$
46 35	100 10	"
39 08	98 99	$\text{KNO}_3 + \text{NaNO}_3$
20 98	94 44	$\text{NaNO}_3$
		"

(Uyeda, Mem Col Sc Kyoto, 1910, 2 245)

Solubility in  $\text{NaNO}_3 + \text{Aq}$  at  $20^\circ, 30^\circ, 40^\circ$  and  $91^\circ$  Data, given in the original, show that each salt increases the solubility of the other (Leather, Mem Dept Agric India 1914, 3 177, Chem Soc 1915, 108 (2), 13)

100 pts  $\text{H}_2\text{O}$  dissolve 28 92 pts  $\text{KNO}_3$  53 68 pts  $\text{NaNO}_3$ , and 26 44 pts  $\text{NaCl}$  at  $15.6^\circ$ , and solution has sp gr = 1 44 (Pag and Keightley, Chem Soc (2) 10 566)

Solubility of  $\text{KNO}_3 + \text{NaNO}_3 + \text{NaCl}$  in  $\text{H}_2\text{O}$  at  $25^\circ$ 

% $\text{KNO}_3$	% $\text{NaNO}_3$	% $\text{NaCl}$	Solid phase
38 44	22 87	32 58	
38 5	44 40	27 67	$\text{NaCl} + \text{KNO}_3$
42 55	63 26	23 59	"
17 77	61 12	23 94	$\text{NaNO}_3, \text{KNO}_3 + \text{NaCl}$
28 08	62 92	23 70	"
44 72	82 82	9 56	"

(Uyeda, Mem Col Sc Kyoto, 1910, 2 245)

 $\text{KNO}_3 + \text{Sr}(\text{NO}_3)_2$ 

1 l  $\text{H}_2\text{O}$  sat with both salts at  $25^\circ$  contain 552 g  $\text{KNO}_3 + 1074$  g  $\text{Sr}(\text{NO}_3)_2$  (Le Blanc and Noyes, Z phys Ch 1890, 6 386)

Solubility of  $\text{KNO}_3 + \text{Sr}(\text{NO}_3)_2$  at  $t^\circ$ 

$t^\circ$	% $\text{KNO}_3$	% $\text{Sr}(\text{NO}_3)_2$	Solid phase
20	22 90	5 49	$\text{KNO}_3$
	21 70	9 17	"
	21 01	17 10	"
	19 60	31 24	"
	19 49	34 91	"
	19 69	39 56	$\text{KNO}_3 + \text{Sr}(\text{NO}_3)_2, 4\text{H}_2\text{O}$
	17 56	40 37	$\text{Sr}(\text{NO}_3)_2, 4\text{H}_2\text{O}$
	12 65	41 12	"
	10	40 70	"
40	30 26	23 70	$\text{KNO}_3$
	26 90	38 52	$\text{KNO}_3 + \text{Sr}(\text{NO}_3)_2, 4\text{H}_2\text{O}$
	22 50	40 22	$\text{Sr}(\text{NO}_3)_2, 4\text{H}_2\text{O}$
	11 19	44 19	"
	0	47 7	"

(Findlay, Morgan and Morris, Chem Soc 1914, 105 779)

 $\text{KNO}_3 + \text{TiNO}_3$ 

100 g  $\text{H}_2\text{O}$  dissolve 43.5 g  $\text{TiNO}_3 + 104.2$  g  $\text{KNO}_3$  at  $58^\circ$  (Rabe, Z anorg 1902, 31 156)

Solubility of mixed crystals of  $\text{KNO}_3 + \text{TiNO}_3$  in  $\text{H}_2\text{O}$  at  $25^\circ$

G per l		Sp gr
$\text{TiNO}_3$	$\text{KNO}_3$	
0 00	351 0	1 2632
2 37	329 0	1 1903
6 15	332 4	1 1956
17 64	333 7	1 2050
49 74	333 3	1 2196
63 60	321 0	1 2436
86 18	330 5	1 2617
123 8	428 3	1 2950
101 3	245 1	1 2050
116 1	0 0	1 0964

(Herz, Z Kryst Min 1897, 28 405)

 $\text{KNO}_3 + \text{KBr}$ 

Solubility in  $\text{KBr} + \text{Aq}$

1 litre of the solution contains

at 14.5		at 25.2	
Mol KBr	Mol $\text{KNO}_3$	Mol KBr	Mol $\text{KNO}_3$
0 0	2 228	0 0	3 217
0 356	2 026	0 38	3 026
0 784	1 835	0 93	2 689
1 092	1 730	1 37	2 492
1 577	1 589	2 08	2 216
2 542	1 406	2 87	1 958
3 536	1 308	3 55	1 807

(Touren, C R 1900, 130 910)

 $\text{KNO}_3 + \text{KCl}$ 

100 pts  $\text{H}_2\text{O}$  dissolve pts of the two salts

	At $12.9^\circ$	At $15.3^\circ$
	18 8	18 9
$\text{KNO}_3$	28 5	29 8
$\text{KCl}$		

(Kopp)

100 pts  $\text{H}_2\text{O}$  dissolve 315.2 pts  $\text{KCl}$  and 19.1 pts  $\text{KNO}_3$  at  $20^\circ$  (Rudorff, B 6 484)

100 pts  $\text{H}_2\text{O}$  dissolve 18.95 pts  $\text{KNO}_3 + 32.84$  pts  $\text{KCl}$ , or 51.79 pts of the mixed salts at  $20^\circ$  (Nicol, Phil Mag (5) 31 385)

Solubility of  $\text{KCl}$  with addition of  $\text{KNO}_3$  at  $17.5^\circ$

Sp gr	100 ccm of solution contain g		
	$\text{KCl}$	$\text{H}_2\text{O}$	$\text{KNO}_3$
1 1730	29 39	87 85	0
1 1980	27 50	85 68	6 58
1 2100	27 34	84 76	8 83
1 2250	26 53	83 58	12 48
1 2360	25 98	82 84	14 83
1 2390	25 96	82 65	15 22
1 2388	25 95	82 43	15 49
1 2410	26 24	82 63	15 33

$\text{KNO}_3$  separated out in last four solutions

Solubility of  $\text{KNO}_3$  with addition of  $\text{KCl}$  at  $20.5^\circ$

Sp gr	100 ccm of solution contain g		
	$\text{KNO}_3$	$\text{H}_2\text{O}$	$\text{KCl}$
1 1625	27 68	88 51	0
1 1700	24 39	87 89	4 72
1 1765	22 44	87 47	7 74
1 1895	20 23	86 48	12 23
1 1983	18 96	85 69	15 15
1 2150	17 67	84 23	19 61
1 2265	17 11	83 40	22 17
1 2400	16 79	82 24	24 96

(Bodlander, Z phys Ch 7 359)

## Solubility in KCl+Aq at t°

t°	Sat solution contains		
	% KNO <sub>3</sub>	% KCl	% total salt
—11 4	4 0	18 4	22 4
—11	3 9	18 1	22 0
—10	3 8	18 6	22 5
—4		19 7	
+2 5	6 3	19 9	26 2
4 5	7 3	20 7	28 0
4 5	7 8	19 8	27 6
8 5	7 9	20 9	28 8
10 5	8 4	21 0	29 4
13 5	8 9	21 8	30 7
14	10 2	21 3	31 5
17	9 7	22 6	32 3
23	12 5	21 8	34 3
27	14 9	21 3	36 2
29	16 1	21 0	37 1
34	18 9	21 2	39 3
36	18 9	21 6	40 5
37 5	19 2	21 6	40 8
39	21 0	21 0	42 0
42 5	21 8	20 9	42 7
48	25 3	20 3	45 6
50	28 3	20 8	49 1
52		20 2	
53			48 7
56	29 5	19 5	49 0
57	34 5	18 3	52 8
	35 4		
	40 5	17 3	57 8
81	47 1	15 4	62 5
85	48 2	15 3	63 5
90	52 8	13 3	66 1
96	54 1	12 6	68 7
97	56 6	12 4	69 0
104	59 9	10 8	70 7
105		10 9	
120	69 6	7 7	77 3
120	69 1	7 6	76 7

(Étard, A ch 1894, (7) 3 285)

## Solubility in KCl+Aq

1 litre of the solution contains at			
14 5°		at 25 2	
Mol KCl	Mol KNO <sub>3</sub>	Mol KCl	Mol KNO <sub>3</sub>
0 0	2 228	0 0	3 217
0 182	2 172	0 26	3 086
0 424	2 057	0 66	2 853
0 880	1 830	1 35	2 510
1 778	1 576	2 08	2 218
2 204	1 515	2 78	2 015
2 635	1 423	3 04	1 946
3 172	1 355		

(Touren, C R 1900, 130 909)

Solubility of KCl in KNO<sub>3</sub>+Aq

t°	Concentration of KNO <sub>3</sub> % mol per l	G salt dissolved in 1 l H <sub>2</sub> O	Molecular solubility
0°	0	283 55	3 81
"	1/4	284 25	3 81
"	1/2	283 60	3 81
"	1	287 60	3 86
25°	0	364 15	4 89
"	1/4	365 00	4 90
"	1/2	361 65	4 86
"	1	353 80	4 81
"	1 1/2	355 20	4 77

(Armstrong and Eyre, Proc R Soc (A) 191 84 127)

Solubility in KCl+Aq at 20°, 30°, 40° and 91°. Data, given in the original, show that each salt diminishes the solubility in H<sub>2</sub>O of the other (Leather, Mem Dept Agric Indus 1914, 3 177 Chem Soc 1915, 108 (2) 13)

KNO<sub>3</sub>+NaCl  
NaCl is sol in sat KNO<sub>3</sub>+Aq, and the mixed solution is capable of dissolving more KNO<sub>3</sub>. An amount of H<sub>2</sub>O, which, when pure, could only dissolve 100 pts KNO<sub>3</sub>, can in this way be made to take up 152 64 pt (Longchamp, A ch (2) 9 8)

Sol in sat NaCl+Aq

100 pts H<sub>2</sub>O dissolve

	Longchamp 4° (1)	Rüdorff		Page and Keightley 15 6° 15 6° (4)
		14° (2)	18° (3)	
NaCl	35 96	38 5	38 9	39 5
KNO <sub>3</sub>	26 01	28 7	36 1	32 3
	61 97	67 2	75 0	71 8

	Karsten 18 75			Mulder At b pt (8)
	(5)	(6)	(7)	
NaCl	36 53	38 25	39 19	37 0
KNO <sub>3</sub>	33 12	29 45	38 53	306 1
	69 65	67 70	77 72	344 0

1, 2, 3, 4, and 8 Both salts in excess  
5 Sat NaCl+Aq treated with KNO<sub>3</sub>  
6 Sat KNO<sub>3</sub>+Aq treated with NaCl  
7 The two salts simultaneously treated with H<sub>2</sub>O  
100 pts H<sub>2</sub>O dissolve 31 44 pts KNO<sub>3</sub>, 13 pts KCl, and 38 58 pts NaCl at 15 6°, an solution has sp gr = 1 33 (Page and Keightley)

## Solubility in NaCl + Aq at t°

t°	Sat solution contains		
	% KNO <sub>3</sub>	% NaCl	% total salt
-22	7 3	22 5	29 8
-19 5	7 9	22 6	30 5
-15 5	8 7	22 1	31 8
-7	10 1	22 5	32 6
-6	10 9	23 0	33 9
-1	12 7	23 3	36 0
+1	12 9	23 8	36 7
+11	16 6	22 8	39 4
17	19 0	22 8	41 8
18	19 8	22 0	41 8
18	18 9	22 5	41 5
20 5	20 4	22 3	42 7
22		21 2	
22	21 8	20 7	42 5
26	20 7	22 3	43 0
27			45 0
30 5	24 7	20 7	45 4
32 5	25 0	20 2	45 2
32 5	25 9	20 2	46 1
33	26 7	20 7	47 4
35	27 9	20 2	48 1
39	29 8	19 5	49 3
42 2	31 1	20 0	51 1
50	38 5	16 5	55 0
54	39 4	17 1	56 5
58 5	40 9	15 3	56 2
70	49 7	14 0	63 7
76	53 9	13 6	67 5
79	54 8	12 9	67 7
84	57 4	12 6	70 0
90	61 4	10 4	71 8
96	64 7	9 5	74 2
105	70 0	9 0	79 0
106	69 9	9 3	79 2
107	71 3	8 4	79 7
115	72 2	9 0	81 2
122	73 8	8 0	81 8
127	73 6	7 9	81 5
127	72 9	8 8	81 7
127	73 0	7 6	80 6
128	74 2	7 9	82 1
132	75 7	7 6	83 3
145	77 7	7 6	85 3
170	80 7	5 8	86 5
171	79 1	5 9	85 0

(Étard, A ch 1894, (7) 3 283)

100 g H<sub>2</sub>O dissolve 41.14 g KNO<sub>3</sub> and 38.25 g NaCl at 25°, 168.8 g KNO<sub>3</sub> and 39.81 g NaCl at 80° (Soch, J phys Ch 1898, 2 46)

See also under NaCl

Sol in sat CuSO<sub>4</sub> + Aq, forming a double salt, which soon separates out

Very slowly and slightly sol in MgSO<sub>4</sub> + Aq with pptn of MgSO<sub>4</sub> (Karsten)

KNO<sub>3</sub> + K<sub>2</sub>SO<sub>4</sub>

Sat KNO<sub>3</sub> + Aq dissolves some K<sub>2</sub>SO<sub>4</sub>, and sat K<sub>2</sub>SO<sub>4</sub> + Aq slowly dissolves some KNO<sub>3</sub>

without pptn, but K<sub>2</sub>SO<sub>4</sub> is afterwards pptd (Karsten)

100 pts H<sub>2</sub>O dissolve

	Mulder 18 75° (1)	Karsten 18 75° (2)	Kopp		Mulder 18 75° (5)
			20° (3)	40° (4)	
KNO <sub>3</sub>	29 90	29 42	26 9	59 35	
K <sub>2</sub> SO <sub>4</sub>		4 0	6 6	5 75	10 8

2 H<sub>2</sub>O sat with KNO<sub>3</sub> and K<sub>2</sub>SO<sub>4</sub> simultaneously, or to a sat solution of one salt the other was added

3 and 4 H<sub>2</sub>O sat with both salts simultaneously

Mulder doubts the results of 3 and 4

Solubility in K<sub>2</sub>SO<sub>4</sub> + Aq at t°

t°	In 100 ccm of the solution		Sp gr of solution
	G KNO <sub>3</sub>	G K <sub>2</sub> SO <sub>4</sub>	
15	216 5	50 7	1 165
25	308 5	47 66	1 210

(Euler, Z phys Ch 1914, 40 313)

Slowly sol in sat Na<sub>2</sub>SO<sub>4</sub> at first without pptn, but afterwards K<sub>2</sub>SO<sub>4</sub> or NaSO<sub>4</sub> separates out

Sol in sat ZnSO<sub>4</sub> + Aq with pptn of double salt (Karsten)

Sol in sat KClO<sub>3</sub> + Aq, from which solution it is not pptd by salts which would ppt it from aqueous solution (Karsten)

Hydrazine dissolves 21.7 pts KNO<sub>3</sub> at 12.5–13° (de Bruyn, R t c 1899, 18 297)

Neither dissolved nor attacked by liquid NO<sub>2</sub> (Frankland, Chem Soc 1901, 79 1361)

Very sol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 829)

Insol in absolute alcohol, in dilute alcohol it dissolves proportional to the amount of H<sub>2</sub>O present, but always less is dissolved than the H<sub>2</sub>O would dissolve by itself (Gerardin)

100 pts alcohol containing % by weight of alcohol dissolve pts KNO<sub>3</sub> at 15°

10 20 30 40 50 60 80% alcohol  
13.2 8.5 5.6 4.3 2.8 1.7 0.4 pts KNO<sub>3</sub>

(Scheff, A 118 365)



Solubility in 100 pts alcohol at  $t^\circ$  D = sp gr  
of alcohol, S = solubility

D = 0.9904		D = 0.9848		D = 0.9793		D = 0.9726	
$t^\circ$	S	$t^\circ$	S	$t^\circ$	S	$t^\circ$	S
12	18 1	12	14 6	10	10 20	14	8 8
21	25 0	21	21 7	10	10 19	25	13 6
33	40 4	36	37 8	13	11 74	34	20 3
43	58 6	41	45 0	18	14 52	44	31 3
53	79 1	56	72 9	20	16 35	47	34 2
61	94 5			31	25 81	60	52 3
62	95 7			34	28 63		
				40	36 66		
				41	37 20		
				50	50 14		
				53	56 01		
				61	72 24		
				62	73 36		

D = 0.9573		D = 0.9390		D = 0.8967		D = 0.8429	
$t^\circ$	S	$t^\circ$	S	$t^\circ$	S	$t^\circ$	S
14	5 4	16	4 13	12	1 61	15	0 29
25	9 0	24	6 00	33	3 62	22	0 39
33	13 2	40	10 94	47	5 77	40	0 62
44	19 1	51	16 51	57	6 97	54	0 78
57	29 1	60	21 54			60	1 10
65	36 2	64	24 22				

(Gerardin, A ch (4) 5 151)

Solubility of  $\text{KNO}_3$  in alcohol at  $18^\circ$

Sp gr	100 ccm contain g		
	Alcohol	Water	$\text{KNO}_3$
1 1475		89 63	25 12
1 1085	3 30	87 44	20 11
1 1010	5 24	86 26	18 60
1 0805	8 69	83 18	16 18
1 0655	14 08	77 93	14 54
1 0490	16 27	76 36	12 27
1 0375	19 97	72 93	10 85
0 9935	28 11	64 74	6 50
0 9585	37 53	54 21	4 11
0 9456	42 98	48 15	3 37
0 9050	51 23	27 32	1 95
0 8722	61 65	24 74	0 83
0 8375	69 60	13 95	0 20

(Bodlander, Z phys Ch 7 316)

Solubility in alcohol

Wt % alcohol	G $\text{KNO}_3$ per 100 g alcohol	
	at $30^\circ$	at $40^\circ$
0	45 6	64 5
8 25	32 3	47 1
17 0	22 4	33 3
25 7	15 1	24 1
35 0	11 4 (34 $5^\circ$ )	16 7
44 9	7 0	11 6 (44 $^\circ$ )
54 3	4 5	7 2 (55 $^\circ$ )
65 0	2 7	4 4
75 6	1 3	2 0 (76 $3^\circ$ )
88 0	0 4	0 6 (88 $5^\circ$ )

(Bathrick, J phys Ch 1896, 1 160)

Solubility of  $\text{KNO}_3$  in ethyl alcohol + Aq at  $30^\circ$

% by wt $\text{H}_2\text{O}$	% by wt alcohol	% by wt $\text{KNO}_3$
68 7	0	31 3
69 2	10 1	20 7
67 3	17 0	15 7
64 1	23 8	12 1
58 8	32 2	9 0
50 8	43 1	6 1
39 8	56 9	3 3
33 9	63 8	2 3
22 3	76 8	0 88
7 5	92 3	0 15

(Schrenemakers, Z phys Ch 1909, 65 556)

Solubility in ethyl alcohol at  $25^\circ$

Concentration of alcohol in g mol per l $\text{H}_2\text{O}$	Solubility in 1 l $\text{H}_2\text{O}$	Mol solubility
0	384 48	3 80
$\frac{1}{4}$	368 30	3 64
$\frac{1}{2}$	354 40	3 50
1	327 00	3 22

(Armstrong and Lyre, Proc R Soc 191 (A) 84 127)

Solubility of  $\text{KNO}_3$  in methyl alcohol + Aq at  $30^\circ$

% by wt $\text{H}_2\text{O}$	% by wt alcohol	% by wt $\text{KNO}_3$
68 7	0	31 3
68 9	7 8	23 3
66 4	17 3	16 3
61 0	27 8	11 2
53 9	38 4	7 7
39 2	57 0	3 8
0 99	98 58	0 43

(Schrenemakers, Z phys Ch 1909, 65 556)

Solubility of  $\text{KNO}_3 + \text{AgNO}_3$  in 51.6%  
 $\text{C}_2\text{H}_5\text{OH} + \text{Aq}$  at  $30^\circ$

% $\text{KNO}_3$	% $\text{AgNO}_3$	Solid phase
4.8	0	$\text{KNO}_3$
4.55	5.15	"
4.11	16.47	"
4.26	21.28	$\text{KNO}_3 + \text{AgNO}_3, \text{KNO}_3$
2.62	36.94	$\text{AgNO}_3, \text{KNO}_3 + \text{AgNO}_3$
0	37	$\text{AgNO}_3$

(Schrenemakers, Z phys Ch 1909, 65 556)

100 g 40% ethyl alcohol sat with  $\text{KNO}_3 + \text{NaCl}$  at  $25^\circ$  contain 13.74 g  $\text{KNO}_3 + 15.78$  g  $\text{NaCl}$  (Soch, J phys Ch 1898, 2 43)

Insol in propyl alcohol (Schlamp, Z phys Ch 1894, 14 277)

Almost insol in ether (Braconnot)

Very sl sol in acetone (Krug and M'Elroy)

Sol in acetone (Eidmann, C C 1899 II, 1014)

Solubility in acetone + Aq at  $40^\circ$

Wt % acetone	G $\text{KNO}_3$ per 100 g solvent
0	64.5
8.5	51.3
16.8	38.9
25.2	22.8
34.3	24.7
44.1	17.0
53.9	11.9
64.8	7.2
76.0	3.0
87.6	0.7

(Bathrick, J phys Ch 1896, 1 160)

100 pts glycerine (sp gr 1.225) dissolve 10 pts  $\text{KNO}_3$  (Vogel, N Rep Ph 16 557)

100 g trichlorethylene dissolve 0.01 g  $\text{KNO}_3$  at  $15^\circ$  (Wester and Bruns, Pharm Weekbl 1914, 51 1443)

Insol in  $\text{CS}_2$  (Arctowski, Z anorg 1894, 6 257)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

100 g  $\text{H}_2\text{O}$  sat with sugar and  $\text{KNO}_3$  dissolve 224.7 g sugar + 41.9 g  $\text{KNO}_3$ , or sat solution contains 61.36 g sugar + 11.45 g  $\text{KNO}_3$  at  $31.25^\circ$  (Kohler, Z Ver Zuckerind 1897, 47 447)

**Potassium hydrogen nitrate,  $\text{KNO}_3, \text{HNO}_3$**

Very hygroscopic. Decomp by  $\text{H}_2\text{O}$  (Groschuff, B 1904, 37 1489)

**Potassium dihydrogen nitrate,  $\text{KNO}_3, 2\text{HNO}_3$**

Decomp by  $\text{H}_2\text{O}$  (Ditte, A ch (5) 18 320)

Solubility in  $\text{H}_2\text{O}$

Solution temp	% by wt $\text{KNO}_3$	% by wt $\text{HNO}_3$	% by wt $\text{H}_2\text{O}$
mpt $+22^\circ$	44.5	55.5	0
20.5	44.1	55.0	0.9
18.0	43.8	54.5	1.7
12.0	43.0	53.6	3.4
6.0	42.3	52.7	5.0
0	41.6	51.8	6.6

(Groschuff, Z anorg 1904, 40 11)

**Potassium silver nitrate,  $\text{KNO}_3, \text{AgNO}_3$**

Sol in  $\text{H}_2\text{O}$  (Russell and Maskelyne, Roy Soc Proc 26 357)

$3\text{KNO}_3, \text{AgNO}_3$  Sol in  $\text{H}_2\text{O}$  (Rose, Pogg 106 320)

**Potassium thallic nitrate,  $2\text{KNO}_3, \text{Th}(\text{NO}_3)_3 + \text{H}_2\text{O}$**

Decomp by  $\text{H}_2\text{O}$  (Meyer, Z anorg 1900, 24 361)

**Potassium thorium nitrate,  $4\text{KNO}_3, \text{Th}(\text{NO}_3)_4$**

Very sol in  $\text{H}_2\text{O}$  and alcohol (Berzelius)

Hydroscopic, very unstable (Meyer, Z anorg 1901, 27 379)

Hydroscopic, sol in dil  $\text{HNO}_3 + \text{Aq}$  (Meyer, Z anorg 1901, 27 378)

**Potassium thorium hydrogen nitrate,  $3\text{KNO}_3, \text{Th}(\text{NO}_3)_4, 3\text{HNO}_3$**

Decomp in the air (Meyer, B 1900, 33 2140)

$+4\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  of 1.2 sp gr Effloresces in the air (Meyer, Z anorg 1901, 27 380)

**Potassium uranyl nitrate,  $\text{K}(\text{UO})_2(\text{NO}_3)_3$**

Decomp by  $\text{H}_2\text{O}$  Sol in conc  $\text{HNO}_3$  (Meyer, B 1903, 36 4057)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

t	In 100 pts of the solution			Solid phase
	Pts by wt $\text{UO}$	Pts by wt $\text{K}$	Pts by wt $\text{NO}$	
0.5	31.98	1.72		Double salt + $\text{KNO}_3$
13.0	33.40	2.74		
25.0 a)	37.08	4.05	23.49	
b)	37.06	3.98	23.46	
45.0	42.18	5.16		
59.0	41.67	6.03		
80.6 a)	43.72	6.42		Double salt
b)	43.70	6.34		

Potassium uranyl nitrate is decomp by  $\text{H}_2\text{O}$  at temp below  $60^\circ$ , above  $60^\circ$  it is sol in  $\text{H}_2\text{O}$  without decomp

(Rimbach, B 1904, 37 473)

**Potassium nitrate barium sulphate,  $\text{KNO}_3$ ,  $2\text{BaSO}_4$** 

Easily decomp Sol in conc  $\text{H}_2\text{SO}_4$   
(Silberberger, M 1904, 25 251)

**Potassium nitrate phosphomolybdate**

See Phosphomolybdate nitrate, potassium

**Potassium nitrate sulphate,  $\text{KNO}_3$ ,  $\text{KHSO}_4$** 

Decomp by  $\text{H}_2\text{O}$  and alcohol (Jacquelin)

**Potassium nitrate sulphotungstate,  $2\text{KNO}_3$ ,  $\text{K}_2\text{WS}_4$  (?)**

Very sol in hot or cold  $\text{H}_2\text{O}$  Insol in alcohol (Berzelius)

**Potassium nitrate tungstate (?)**

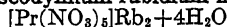
100 pts boiling  $\text{H}_2\text{O}$  dissolve 5 pts salt  
(Storer's Dict, p 393)

**Potassium nitrate zinc iodide**

Permanent Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol (Anthon)

**Praseodymium nitrate,  $\text{Pr}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (von Schule, Z anorg 1898, 18 355)

**Praseodymium rubidium nitrate,**

Hygroscopic (Jantsch, Z anorg 1911, 69 230)

**Praseodymium sodium nitrate,  $\text{Pr}(\text{NO}_3)_3$ ,  $2\text{NaNO}_3 \cdot \text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (von Schule, Z anorg 1898, 18 356)

**Praseodymium zinc nitrate,  $2\text{Pr}(\text{NO}_3)_3$ ,  $3\text{Zn}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$** 

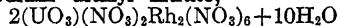
1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1.325) contains 14.69 g hydrous salt at  $16^\circ$   
(Jantsch, Z anorg 1912, 76 321)

**Radium nitrate**

Has apparently the same solubility in  $\text{H}_2\text{O}$  as the corresponding Ba comp (Curie, Dis sert 1903)

**Rhodium nitrate,  $\text{Rh}(\text{NO}_3)_3 \cdot 2\text{H}_2\text{O}$  (?)**

Deliquescent Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Claus)

**Rhodium uranyl nitrate,**

Sol in  $\text{H}_2\text{O}$  and acids, insol in aq alkalis  
(Lancien, C C 1912, I 208)

**Rubidium nitrate,  $\text{RbNO}_3$** 

100 pts  $\text{H}_2\text{O}$  dissolve 20.1 pts at  $0^\circ$ , 43.5 pts at  $10^\circ$  (Bunsen)

**Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$** 

$t^\circ$	G $\text{PbNO}_3$ per 100 g		$t^\circ$	G $\text{RbNO}_3$ per 100 g	
	$\text{H}_2\text{O}$	Solu tion		$\text{H}_2\text{O}$	Sol tic
0	19.5	16.3	60	200	66
10	33.0	24.8	70	251	71
20	53.3	34.6	80	309	75
30	81.3	44.8	90	375	78
40	116.7	53.9	100	452	81
50	155.6	60.9	118.3	617	86

(Berkeley, Trans Roy Soc 1904, 203 207)

100 g  $\text{H}_2\text{O}$  dissolve 66.855 g  $\text{RbNO}_3$  at  $25^\circ$  (Haigh, J Am Chem Soc 1912, 1148)

Sp gr  $20^\circ/4^\circ$  of a normal solution of  $\text{RbNO}_3$  = 1.100835, of a 0.5 normal solution = 1.049 (Haigh, J Am Chem Soc 1912, 34 1151)

Sp gr of  $\text{RbNO}_3 + \text{Aq}$

G-equiv  $\text{RbNO}_3$  per l

at $18^\circ$ =	0.5035	1.006
Sp gr at $6^\circ/6^\circ$	1.05342	1.106
Sp gr at $18^\circ/18^\circ$	1.05226	1.101
Sp gr at $30^\circ/30^\circ$	1.05156	1.102

G-equiv  $\text{RbNO}_3$  per l

at $18^\circ$ =	2.000	2.681
Sp gr at $6^\circ/6^\circ$	1.20655	
Sp gr at $18^\circ/18^\circ$	1.20302	1.270
Sp gr at $30^\circ/30^\circ$	1.20036	1.267

(Clausen, W Ann 1914, (4) 44 1069)

Easily sol in  $\text{HNO}_3$  (Schultz, Zeit (1) (2) 5 531)

Sol in acetone (Eidmann, C C 1899, I 1014, Naumann, B 1904, 37 4328)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

**Rubidium hydrogen nitrate,  $\text{RbNO}_3$ ,  $\text{HNO}_3$** 

Fairly stable in air (Wells, Am Ch J 1901, 26 273)

**Rubidium dihydrogen nitrate,  $\text{RbNO}_3$ ,  $2\text{HNO}_3$** 

Decomp rapidly in air (Wells, Am Ch J 1901, 26 273)

$2\text{RbNO}_3$ ,  $5\text{HNO}_3$  Decomp by  $\text{H}_2\text{O}$   
Known only in solution in  $\text{HNO}_3 + \text{aq}$   
(Ditte, A ch (5) 18 320)

**Rubidium silver nitrate,  $\text{RbNO}_3$ ,  $\text{AgNO}_3$** 

Sol in  $\text{H}_2\text{O}$  (Russell and Maskelyne, R y Soc Proc 26 357)

**Rubidium thorium nitrate,  $\text{Rb}_2\text{Th}(\text{NO}_3)_6$** 

Sl sol in  $\text{HNO}_3$ , decomp by  $\text{H}_2\text{O}$  (Me r, Z anorg 1901, 27 384)

**Rubidium uranyl nitrate,  $\text{Rb}(\text{UO}_2)(\text{NO}_3)_3$** 

Decomp by  $\text{H}_2\text{O}$  Sol in conc  $\text{HNO}_3$   
(Meyer, B 1903, 36 4057)

**Solubility of  $\text{H}_2\text{O}$  at  $t^\circ$** 

$t^\circ$	In 100 pts of the solution				Solid phase
	Pts by wt $\text{UO}_2$	Pts by wt $\text{NO}_3$	Pts by wt Rb	Pts by wt total salt	
25	a) 35 42	19 72	4 63	59 57	Double salt + $\text{RbNO}_3$
80	b) 35 40	19 76	4 67	59 64	Double salt
	a) 34 64		11 01	69 46	
	b) 34 68		11 01	69 52	

Rubidium uranyl nitrate is decomp by  $\text{H}_2\text{O}$  at low temp, at  $80^\circ$  it is sol in  $\text{H}_2\text{O}$  without decomp

(Rumbach, B 1904, 37 476)

**Samarium nitrate,  $\text{Sm}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  (Cleve, C N 48 74)  
Very hygroscopic (Demargay, C R 1900, 130 1187)

**Samarium zinc nitrate,  $2\text{Sm}(\text{NO}_3)_3 \cdot 3\text{Zn}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$** 

1 l sat solution in  $\text{HNO}_3 + \text{Aq}$  (sp gr 1.325) contains 36.47 g hydrous salt at  $16^\circ$  (Jantsch, Z anorg 1912, 76 321)

**Scandium nitrate, basic**

Sol in  $\text{H}_2\text{O}$  (Nilson, B 13 1444)  
 $\text{ScOH}(\text{NO}_3) + \text{H}_2\text{O}$  (Crookes, Roy Soc Proc 1908, 80 A 518)  
 $\text{Sc}_2\text{O}(\text{NO}_3)_4$  (Crookes)

**Scandium nitrate,  $\text{Sc}(\text{NO}_3)_3$** 

(Crookes, Roy Soc Proc 1908, 80 A, 518)  
 $+4\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Crookes)

**Silver nitrate,  $\text{AgNO}_3$** 

100 pts  $\text{H}_2\text{O}$  at  $11^\circ$  dissolve 127.7 pts (Schnauss, Arch Pharm (2) 82 260)

100 pts  $\text{H}_2\text{O}$  dissolve at

$0^\circ$  19.5 54 85 110  
121.9 227.3 500 714 1111 pts  $\text{AgNO}_3$

(Kremers, Pogg 92 497)

100 pts  $\text{H}_2\text{O}$  dissolve 1622.5 pts at  $125^\circ$ , and 1941.4 pts at  $133^\circ$  (Tilden and Shennstone, Phil Trans 1884 23)

Sat solution boils at  $125^\circ$  (Kremers)

**Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$** 

Sat  $\text{AgNO}_3 + \text{Aq}$  contains %  $\text{AgNO}_3$  at  $t^\circ$

$t^\circ$	% $\text{AgNO}_3$	$t^\circ$	% $\text{AgNO}_3$
$-7$	46.2	36.5	75.7
$-7$	46.0	40.5	76.8
$-5$	47.6	45	77.1
$-1$	52.4	48	78.5
$-1$	51.9	73	84.0
$+5$	56.3	122	88.7
10	61.2	134	92.1
15.5	66.1	135	92.8
20	67.8	135	92.7
26	71.1	148	93.3
29	73.0	160	95.2
31	73.8	182	96.9

(Étard, A ch 1894, (7) 2 526)

100 g sat  $\text{AgNO}_3 + \text{Aq}$  at  $15.5^\circ$  contain 65.5 g  $\text{AgNO}_3$  (Greenish and Smith, Pharm Jour 1903, 71 881)

Solubility of  $\text{AgNO}_3$  in  $\text{H}_2\text{O}$  at  $30^\circ = 10.31$  mol-litre (Masson Chem Soc 1911 99)

C. K. = Kohlrausch, rousch by Mendelejeff (Z anal 27 284), and K = Kohlrausch (W Ann 1879 1), containing

	5	10	15	20% $\text{AgNO}_3$
C K	1.041	1.080	1.125	1.160
K M	1.0440	1.0901		1.1969
K	1.0422	1.0893	1.1404	1.1958

	25	30	35	40% $\text{AgNO}_3$
C K	1.206	1.251		
K M				1.4791
K	1.2555	1.3213	1.3945	1.4773

	45	50% $\text{AgNO}_3$
K	1.5705	1.6745

**Sp gr of  $\text{AgNO}_3 + \text{Aq}$  at  $25^\circ$** 

Concentration of $\text{AgNO}_3$	Sp gr
1-normal	1.1386
$1/2$ - "	1.0692
$1/4$ - "	1.0348
$1/8$ - "	1.0173

(Wagner, Z phys Ch 1890, 5 40)

Sol in 500 pts  $\text{HNO}_3$ , 30 pts  $2\text{HNO}_3$ ,  $3\text{H}_2\text{O}$  at  $20^\circ$ , and 6 pts  $2\text{HNO}_3$ ,  $3\text{H}_2\text{O}$  at  $100^\circ$  (Schultz, Zeit Ch 1869 531)  
Insol in conc  $\text{HNO}_3$  (Warren, C C 1897 I, 438)

Solubility of  $\text{AgNO}_3$  in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$ 

G mol per l		G $\text{AgNO}_3$ per l	Sp gr $25^\circ$
$\text{HNO}_3$	$\text{AgNO}_3$		
0	10 31	1752	2 3921
0 404	9 36	1591	2 2754
0 962	8 08	1373	2 1243
1 698	6 54	1111	1 9402
2 834	4 526	769 1	1 7052
4 497	2 590	440 1	1 4980
5 992	1 698	288 6	1 4195
8 84	0 843	143 2	1 3818
12 53	0 347	58 90	1 3976

(Masson, Chem Soc 1911, **99** 1132)

$\text{AgNO}_3 + \text{NH}_4\text{NO}_3$  Solubility of  $\text{AgNO}_3$   
in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  See under  $\text{NH}_4\text{NO}_3$   
 $\text{AgNO}_3 + \text{KNO}_3$  Solubility of  $\text{AgNO}_3$   
+  $\text{KNO}_3$  in  $\text{H}_2\text{O}$  See under  $\text{KNO}_3$

 $\text{AgNO}_3 + \text{AgNO}_2$ Solubility of  $\text{AgNO}_3 + \text{AgNO}_2$  at  $18^\circ$ 

G per l		G per l	
$\text{AgNO}_3$	$\text{AgNO}_2$	$\text{AgNO}_3$	$\text{AgNO}_2$
0 000	3 184	3 512	2 201
0 439	3 042	7 024	1 799
0 878	2 926	14 048	1 480
1 756	2 601		

(Naumann and Rucker, B 1905, **38** 2293)See also under  $\text{AgNO}_2$ Insol in liquid  $\text{CO}_2$  (Buchner, Z phys Ch 1906, **54** 674)Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, **20** 829)

Sol in 4 pts boiling alcohol

Sol in 10 pts alcohol (Dumas)

Sol in 11 pts alcohol of 90% (Hager)

Solubility in 100 pts alcohol of given vol %  
at  $t^\circ$ 

$t^\circ$	95%	80%	70%	60%
15	3 8	10 3	22 1	30 5
50	7 3			58 1
75	18 3	42 0		89 0

$t^\circ$	50%	40%	30%	20%	10%
15	35 8	56 4	73 7	107	158
50		98 3		214	
75		160		340	

(Eder, J pr (2) 17 44)

100 pts absolute methyl alcohol dissolve  
3 72 pts at  $19^\circ$ , 100 pts absolute ethyl alcohol  
dissolve 3 1 pts at  $19^\circ$  (de Bruyn, Z  
phys Ch 10 783)

Only traces are sol in absolute alcohol  
ether 100 pts of a mixture of 1 vol alcohol  
(95 vol %) + 1 vol pure ether dissolve 1  
pts  $\text{AgNO}_3$  at  $15^\circ$ , 100 pts of 2 vols alcohol  
+ 1 vol ether dissolve 2 3 pts  $\text{AgNO}_3$   
(Eder, J pr 1878, (2) 17 45)

Solubility of  $\text{AgNO}_3$  in ethyl alcohol +  
at  $30^\circ$ 

% by wt $\text{H}_2\text{O}$	% by wt alcohol	% by wt $\text{AgNO}_3$
27 0		73 0
27 71	2 8	69 49
30 80	13 67	55 53
32 10	20 13	47 77
31 40	25 85	42 75
28 95	37 26	33 79
27 91	44 54	27 55
20 92	64 42	14 66
6 83	86 54	6 63

(Schreinemakers, Z phys Ch 1909, **65** 57)Solubility of  $\text{AgNO}_3 + \text{KNO}_3$  in alcohol  
See under  $\text{KNO}_3$ Sol in methyl, ethyl, and isobutyl alcohol  
 $\text{CCl}_4$ ,  $\text{CHCl}_3$ , acetone and pyridine (Wilcox,  
J phys Chem 1910, **14** 587)100 pts  $\text{H}_2\text{O}$  sat with ether dissolve 88  
pts  $\text{AgNO}_3$  at  $15^\circ$  (Eder, l c)

Sol in glycerine

Sol in benzonitrile 100 g benzonitrile  
dissolve about 105 g  $\text{AgNO}_3$  at  $18^\circ$  (Naumann  
and Schier, B 1914, **47** 1369)1 pt acetonitrile dissolves about 1 5 p  
 $\text{AgNO}_3$  (Scholl and Steinkopf, B 1906, **4398**)Easily sol in methyl, ethyl, and amine  
(Shinn, J phys Chem 1907, **11** 53)Sol in acetone (Krug and McElroy,  
Anal Ch 6 184)

0 35 pts are sol in 100 pts acetone at 1

0 35 " " " " 100 " " " 5

(Laszyznski, B 1894, **27** 2287)Sol in acetone and in methylal (Lidmar,  
C C 1899, **11** 1014)1 g  $\text{AgNO}_3$  is sol in 227 g acetone at 1  
Sp gr of sat solution  $18^\circ/4^\circ = 0 798$  (Naumann,  
B 1904, **37** 4339)Insol in  $\text{CS}_2$  (Arctowski, Z anorg 18,  
**6** 257)Difficultly sol in methyl acetate (Naumann,  
B 1909, **42** 3790)Insol in methyl acetate (Naumann,  
1909, **42** 3790), ethyl acetate (Naumann,  
B 1904, **37** 3601)Sol in urethane (Castoro, Z anorg 18,  
**20** 61)100 g  $\text{C}_6\text{H}_6$  dissolve 0 022 g  $\text{AgNO}_3$  at 3,  
0 044 g at  $40 5^\circ$  (Linebarger, Am J Sci  
1895, **49** 48)Mol weight determined in piperidine,  
pyridine and benzonitrile (Werner, Z anorg  
1897, **15** pp 17, 23 and 32)

Solubility of  $\text{AgNO}_3$  in pyridine at  $t^\circ$ 

$t^\circ$	G $\text{AgNO}_3$ per 100 g $\text{C}_5\text{H}_5\text{N}$	Solid phase
-48 5°*	0	$\text{C}_5\text{H}_5\text{N}$
-50 5	3	"
-53	6	"
-59	9	"
-65		$\text{C}_5\text{H}_5\text{N} + \text{AgNO}_3, 6\text{C}_5\text{H}_5\text{N}$
-51 25	11 1	$\text{AgNO}_3, 6\text{C}_5\text{H}_5\text{N}$
-44	11 7	"
-40	12 2	"
-35	12 6	"
-30	13 9	"
-25	17 6	"
-24		" + $\text{AgNO}_3, 3\text{C}_5\text{H}_5\text{N}$
-22	18 8	$\text{AgNO}_3, 3\text{C}_5\text{H}_5\text{N}$
-10	20 03	"
0	22 34	"
+10	27 21	"
20	33 64	"
30	40 86	"
40	53 52	"
45	62 26	"
46	63 06	"
47	66 35	"
48	70 85	"
48 5		" + $\text{AgNO}_3, 2\text{C}_5\text{H}_5\text{N}$
45	69 85	$\text{AgNO}_3, 2\text{C}_5\text{H}_5\text{N}$
50	72 25	"
60	78 60	"
70	89 10	"
80	121 21	"
87	215 02	"
80	228 5	"
74	230 6	"
74	235 4	"
80	230 4	"
87	237 1	"
90	241 9	"
100	253 8	"
110	271 4	"

\* M pt

(Kahlenberg and Brewer, J phys Ch 1908, 12 283)

Silver nitrate acetylde,  $\text{AgNO}_3, \text{AgHC}_2$ 

(Willgerodt, B 1895, 28 2108)

 $\text{AgNO}_3, \text{Ag}_2\text{C}_2$  Ppt (Chavastelon, C R 1897, 124 1365) $2\text{AgNO}_3, \text{Ag}_2\text{C}_2$  (Chavastelon)Silver nitrate ammonia,  $\text{AgNO}_3, \text{NH}_3$ Partly sol in  $\text{H}_2\text{O}$ , rather sol in alcohol  
Sl sol in ether (Reychler, B 16 990)Very sol in liquid ammonia below  $-10^\circ$   
(Joannis, C R 1894, 118 1151) $\text{AgNO}_3, 2\text{NH}_3$  Easily sol in  $\text{H}_2\text{O}$  (Mitscherlich)

1 l alcohol dissolves 0.0383 g mols (Kuri-low, C C 1903 II, 97)

 $\text{AgNO}_3, 3\text{NH}_3$  Completely sol in  $\text{H}_2\text{O}$   
(Rose, Pogg 20 153)Silver nitrate antimonide,  $\text{AgNO}_3, \text{Ag}_3\text{Sb}$ Decomp at once by  $\text{H}_2\text{O}$  (Poleck and Thummel, B 16 2435)Silver nitrate arsenide,  $\text{AgNO}_3, \text{Ag}_3\text{As}$ Decomp at once by  $\text{H}_2\text{O}$  (Poleck and Thummel)Silver nitrate bromide,  $\text{AgNO}_3, \text{AgBr}$ Decomp immediately by  $\text{H}_2\text{O}$  or alcohol, with separation of  $\text{AgBr}$  (Russe, A 111 39)Silver nitrate chloride,  $\text{AgNO}_3, \text{AgCl}$ Quickly decomp with  $\text{H}_2\text{O}$ , more slowly with absolute alcohol, not decomp by ether-alcohol (Reichert, J pr 92 237)Silver nitrate cyanide,  $2\text{AgNO}_3, \text{AgCN}$ Decomp by  $\text{H}_2\text{O}$ , not by alcohol (Hellwig, Z anorg 1900, 25 177)Silver nitrate iodide,  $\text{AgNO}_3, \text{AgI}$ Cold  $\text{H}_2\text{O}$  separates  $\text{AgI}$ , which redissolves on heating (Sturenberg, Arch Pharm (2) 143 12) Sol in little  $\text{H}_2\text{O}$  without decomp, more  $\text{H}_2\text{O}$  separates  $\text{AgI}$  (Kremers, J pr 71 54) Insol in absolute alcohol Sol in conc  $\text{AgNO}_3 + \text{Aq}$  $2\text{AgNO}_3, \text{AgI}$  Sol in little but decomp by more boiling  $\text{H}_2\text{O}$  (Russe, A 111 39)Silver nitrate mercuric oxide,  $\text{AgNO}_3, 2\text{HgO}$ Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  (Finci, Gazz ch it 1910, 41 (2) 548)Silver nitrate phosphide,  $3\text{AgNO}_3, \text{Ag}_3\text{P}$ 

(Warren, C N 56 113)

Silver nitrate silicide,  $4\text{AgNO}_3, \text{AgSi}$ 

(Buchner, Ch Ztg 9 484)

Silver nitrate silicate,  $2\text{AgNO}_3, 3\text{Ag}_2\text{SiO}_4$ Sol in dil  $\text{HNO}_3 + \text{Aq}$ , but  $\text{SiO}_2$  separates out after heating (Rousseau and Tite, C R 114 294)Silver nitrate sulphide,  $\text{AgNO}_3, \text{Ag}_2\text{S}$ Decomp by  $\text{H}_2\text{O}$  (Poleck and Thummel, B 16 2435)Silver nitrate sulphocyanide,  $2\text{AgNO}_3, \text{AgSCN}$ Decomp by  $\text{H}_2\text{O}$ , not by alcohol (Hellwig, Z anorg 1900, 25 178)Sodium nitrate,  $\text{NaNO}_3$ Deliquescent in moist air Sol in  $\text{H}_2\text{O}$  with absorption of heat 75 pts  $\text{NaNO}_3$  mixed with 100 pts  $\text{H}_2\text{O}$  at  $13.2^\circ$  lower the temperature  $18.5^\circ$  (Rudorff, B 2 68)

Sol in 1 58 pts H <sub>2</sub> O at -6°	}	(Marx)	
0 46 +119°			
2 89 2°	}	(Osann)	
1 12 28°			
0 79 47°	}	(Kopp)	
1 14 18 5			
1 136 18 75	}	(Karsten)	
1 16 20°			
2 18 7°	(Schiff A 109 326)		
	(Abl)		

100 pts H <sub>2</sub> O at t° dissolve pts NaNO <sub>3</sub>			
t°	Pts NaNO <sub>3</sub>	t	Pts NaNO <sub>3</sub>
—6	68 80	50	111 13
0	79 75	60	119 94
10	84 30	70	129 63
16	87 63	80	140 72
20	89 55	90	153 63
30	95 37	100	168 20
40	102 31	120	225 30

(Poggiale, A ch (3) 8 469)

100 pts H<sub>2</sub>O at 119° dissolve 150 pts NaNO<sub>3</sub> (Grif fiths)  
 NaNO<sub>3</sub>+Aq sat at 18 75° has 1 3769 sp gr and 100 pts H<sub>2</sub>O have dissolved 88 001 pts NaNO<sub>3</sub> (Karsten)

NaNO<sub>3</sub>+Aq sat in cold contains 33 3% NaNO<sub>3</sub> (Fourcroy)

NaNO<sub>3</sub>+Aq sat at 12 5° contains 34% NaNO<sub>3</sub> (Hassenfratz)

100 pts H<sub>2</sub>O at 15 5° dissolve 33 pts at 52° 100 pts NaNO<sub>3</sub> (Ure s Diet)

100 pts H<sub>2</sub>O dissolve pts NaNO<sub>3</sub> at t°

t	Pts NaNO <sub>3</sub>	t°	Pts NaNO <sub>3</sub>
0	73 0	60 65	125 5
13 9	81 6	99 9	173 6
44 65	110 5	119 7	211 4

(Nordenskjold, Pogg 136 312)

100 pts H<sub>2</sub>O dissolve pts NaNO<sub>3</sub> at t°

t°	Pts NaNO <sub>3</sub>	t°	Pts NaNO <sub>3</sub>
0	70 94	70	142 31
10	78 57	80	153 72
20	87 97	90	165 55
30	98 26	100	178 18
40	109 01	110	194 26
50	120 00	119 4	213 43
60	131 11		

(Maumené, C R 58 81)

100 pts NaNO<sub>3</sub>+Aq sat at 14° contain 43 88 pts NaNO<sub>3</sub>, at 15°, 44 53 pts NaNO<sub>3</sub> (v Hauer, J pr 98 137)

100 pts H<sub>2</sub>O dissolve 84 21–84 69 pts NaNO<sub>3</sub> at 15 6°, and sat solution has sp gr 1 337–1 378 (Page and Keightley, Chem Soc (2) 10 556)

100 pts H<sub>2</sub>O dissolve pts NaNO<sub>3</sub> at t°

t°	Pts NaNO <sub>3</sub>	t°	Pts NaNO <sub>3</sub>
0	66 69	18	83 62
2	70 97	21	85 73
4	71 04	26	90 33
8	75 65	29	92 93
10	76 31	36	99 39
13	79 00	51	113 63
15	80 60	68	125 07

Solubility is constant from 0° to —15 7°, when NaNO<sub>3</sub>+7H<sub>2</sub>O separates out (Ditte, C R 80 1164)

Solubility in 100 pts H<sub>2</sub>O at t°

t°	Pts NaNO <sub>3</sub>	t°	Pts NaN
0	72 9	60	122
1	74 7	61	124
2	75 4	62	125
3	76 0	63	126
4	76 7	64	127
5	77 4	65	128
6	78 1	66	130
7	78 7	67	131
8	79 4	68	132
9	80 1	69	133
10	80 8	70	134
11	81 4	71	136
12	82 0	72	137
13	82 7	73	138
14	83 4	74	139
15	84 0	75	140
16	84 7	76	142
17	85 4	77	143
18	86 1	78	145
19	86 8	79	146
20	87 5	80	148
21	88 3	81	149
22	89 0	82	151
23	89 7	83	152
24	90 3	84	153
25	91 0	85	155
26	91 8	86	156
27	92 5	87	158
28	93 2	88	159
29	94 0	89	161
30	94 9	90	162
31	96 0	91	164
32	96	92	166
33	97	93	168
34	98	94	169
35	99	95	171
36	100	96	173
37	100	97	175
38	101	98	177
39	102	99	178
40	102	100	180
41	103	101	182
42	104	102	184
43	105	103	186
44	106	104	188
45	107	105	190
46	108	106	192
47	109	107	194
48	110	108	196
49	111	109	198
50	112	110	200
51	113	111	202
52	114	112	204
53	115	113	207
54	116	114	209
55	117	115	211
56	118	116	213
57	119	117	215
58	120	117 5	216 4
59	211		

(Mulder, Scheik Verhandel 1864 83)

Sat solution at b pt contains 216.4 pts  $\text{NaNO}_3$  (Mulder) 218.5 pts  $\text{NaNO}_3$  (Marx) 213.4 pts  $\text{NaNO}_3$  (Maumené) 211.4 pts  $\text{NaNO}_3$  (Nordenskjöld) 224.8 pts  $\text{NaNO}_3$  (Legrand) 150 pts  $\text{NaNO}_3$  (Griffiths)

Sat  $\text{NaNO}_3 + \text{Aq}$  contains at  
 120° 130° 172° 180° 199°  
 66.8 67.5 77.1 78.1 82.0%  $\text{NaNO}_3$ ,

220° 250° 255° 290° 313° (mpt)  
 83.5 89.5 91.5 97.5 100%  $\text{NaNO}_3$   
 (Étard, A ch 1894, (7) 2 527)

100 g sat  $\text{NaNO}_3 + \text{Aq}$  contain 42.47 g  $\text{NaNO}_3$  at 0° (Coppadoro, Rass Mm 1911, XVII, 35 123)

100 g sat  $\text{NaNO}_3 + \text{Aq}$  contain 49.16 g  $\text{NaNO}_3$  at 30° (Coppadoro, Rass Mm 1912, 37 7)

100 g  $\text{H}_2\text{O}$  dissolve 92.14 g  $\text{NaNO}_3$  at 25° (Haigh, J Am Chem Soc 1912, 34 1148)

The solubility of crystals on different faces has been determined by Lebrun (Belg Acad Bull 1913 953)

#### Sp gr of $\text{NaNO}_3 + \text{Aq}$ at 19.5°

% $\text{NaNO}_3$	Sp gr	% $\text{NaNO}_3$	Sp gr
12.057	1.0844	39.860	1.3176
22.726	1.1667	46.251	1.3805
31.987	1.2450		

(Kremers, Pogg 95 120)

#### Sp gr of $\text{NaNO}_3 + \text{Aq}$ at 20.2°

% $\text{NaNO}_3$	Sp gr	% $\text{NaNO}_3$	Sp gr
1	1.0065	26	1.1904
2	1.0131	27	1.1987
3	1.0197	28	1.2070
4	1.0264	29	1.2154
5	1.0332	30	1.2239
6	1.0399	31	1.2325
7	1.0468	32	1.2412
8	1.0537	33	1.2500
9	1.0606	34	1.2589
10	1.0676	35	1.2679
11	1.0746	36	1.2770
12	1.0817	37	1.2863
13	1.0889	38	1.2958
14	1.0962	39	1.3055
15	1.1035	40	1.3155
16	1.1109	41	1.3225
17	1.1184	42	1.3355
18	1.1260	43	1.3456
19	1.1338	44	1.3557
20	1.1418	45	1.3659
21	1.1498	46	1.3761
22	1.1578	47	1.3864
23	1.1659	48	1.3968
24	1.1740	49	1.4074
25	1.1822	50	1.4180

(Schriff, calculated by Gerlach, Z anal 8 280)

#### Sp gr of $\text{NaNO}_3 + \text{Aq}$ at 18°

% $\text{NaNO}_3$	Sp gr	% $\text{NaNO}_3$	Sp gr
5	1.0327	20	1.1435
10	1.0681	30	1.2278

(Kohlrausch, W Ann 1879 1)

Sp gr of  $\text{NaNO}_3 + \text{Aq}$  at 20°, containing mols  $\text{NaNO}_3$  in 100 mols  $\text{H}_2\text{O}$

Mols $\text{NaNO}_3$	Sp gr
2	1.05980
5	1.13813

(Nicol, Phil Mag (5) 16 122)

The saturated solution boils at 117.5° (Mulder)  
 118.9° (Griffiths)  
 119° (Marx)  
 119.4° (Maumené)  
 119.7° (Nordenskjöld)  
 121° (Legrand)  
 122–123° (Kremers)

$\text{NaNO}_3 + \text{Aq}$  forms a crust at 118°, and contains 194 pts  $\text{NaNO}_3$  to 100 pts  $\text{H}_2\text{O}$ , highest temp observed, 120.5° (Gerlach, Z anal 26 427)

B-pt of  $\text{NaNO}_3 + \text{Aq}$  containing pts  $\text{NaNO}_3$  to 100 pts  $\text{H}_2\text{O}$  G=according to Gerlach (Z anal 26 433), L=according to Legrand (A ch (2) 59 431)

B pt	G	L	B pt	G	L
101°	9	9.3	112°	121.5	120.3
102	18.5	18.7	113	133	131.3
103	28	28.2	114	144.5	142.4
104	38	37.9	115	156	153.7
105	48	47.7	116	168.5	165.2
106	58	57.6	117	181	176.8
107	68	67.7	118	194	188.6
108	78.5	77.9	119	207.5	200.5
109	89	88.3	120	222	212.6
110	99.5	98.8	121		224.8
111	110.5	109.5			

50 pts  $\text{NaNO}_3$  mixed with 100 pts snow at —1° gave a temp of —17.5° (Rudorff, Pogg 122 337)

#### Sp gr of $\text{NaNO}_3 + \text{Aq}$ at t°

G $\text{NaNO}_3$ dissolved in 100 g $\text{H}_2\text{O}$	G $\text{NaNO}_3$ in 100 g of the solution	t	Sp gr
4.166	4	17.8°	1.0276
11.111	10	13.9°	1.0704
25.000	20	12°	1.1441

(de Lannoy, Z phys Ch 1895, 18 465)



Sp gr of  $\text{NaNO}_3 + \text{Aq}$  at  $20^\circ$ , when  $p$  = per cent strength of sol,  $d$  = observed density,  $w$  = volume conc in grams per cc ( $\frac{pd}{100} = w$ )

$p$	$d$	$w$
42 05	1 3380	0 56267
35 65	1 2765	0 45510
31 72	1 2407	0 39365
23 24	1 1696	0 27180
17 370	1 1228	0 19505
11 915	1 0819	0 12888
9 665	1 0656	0 10300
7 039	1 0468	0 07369
4 241	1 0273	0 04357
1 589	1 0096	0 01604

(Barnes, J phys Chem 1898, 2 545)

Sp gr  $20^\circ/4^\circ$  of a normal solution of  $\text{NaNO}_3$  = 1 05386, of a 0 5 normal solution = 1 02646 (Haugh, J Am Chem Soc 1912, 34 1151)

Sp gr of sat  $\text{NaNO}_3 + \text{Aq}$  at  $t^\circ$

$t^\circ$	G $\text{NaNO}_3$ sol in 100 g $\text{H}_2\text{O}$	Sp gr
-10	68 0	1 342
0	43 0	1 358
10	80 5	1 377
20	88 0	1 387
30	96 2	1 406
40	104 9	1 418
50	114 0	1 437
60	124 6	1 456
70	136 0	1 467

(Tschernaj, J Russ Phys Chem Soc 1912, 44 1565)

Sol in 66 pts  $\text{HNO}_3$ , in 32 pts  $2\text{HNO}_3$ ,  $3\text{H}_2\text{O}$  at  $32^\circ$ , in 4 pts  $2\text{HNO}_3$ ,  $3\text{H}_2\text{O}$  at  $123^\circ$  (Schultz, Zeit Ch (2) 5 531)

Solubility in  $\text{HNO}_3 + \text{Aq}$  at  $0^\circ$

G per 100 cc of solution		Sp gr
$\text{NaNO}_3$	$\text{HNO}_3$	
56 5	0 00	1 341
54 2	1 67	1 338
51 48	3 59	1 331
48 42	5 55	1 324
44 88	7 92	1 312
41 44	10 65	1 308
33 61	17 02	1 291
29 86	20 33	1 285
26 46	23 48	1 282
20 00	30 26	1 276
15 32	36 09	1 276
10 97	44 76	1 291

(Engel, C R 1887, 104 911)

Solubility of  $\text{NaNO}_3$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $1^\circ$

G per 100 g $\text{H}_2\text{O}$		Sp gr
$\text{NH}_3$	$\text{NaNO}_3$	
13 87	75 03	1 253
17 28	73 99	1 233
20 38	73 18	1 212

(Fedotieff and Koltunoff, Z anorg 1914, 5 251)

$\text{NaNO}_3 + \text{Na}_2\text{CO}_3$  (See  $\text{Na}_2\text{CO}_3$ )

Sol in sat  $\text{NH}_4\text{Cl} + \text{Aq}$

Very rapidly sol in sat  $\text{BaCl}_2 + \text{Aq}$  with pptn of  $\text{Ba}(\text{NO}_3)_2$

Sol in sat  $\text{KCl} + \text{Aq}$ , with formation of  $\text{KNO}_3$

Sol in sat  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (See  $\text{NH}_4\text{NO}_3$ )

Sol in sat  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$ , with partial pptn of  $\text{Ba}(\text{NO}_3)_2$  (See  $\text{Ba}(\text{NO}_3)_2$ )

Sol in sat  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ , with subsequent pptn of  $\text{Pb}(\text{NO}_3)_2$  (See  $\text{Pb}(\text{NO}_3)_2$ )

$\text{NaNO}_3 + \text{KNO}_3$

Sol in sat  $\text{KNO}_3 + \text{Aq}$ , solution thus made at  $18^\circ$  contains 54 33% mixed salt, or 100 pts  $\text{H}_2\text{O}$  dissolve 118 98 pts mixed salt, or 89 53 pts  $\text{NaNO}_3$  and 29 45 pts  $\text{KNO}_3$  (See  $\text{KNO}_3$ )

$\text{NaNO}_3 + \text{Sr}(\text{NO}_3)_2$

If  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  sat at  $14 5^\circ$  is sat with  $\text{NaNO}_3$ , 100 pts  $\text{H}_2\text{O}$  dissolve

$\text{NaNO}_3$	83 7	66 4	62 )
$\text{Sr}(\text{NO}_3)_2$		51 0	
117 4			

(Mulder)

$\text{NaNO}_3 + \text{NaNO}_2$  See under  $\text{NaNO}_2$

$\text{NaNO}_3 + \text{NaCl}$

100 pts  $\text{H}_2\text{O}$  dissolve 24 91 pts  $\text{NaNO}_3$  + 54 55 pts  $\text{NaNO}_2$  = 79 46 pts of the two salts at  $20^\circ$  (Nicol, Phil Mag (5) 31 386)

100 pts  $\text{H}_2\text{O}$  dissolve at  $18 75^\circ$

	1	2	3	4	5	6
$\text{NaCl}$	36	25 22	24 96	24 98		4 6
$\text{NaNO}_3$		52 89	52 84	52 82	86 6	6 8

2 Sat  $\text{NaCl} + \text{Aq}$  treated with  $\text{NaNO}_3$

3 Sat  $\text{NaNO}_3 + \text{Aq}$  treated with  $\text{NaCl}$

4 Simultaneous treatment of the two salts by  $\text{H}_2\text{O}$  (Karsten)

6 Excess of both salts +  $\text{Aq}$  warmed and cooled to  $20^\circ$  (Rudorff, B 6 484)

Solubility of NaCl with addition of NaNO<sub>3</sub> at 15°

Sp gr	100 ccm contain in g		
	NaCl	H <sub>2</sub> O	NaNO <sub>3</sub>
1 2025	31 78	98 47	0 00
1 2305	27 89	87 63	7 53
1 2580	26 31	86 25	13 24
1 2810	23 98	82 66	21 58
1 3090	22 30	80 42	28 18
1 3345	20 40	79 25	33 80
1 3465	19 40	77 37	37 88
1 3465	19 67	77 34	37 64

NaNO<sub>3</sub> separated in last two solutionsSolubility of NaNO<sub>3</sub> with addition of NaCl at 15°

Sp gr	100 ccm contain in g		
	NaNO <sub>3</sub>	H <sub>2</sub> O	NaCl
1 3720	62 38	74 82	0
1 3645	56 56	75 69	4 00
1 3585	52 09	75 71	7 24
1 3530	47 08	76 86	11 36
1 3495	42 66	76 96	15 33
1 3485	39 90	77 14	17 81
1 3485	38 73	77 15	18 97
1 3485	38 02	77 49	19 34

NaCl separated in last two solutions  
(Bodlander, Z phys Ch 7 360)Solubility of NaNO<sub>3</sub> in NaCl+Aq at 15°

Sp gr	G per 100 cc sat solution		
	NaCl	NaNO <sub>3</sub>	H <sub>2</sub> O
1 3720	0	62 38	74 82
1 3645	4 0	56 76	75 69
1 3585	7 24	52 09	75 71
1 3530	11 36	47 08	76 86
1 3495	15 33	42 66	76 96
1 3485	17 81	39 90	77 14
1 3485	18 97*	38 73*	77 15
1 3485	19 34*	38 02*	77 49

\* Solutions sat with both salts  
(Bodlander, Z phys Ch 1891, 7 361)Solubility of NaNO<sub>3</sub>+NaCl (g in 100 g H O) at 25°

NaNO <sub>3</sub>	NaCl	Solid phase
79 20	8 39	NaNO <sub>3</sub>
68 38	16 32	"
56 56	23 74	NaNO <sub>3</sub> +NaCl
39 20	27 56	NaCl
20 17	31 48	"

(Uyeda, Mem Col Sc Kyoto, 1910, 2 245)

Solubility in NaCl+Aq at 20°, 30°, 40° and 91° Tables given in the original show that each salt diminishes the solubility of the other (Leather, Mem Dept Agric India, 1914, 3 177, Chem Soc 1915, 108 (2) 13)  
See also under NaClNaNO<sub>3</sub>+NaOHSolubility in NaOH+Aq at 0° NaNO<sub>3</sub>=  
mols NaNO<sub>3</sub> (in mg) in 10 ccm of solution,  
Na<sub>2</sub>O=mols Na<sub>2</sub>O (in mg) in 10 ccm of solution

NaNO <sub>3</sub>	Na <sub>2</sub> O	NaNO <sub>3</sub> +Na <sub>2</sub> O	Sp gr
66 4	0	66 4	1 341
62 5	2 875	65 375	1 338
57 15	6 1	63 25	1 333
47 5	12 75	60 25	1 327
29 5	26	55 5	1 326
17 5	39	56 5	1 332
13 19	45 875	59 065	1 356
6 05	60 875	66 925	1 401

(Engel, Bull Soc (3) 6 16)

## Solubility in NaOH+Aq at 0°

G per 100 cc solution		Sp gr
NaOH	NaNO <sub>3</sub>	
0 0	56 50	1 341
2 30	53 19	1 338
4 89	48 63	1 333
10 21	40 42	1 327
20 83	25 10	1 326
31 25	14 89	1 332
36 76	11 22	1 356
48 75	5 15	1 401

(Engel, l c)

Easily sol in K<sub>2</sub>SO<sub>4</sub>+Aq without pptn  
Easily sol in Na<sub>2</sub>SO<sub>4</sub>+Aq without pptn  
Sol in MgSO<sub>4</sub>+Aq, at first to a clear solution, but afterwards NaNO<sub>3</sub> is pptd  
Very sol in sat CuSO<sub>4</sub>+Aq, but double sulphate separates out  
Very sol in ZnSO<sub>4</sub>+Aq with pptn of double sulphate (Karsten)Solubility of NaNO<sub>3</sub> in Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>+Aq at t°

t	% NaNO <sub>3</sub>	% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	Solid phase
9	33 31	12 26	NaNO <sub>3</sub>
	22 57	23 41	" + Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , 5H <sub>2</sub> O
	4 22	34 77	Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , 5H <sub>2</sub> O
25	35 42	12 72	NaNO <sub>3</sub>
	25 40	24 25	"
	19 90	31 81	" + Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , 5H <sub>2</sub> O
	18 02	32 83	Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , 5H <sub>2</sub> O
	4 33	40 50	"

(Kremann and Rothmund, Z anorg 1914, 86 373)

Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Easily sol in liquid  $\text{HF}$  (Franklin, Z anorg 1905, 46 2)

Hydrazine dissolves 26.6 pts  $\text{NaNO}_3$  at  $12.5-13^\circ$  (de Bruyn, R t c 1899, 18 297)

100 pts alcohol of 0.9 sp gr dissolve 10.5 pts  $\text{NaNO}_3$  0.872 sp gr 6 pts 0.834 sp gr 0.38 pt insol in alcohol of 0.817 sp gr (Kirwan)

100 pts alcohol of 61.4% by weight dissolve 21.2 pts  $\text{NaNO}_3$  at  $26^\circ$  (Pohl W A B 6 600)

100 pts alcohol of 62° Tr dissolve 7.4 pts  $\text{NaNO}_3$  at  $19.5^\circ$

100 pts alcohol of 93° Tr dissolve 0.93 pt  $\text{NaNO}_3$  at  $19.5^\circ$  (Wittstein)

100 pts alcohol containing % alcohol by weight dissolve pts  $\text{NaNO}_3$  at  $15^\circ$ , or 100 pts solution contain %  $\text{NaNO}_3$

10	20	30	40	60	80% alcohol
65.3	48.8	35.5	25.8	11.4	2.8 pts $\text{NaNO}_3$
39.5	32.8	26.2	20.5	10.2	2.7% $\text{NaNO}_3$

(Schiff)

100 pts wood-spirit of 40% dissolve 32.3 pts  $\text{NaNO}_3$  (Schiff, A 118 365)

#### Solubility in alcohol at $16.5^\circ$

Sp gr	100 ccm contain in g		
	Alcohol	Water	$\text{NaNO}_3$
1 3745	0	75 25	62 20
1 3162	6 16	70 82	54 64
1 2576	11 60	68 10	46 06
1 2140	16 49	65 04	39 87
1 1615	22 17	61 67	32 31
1 0855	32 22	52 92	23 41
1 0558	37 23	48 50	19 85
1 0050	43 98	42 78	13 74
0 9420	52 60	32 13	9 47
0 9030	60 00	25 65	4 65
0 8610	63 16	21 31	1 63

(Bodlander, Z phys Ch 7 317)

100 pts absolute methyl alcohol dissolve 0.41 pt at  $25^\circ$

100 pts absolute ethyl alcohol dissolve 0.036 pt at  $25^\circ$  (de Bruyn, Z phys Ch 10 783)

#### Solubility in alcohol at $40^\circ$

Wt % alcohol	G $\text{NaNO}_3$ per 100 g alcohol + Aq
0	104.5
8 22	90.8
17 4	73.3
26 0	61.6
36 0	48.4
42 8	40.6
55 3	27.1
65 1	18.1
77 0	9.4
87 2	4.2

(Bathrick, J phys Ch 1896, 1 162)

#### Solubility in alcohol at $30^\circ$

Wt % alcohol in solvent	G $\text{NaNO}_3$ per 100 g	
	Solution	Water
0	49 10	96 45
5	46 41	91 15
10	43 50	85 55
20	37 42	74 75
30	31 31	65 10
40	25 14	55 95
50	18 94	46 75
60	12 97	37 25
70	7 81	28 25
90	1 21	12 25

(Taylor, J phys Ch 1897, 1 723)

#### Solubility in ethyl alcohol at $25^\circ$

(Concentration of alcohol in g mol er 1000 g  $\text{H}_2\text{O}$ )

Normality	Solubility in 1000 g $\text{H}_2\text{O}$	Mol solub
	920 30	10 83
$\frac{1}{4}$	908 80	10 70
$\frac{1}{2}$	896 60	10 54
1	870 95	10 24
2	825 35	9 70

(Armstrong and Eyre, Proc R Soc 1910 ( ), 84 127)

Very sl sol in acetone (Klug and M J-roy, J Anal Ch 6 184)

#### Solubility of $\text{NaNO}_3$ in acetone at $40^\circ$

Wt % acetone	G $\text{NaNO}_3$ per 100 g acetone + Aq
0 0	105
8 47	91 2
16 8	78 3
25 2	66 4
34 3	57 9
44 1	46 2
53 9	32 8
64 8	23 0
76 0	10 8
87 6	3 2

(Bathrick, J phys Ch 1896, 1 162)

Solubility of  $\text{NaNO}_3$  in acetone at  $30^\circ$ 

Wt % acetone in solvent	G $\text{NaNO}_3$ per 100 g	
	Solution	Water
0	49 10	96 45
5	46 96	93 20
9 09	45 11	90 40
20	40 10	83 70
30	35 08	77 20
40	29 80	70 75
50	24 34	64 40
60	18 55	59 95
70	13 15	50 50
80	7 10	38 20
90	1 98	20 20

(Taylor, Z phys Ch 1897, 2 723)

Sol in glycerine

Insol in ethylamine (Shunn, J phys Chem 1907, 11 538)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Sodium thorium nitrate,  $\text{NaTh}(\text{NO}_3)_8 + 9\text{H}_2\text{O}$ Hydroscopic, sol in dil  $\text{HNO}_3$  and Aq (Meyer, Z anorg 1901, 27 331)Sodium nitrate sulphate,  $\text{NaNO}_3, \text{Na}_2\text{SO}_4 + \frac{3}{2}\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  (Marignac, Ann Min (5) 12 44)+  $\text{H}_2\text{O}$  Min DarapskiteSodium nitrate tungstosilicate,  $3\text{Na}_4\text{W}_{12}\text{SiO}_{40} + 4\text{NaNO}_3 + 45\text{H}_2\text{O}$ 

(Wyruboff, Chem Soc 1897, 72 (2) 174)

Strontium nitrate,  $\text{Sr}(\text{NO}_3)_2$ Sol in 5 pts cold and 0.5 pt boiling  $\text{H}_2\text{O}$  (Dumas) 2 05 (Wittstein)100 pts sat  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $19-20^\circ$  contain 45.49 pts  $\text{Sr}(\text{NO}_3)_2$  (v Hauer J pr 98 137)1 pt  $\text{Sr}(\text{NO}_3)_2$  dissolves in pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{H}_2\text{O}$	$t^\circ$	Pts $\text{H}_2\text{O}$	$t^\circ$	Pts $\text{H}_2\text{O}$
0	2 32	25	1 10	75	0 99
10	1 73	50	1 02	100	0 94

(Kremers Pogg 92 499)

100 pts  $\text{H}_2\text{O}$  dissolve at  $0^\circ$ , 39.5 pts  $\text{Sr}(\text{NO}_3)_2$  (Mulder), at  $0^\circ$ , 40.16 pts  $\text{Sr}(\text{NO}_3)_2$  (Poggiale), at  $0^\circ$ , 43.1 pts  $\text{Sr}(\text{NO}_3)_2$  (Kremers), at  $100^\circ$ , 101.1 pts  $\text{Sr}(\text{NO}_3)_2$  (Mulder), at  $100^\circ$ , 106.5 pts  $\text{Sr}(\text{NO}_3)_2$  (Kremers, Pogg 92 499), at  $100^\circ$ , 119.25 pts  $\text{Sr}(\text{NO}_3)_2$  (Poggiale)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{Sr}(\text{NO}_3)_2$	$t^\circ$	Pts $\text{Sr}(\text{NO}_3)_2$	$t$	Pts $\text{Sr}(\text{NO}_3)_2$
0	39 5	36	90 7	73	96 0
1	41 2	37	90 8	74	96 2
2	42 8	38	91 0	75	96 4
3	44 3	39	91 1	76	96 5
4	45 8	40	91 3	77	96 7
5	47 3	41	91 4	78	96 8
6	48 8	42	91 5	79	97 0
7	50 3	43	91 6	80	97 2
8	51 8	44	91 8	81	97 4
9	53 4	45	91 9	82	97 5
10	54 9	46	92 1	83	97 7
11	56 5	47	92 2	84	97 9
12	58 0	48	92 3	85	98 0
13	59 6	49	92 5	86	98 2
14	61 2	50	92 6	87	98 4
15	62 8	51	92 8	88	98 6
16	64 4	52	92 9	89	98 8
17	66 0	53	93 1	90	99 0
18	67 6	54	93 2	91	99 2
19	69 2	55	93 4	92	99 4
20	70 8	56	93 5	93	99 6
21	72 5	57	93 6	94	99 8
22	74 1	58	93 8	95	100 0
23	75 8	59	93 9	96	100 2
24	77 4	60	94 0	97	100 4
25	79 0	61	94 2	98	100 6
26	80 7	62	94 3	99	100 9
27	82 4	63	94 5	100	101 1
28	84 1	64	94 6	101	101 3
29	85 8	65	94 8	102	101 6
30	87 6	66	94 9	103	101 8
31	89 5	67	95 1	104	102 0
31 3	90 0	68	95 2	105	102 3
32	90 2	69	95 4	106	102 5
33	90 3	70	95 6	107	102 7
34	90 5	71	95 7	107 9	102 9
35	90 6	72	95 9		

(Mulder, Scheik Verhandel 1864 114)

Sat  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  contains at

$-6^\circ$   $+14^\circ$   $20^\circ$   $32^\circ$   
 24.5 35.9 39.8 46.9%  $\text{SrNO}_3$ ,

$53^\circ$   $56^\circ$   $76^\circ$   $94^\circ$   $110^\circ$   
 47.2 47.8 49.1 50.4 50.2%  $\text{SrNO}_3$

(Etard, A ch 1894, (7) 2 528)

79.27 g anhydrous  $\text{Sr}(\text{NO}_3)_2$  are sol in 100 g  $\text{H}_2\text{O}$  at  $25^\circ$  (Parsons and Carson, J Am Chem Soc 1910, 32 1385)

Solubility of  $\text{Sr}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	G $\text{Sr}(\text{NO}_3)_2$ in 100 g $\text{H}_2\text{O}$	Sp gr
0 58	40 124	1 2856
14 71	60 867	1 3938
26 40	82 052	1 4883
29 06	87 648	1 5110
30 28	88 577	1 5144
32 58	88 943	1 5141
39 74	90 086	1 5128
47 73	91 446	1 5115
61 34	93 856	1 5105
68 96	95 576	1 5106
78 98	97 865	1 5109
88 94	100 136	1 5117

(Berkeley and Appleby, Proc R Soc 1911,  
(A) 85 503)

100 g of the sat solution contain at  $20^\circ$ ,  
41.43 g  $\text{Sr}(\text{NO}_3)_2$  (Findlay, Chem Soc  
1914, 105 782)

Sp gr of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $19.5^\circ$ 

$\text{Sr}(\text{NO}_3)_2$	Sp gr	$\text{Sr}(\text{NO}_3)_2$	Sp gr
1	1 009	21	1 192
2	1 017	22	1 202
3	1 025	23	1 213
4	1 034	24	1 223
5	1 041	25	1 233
6	1 049	26	1 246
7	1 059	27	1 257
8	1 068	28	1 268
9	1 076	29	1 280
10	1 085	30	1 292
11	1 095	31	1 304
12	1 103	32	1 316
13	1 113	33	1 330
14	1 122	34	1 340
15	1 131	35	1 354
16	1 140	36	1 367
17	1 150	37	1 381
18	1 160	38	1 395
19	1 170	39	1 410
20	1 181	40	1 422

(Kremers, calculated by Gerlach, Z anal 8  
286)

Sp gr of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $23.4^\circ$  a=no of  
grms  $\times \frac{1}{2}$  mol wt dissolved in 1000  
grms  $\text{H}_2\text{O}$ , b=sp gr if a is  $\text{Sr}(\text{NO}_3)_2$ ,  
 $4\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol wt = 142, c=sp gr if a is  
 $\text{Sr}(\text{NO}_3)_2$ ,  $\frac{1}{2}$  mol wt = 106

a	b	c	a	b	c
1	1 078	1 081	5	1 303	1 350
2	1 146	1 155	6	1 345	1 407
3	1 205	1 224	7	1 383	
4	1 257	1 284			

(Favre and Valson, C R. 79 968)

Sp gr of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $17.5^\circ$ 

% $\text{Sr}(\text{NO}_3)_2$	Sp gr	% $\text{Sr}(\text{NO}_3)_2$	Sp gr
10	1 083	40	1 422
20	1 180	Sat sol	1 52
30	1 294		

(Gerlach, Z anal 27 283)

Sp gr of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	% $\text{Sr}(\text{NO}_3)_2$	Sp gr
14 $0^\circ$	5	1 0420
14 $3^\circ$	10	1 0859
14 $5^\circ$	15	1 1319
14 $5^\circ$	20	1 1816
14 $5^\circ$	25	1 2364
14 $4^\circ$	34 33	1 3470

(Long, W Ann 1880, 11 39)

Sp gr of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at room tem  
containing

10 29 21 19 32 61%  $\text{Sr}(\text{NO}_3)_2$   
1 0885 1 124 1 3067

(Wagner, W Ann 1883, 18 266)

Sp gr of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ 

Concentration of $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$	Sp gr
1-normal	1 0822
$\frac{1}{2}$ -normal	1 0419
$\frac{1}{4}$ -normal	1 0208
$\frac{1}{8}$ -normal	1 0104

(Wagner, Z phys Ch 1890, 5 40)

$\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  containing 10.50%  $\text{Sr}(\text{NO}_3)_2$   
has sp gr  $20^\circ/20^\circ = 1.0905$

$\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  containing 25.51%  $\text{Sr}(\text{NO}_3)_2$   
has sp gr  $20^\circ/20^\circ = 1.2440$

(Le Blanc and Rohland, Z phys Ch 1890,  
19 279)

Sp gr of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $20^\circ$  containi  
M g mols of salt per liter

M 0 01 0 025 0 05 0 075  
Sp gr 1 001525 1 004207 1 008391 1 0126

M 0 10 0 25 0 50 0 75  
Sp gr 1 016834 1 04201 1 08312 1 12386

M 1 00  
Sp gr 1 16354

(Jones and Pearce, Am Ch J 1907, 38 70)

B-pt of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$ , containing pts  $\text{Sr}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$

B-pt	Pts $\text{Sr}(\text{NO}_3)_2$	B pt	Pts $\text{Sr}(\text{NO}_3)_2$
100 5°	12	104°	81 4
101	24	104 5	89 6
101 5	34 8	105	97 6
102	45	105 5	105
102 5	54 4	106	112 2
103	63 6	106 3	116 5
103 5	72 6		

(Gerlach, Z anal 26 448)

Sat  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  boils at 106 8°, and contains 112 9 pts salt to 100 pts  $\text{H}_2\text{O}$  (Griffiths)

Sat  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  boils at 107 5–108° (Kremers), 107 9° (Mulder)

Sat  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  forms a crust at 106 3°, and contains 116 5 pts  $\text{Sr}(\text{NO}_3)_2$  to 100 pts  $\text{H}_2\text{O}$ , highest temp observed was 107° (Gerlach, Z anal 26 427)

Very sl sol in conc  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$  (Wurtz)

Insol in  $\text{HNO}_3 + \text{Aq}$  (Schultz, Zeit Ch (2) 5 537)

Solubility in  $\text{Sr}(\text{OH})_2, 8\text{H}_2\text{O} + \text{Aq}$  at 25°

Sp gr 25/25	G $\text{SrO}$ as $\text{Sr}(\text{OH})_2$ in 100 g $\text{H}_2\text{O}$	G $\text{Sr}(\text{NO}_3)_2$ in 100 g $\text{H}_2\text{O}$
1 492	0 38	79 47
1 494	0 78	80 83

(Parsons, J Am Chem Soc 1910, 32 1388)

Very sol in liq  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Sol in 8500 pts absolute alcohol Sol in 60,000 pts of a mixture of 1 pt ether and 1 pt alcohol (Rose, Pogg 110 296)

Sol in 4189 pts abs alcohol and in 199 87 pts ordinary rectified spirits (Hill, Pharm J 1888 (3) 19 420)

Solubility in ethyl alcohol + Aq at 25°

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Sr}(\text{NO}_3)_2$ in the solution
99 4	99 38	0 02
79 2	77 15	2 60
59 9	53 6	10 5
40 65	32 35	20 5
20 6	13 8	33 2
18 8	12 35	34 3
16 25	10 45	35 7
15 05	9 5	36 7
10 0	6 0	40 05
6 0	3 45	42 7
0	0	46 6

$\text{Sr}(\text{NO}_3)_2$  is the solid phase in the solutions which are rich in alcohol,  $\text{Sr}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$  in

the solutions which contain small amounts of alcohol

(D'Ans and Siegler, Z phys Ch 1913, 82 39)

Not completely insol in boiling amyl alcohol, 30 com dissolving about 1 mg (Browning, Sil Am J 143 52)

Perfectly anhydrous  $\text{Sr}(\text{NO}_3)_2$  is sol in 83044 pts absolute ether-alcohol (1 1) (Fresenius, Z anal 32 190)

Solubility in organic solvents

Solvent	% $\text{Sr}(\text{NO}_3)_2$ in the solution at 25°
Methyl alcohol	1 26
Ethyl alcohol	0 02
Propyl alcohol	0 02
Isobutyl alcohol	0 01
Amyl alcohol	0 003
Acetone	0 02

(D'Ans and Siegler, Z phys Ch 1913, 82 44)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Sol in acetone (Eidmann, C C 1899 II, 1014)

Difficultly sol in acetone (Naumann, B 1904, 37 4328)

The composition of the hydrates formed by  $\text{Sr}(\text{NO}_3)_2$  at different dilutions is calculated from determinations of the lowering of the fr-pt produced by  $\text{Sr}(\text{NO}_3)_2$  and of the conductivity and sp gr of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  (Jones, Am Ch J 1905, 34 305)

+4 $\text{H}_2\text{O}$  Efflorescent

Solubility in ethyl alcohol + Aq at 25°

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Sr}(\text{NO}_3)_2$ in the solution
0	0	44 25
4	1 7	42 5
6	2 6	42 1
10 8	4 95	40 4
16 0	7 95	37 6
20	12 35	34 3

(D'Ans and Siegler, Z phys Ch 1913, 82 39)

Tellurium nitrate, basic,  $4\text{TeO}_2, \text{N}_2\text{O}_5 + 1\frac{1}{2}\text{H}_2\text{O}$

Very hygroscopic Easily decomp by  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3 + \text{Aq}$ , but more sol when dil than conc (Klein and Morel, Bull Soc (2) 43 205)

Tellurium nitrate,  $\text{TeNO}_3$

Sol in acetone (Eidmann, C C 1899 II, 1014)

**Terbium nitrate,  $Tb(NO_3)_3 \cdot 6H_2O$** 

Sol in  $H_2O$  Sol in alcohol (Urban, C R 1908, 146 128)

**Thallous nitrate,  $TlNO_3$** 

1 pt  $TlNO_3$  dissolves, according to C = Crookes, L = Lamy

at 15°	18°	58°	107°
in 9 4	10 3	2 3	0 17 pts $H_2O$
C	L	L	L

Sat  $TlNO_3$  + Aq contains at

3 5°	18°	32°	58°	95°
4 2	8 8	13 2	30 4	74 5% $TlNO_3$

107°	135°	145°	150°	155°
85	95	95 2	96 5	97% $TlNO_3$

(Étard, A ch 1894, (7) 2 527)

**Solubility in  $H_2O$  at t°**

t°	g $TlNO_3$ in 100 g $H_2O$	g mol $TlNO_3$ in 1 l
0	3 91	0 149
10	6 22	0 230
20	9 55	0 357
25		0 433
30	14 3	0 522
40	20 9	0 755
50	30 4	1 07
60	46 2	1 58
70	69 5	2 29
80	111	3 40
90	200	5 32
100	414	8 29
105	594	10 25

(Berkeley, Trans Roy Soc 1904, 203 A, 211)

**Sp gr of  $TlNO_3$  + Aq at 25°**

Concentration of $TlNO_3$ + Aq	Sp gr
$\frac{1}{4}$ -normal	1 0562
$\frac{1}{8}$ - " "	1 0283

(Wagner, Z phys Ch 1890, 5 40)

Solubility of  $TlNO_3$  +  $KNO_3$  (See  $KNO_3$ )

Insol in alcohol (Lamy)

Sol in acetone (Eidmann, Dissert 1899, Naumann, B 1904, 37 4328)

**Thallous hydrogen nitrate,  $TlNO_3 \cdot 2HNO_3$** 

(Wells, Am Ch J 1901, 26 273)

$TlNO_3 \cdot 3HNO_3$  (Ditte)

**Thallic nitrate,  $Tl(NO_3)_3 \cdot 3H_2O$** 

Effloresces in the air (Meyer, Z anorg 1900, 24 361)

+  $6H_2O$ , or  $8H_2O$  Deliquescent Sol in  $H_2O$

**Thallic thallic nitrate,  $2TlNO_3 \cdot Tl(NO_3)_3$** 

Decomp by  $H_2O$  (Wells, Am Ch J 1901, 26 278)

**Thallic uranyl nitrate,  $Tl(UO_2)(NO_3)_3$** 

Decomp in moist air Decomp by H (Meyer, B 1903, 36 4058)

**Thorium nitrate,  $ThO_2 \cdot 2N_2O_5 \cdot 6H_2O$** 

Crystallized SI hygroscopic (Ful, Zeit angew Ch 1897, 10 116)

+  $12H_2O$  Very deliquescent, and sol in  $H_2O$  and alcohol

Difficultly sol in acetone (Naumann, B 1904, 37 4328)

**Thorium zinc nitrate,  $ZnTh(NO_3)_6 \cdot 8H_2O$** 

Sol in  $HNO_3$ , very hygroscopic (Merz, Z anorg 1901, 27 386)

**Thulium nitrate,  $Tm_2(NO_3)_6 \cdot 8H_2O$** 

Deliquescent Can readily be cryst fr in  $HNO_3$  (James, J Am Chem Soc 1911, 3 1344)

**Tin (stannous) nitrate, basic,  $2SnO \cdot N_2O_5$** 

Difficultly sol with partial decomp in H (Weber, J pr (2), 26 121)

**Tin (stannous) nitrate,  $Sn(NO_3)_2 \cdot 20H_2O$** 

Deliquescent, and easily decomp (Weber, J pr (2) 26 121)

**Tin (stannic) nitrate, basic,  $4SnO_2 \cdot N_2O_5 + 4H_2O$** 

(Thomas, Bull Soc 1896 (3) 15 312)

**Tin (stannic) nitrate,  $Sn(NO_3)_4$** 

Sol in  $H_2O$ , but decomp very soon n standing Stable in presence of conc  $HNO_3$  + Aq at 90°, but decomp at 100° (Mor martin, Gazz ch it 22 384)

Insol in moderately conc  $HNO_3$ , reacts by decomp by  $H_2O$  (Engel, C R 1897, 1 710)

**Titanium nitrate,  $5TiO_2 \cdot N_2O_5 \cdot 6H_2O$** 

Sol to a slight milkiness in cold H (Decomp on boiling (Merz, J pr 99 157)

**Uranyl nitrate, basic**

Sol in  $H_2O$  (Ordway, Sill Am J (2) 209)

**Uranyl nitrate,  $UO_2(NO_3)_2$** 

+  $H_2O$  (de Forcrand, C R 1913, 1 1046)

Sol in fuming  $HNO_3$  from which it can be cryst

+  $2H_2O$  52 39% is sol in dry ether at 25°  
54 25% " " " " " " " " " " " "

(Lebeau, Bull Soc 1911, (4) 9 300)

+2H<sub>2</sub>O (Vasilieff, C C 1910, II 1527)  
 +3H<sub>2</sub>O Mpt 121.5° (Vasilieff)  
 Cryst out of hot HNO<sub>3</sub>+Aq (Ditte)  
 100 pts HNO<sub>3</sub> dissolve 39 pts at 14°  
 (Ditte, A ch 1879, (5) 13 337)  
 +4H<sub>2</sub>O (de Connck, C C 1901, I 1354)  
 +6H<sub>2</sub>O Deliquescent in moist, and efflorescent in dry air Sol in 0.5 pt cold H<sub>2</sub>O, in 0.3 pt absolute alcohol, and in 4.0 pts ether (Bucholz)

Melts in crystal H<sub>2</sub>O at 59.4° (Ordway)  
 1 pt is sol in 2 pts H<sub>2</sub>O at 12.9°-14.2°  
 (de Connck, C R 1900, 131 1220)

Solubility in H<sub>2</sub>O at t°

t°	% by wt UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> 6H <sub>2</sub> O
-18 1	54 90
-12 1	58 00
-2 2	62 13
0	63 01
+12 3	67 36
25 6	72 83
36 7	78 05
45 2	82 96
71 8	86 32

(Vasilieff, J Russ Phys Chem Soc 1910, 42 570)

Sp gr of (UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>)+Aq at t°

t°	% salt	Sp gr
11 5	1	1 0049
12 4	2	1 0096
15 1	3	1 01401
14 1	4	1 0187
16 7	5	1 0230
14 1	6	1 8281
15 7	7	1 0236
15 2	8	1 0378
16 5	9	1 0410
15 2	10	1 0462
13 7	11	1 0504
11 5	12	1 0550
14 5	13	1 0594
11 3	14	1 0643
12 5	15	1 0680
13 2	16	1 0718

(de Connck, C R 1900, 131 1219)

Sp gr of a sat aq solution=1.7536 at 17°, containing 54.77% UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>

Sp gr =1.0257 when 2.80% UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> is present (Vassiliev, C C 1912 I, 1430)

Sp gr of solution in HNO<sub>3</sub>+Aq

Pts of salt in 100 pts HNO <sub>3</sub> sp gr 1.153	1	2	3	4	5
Temp	11 0°	11 8°	11 3°	12 0°	11 6°
Sp gr of the solution	1 1585	1 1614	1 1663	1 1698	1 1751

(de Connck, C R 1901, 132 90)

Sp gr of solution in H<sub>2</sub>SO<sub>4</sub>+Aq

Pts of salt in 100 pts H <sub>2</sub> SO <sub>4</sub> sp gr 1.138	1 pt	2 pts	3 pts	4 pts	5 pts
Temp	11 2°	11 8°	10 7	12 0°	11 4°
Sp gr of solution	1 1427	1 1450	1 1511	1 1540	1 1576

(de Connck)

Very sol in dil HBr and selenic acid (d=1.4) Sol in conc H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, dil HCl and less sol in conc HCl (de Connck, C R 1900, 131 1220)

## Sp gr of solution in HBr+Aq of sp gr 1.21

Sp gr	% salt dissolved
1 2122	1
1 2168	2
1 2198	3
1 2250	4
1 2305	5

(de Connck, Belg Acad Bull 1901 222)

Insol in KOH+Aq, NaOH+Aq or NH<sub>4</sub>OH+Aq Sol in lime water (de Connck, C R 1900, 131 1220)

Sl attacked by liquid NH<sub>3</sub> (Gore, Am Ch J 1898, 20 830)

At 15°, uranyl nitrate is sol in comm methyl alcohol, dil and conc ethyl alcohol, propyl and isobutyl alcohol, comm amyl alcohol, acetone, ether, ethyl acetate, dil and conc formic acid and dil acetic acid, sl sol in comm essence of terebenthine, insol in benzene (cryst), comm toluene and xylene, ligroin, CHCl<sub>3</sub>, glycerine and CS<sub>2</sub> (de Connck, C R 1900, 131 1220)

1 pt is sol in 55 pts methyl alcohol at ca 11.8°

1 pt is sol in 30 pts ethyl alcohol (85°) at ca 12.9°

1 pt is sol in 65 pts acetone at ca 12.0°

1 pt is sol in 5.6 pts acetic acid (d=1.035) at ca 14.25°

(de Connck, C R 1900, 131 1304)

1 pt sol in 23.5 pts methyl alcohol at 11.2°

1 " " " 16.0 " ether " 11.9°

1 " " " 18.4 " ethyl acetate " 10.3°

1 " " " 5.3 " conc formic acid at 15.1°

(de Connck, C R 1901, 132 91)

## Sp gr of solution in comm methyl alcohol at t°

t°	% salt	Sp gr referred to H <sub>2</sub> O
11	1	0 8902
12 9	2	0 8938
12 2	3	0 9003
10 7	4	0 9068
12 8	5	0 9108

(de Connck, C R 1900, 131 1304)



Sp gr of solution in ethyl alcohol (85°) at t°

d<sub>2</sub>=sp gr referred to alcohold<sub>1</sub>=sp gr referred to H<sub>2</sub>O

t°	% salt	d <sub>1</sub>	d <sub>2</sub>
11 9	1	0 8918	1 0060
12 2	2	0 8979	1 0127
11 6	3	0 9023	1 0177
13 1	4	0 9056	1 0227
11 7	5	0 9131	1 0280

(de Coninck, C R 1900, 131 1219)

Sp gr of solution in acetic acid (d=1.055) at t°

d<sub>1</sub>=sp gr referred to H<sub>2</sub>Od<sub>2</sub>=sp gr referred to acetic acid

t°	% salt	d <sub>1</sub>	d <sub>2</sub>
14 0	1	1 0387	1 0034
13 8	2	1 0434	1 0080
14 8	3	1 0469	1 0100
16 9	4	1 0505	1 0148
14 6	5	1 0564	1 0205
10 4	6	1 0626	1 0265
11 7	7	1 0662	1 0300

(de Coninck, C R 1900, 131 1304)

When excess of UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> is shaken with ether at 7°, two layers are formed, the ether layer containing 59 g salt per 100 g solution and the aqueous layer 62.5 g salt per 100 g solution (Lebeau, C R 1911, 152 440)

Sol in nearly all proportions in glycerine (Postans, Pharm J 1883, (3) 13 752)

Sol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3601)

Sol in acetone (Eidmann, C C 1899 II, 1014, Naumann, B 1904, 37 4328)

+18H<sub>2</sub>O Sat aq solution has D<sub>17</sub><sup>17</sup>/17°=1.7536 (Vasilieff, J Russ phys Chem Soc 1911, 43 1183)

Uranyl nitrate ammonia, (UO<sub>2</sub>)(NO<sub>3</sub>)<sub>2</sub>, 2NH<sub>3</sub>

(v Unruh, Dissert 1909)

(UO<sub>2</sub>)(NO<sub>3</sub>)<sub>2</sub>, 3NH<sub>3</sub> (v Unruh)(UO<sub>2</sub>)(NO<sub>3</sub>)<sub>2</sub>, 4NH<sub>3</sub> (v Unruh)

Uranyl nitrate phosphate, UO<sub>2</sub>H<sub>4</sub>(PO<sub>4</sub>)<sub>2</sub>, UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>+14H<sub>2</sub>O

Easily sol in warm H<sub>2</sub>O, with gradual decomp. Easily sol in HNO<sub>3</sub>, HCl, or H<sub>2</sub>SO<sub>4</sub>+Aq. Sol in acetic acid with decomp (Hentz, A 151 216)

Divanadyl nitrate (?)

Known only in solution. Decomp on evaporation

Ytterbium nitrate, basic

Easily sol in H<sub>2</sub>O

Ytterbium nitrate

Very sol in H<sub>2</sub>O

+3H<sub>2</sub>O Ppt (Cleve, Z anorg 190 32 140)

+4H<sub>2</sub>O (Cleve)

Yttrium nitrate, basic, 2Y<sub>2</sub>O<sub>3</sub>, 3N<sub>2</sub>O<sub>5</sub>+9H<sub>2</sub>O

Deliquescent in moist air. Decomp b cold or boiling H<sub>2</sub>O. Sol in a solution of yttrium nitrate without decomp (Bahr and Bunsen, A 137 1)

Yttrium nitrate, Y(NO<sub>3</sub>)<sub>3</sub>+6H<sub>2</sub>O

Easily sol in H<sub>2</sub>O, alcohol, or ether (Cleve)

141.6 grams are sol in 100 grams H<sub>2</sub>O at 25° (James, J Am Chem Soc 1910, 3 876)

Zinc nitrate, basic, 8ZnO, N<sub>2</sub>O<sub>5</sub>+2H<sub>2</sub>O

Insol in H<sub>2</sub>O (Grouvelle, A ch 19 137

6ZnO, N<sub>2</sub>O<sub>5</sub>+8H<sub>2</sub>O=Zn(NO<sub>3</sub>)<sub>2</sub>, 5Zn(OH)+3H<sub>2</sub>O (Bertels, J B 1784 274)

5ZnO, N<sub>2</sub>O<sub>5</sub>+5½H<sub>2</sub>O Insol in cold somewhat sol in hot H<sub>2</sub>O (Havermann +6H<sub>2</sub>O Slowly decomp by cold H<sub>2</sub>O (Rousseau and Tite)

9ZnO, 2N<sub>2</sub>O<sub>5</sub> Decomp by H<sub>2</sub>O (Vog and Reischauer, N Jahrb Pharm 11 137

4ZnO, N<sub>2</sub>O<sub>5</sub>+2H<sub>2</sub>O (Schindler) +3H<sub>2</sub>O (Ordway, Sill Am J (2) 32 14

Gerhardt, J Pharm (3) 12 61) Insol in H<sub>2</sub>O, sol in dil acids (Athar asasco, Bull Soc 1896, 15 1080)

2ZnO, N<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O Decomp by H<sub>2</sub>O, and slowly by alcohol (Wells, Am Ch J 9 304

7ZnO, 4N<sub>2</sub>O<sub>5</sub>+14H<sub>2</sub>O=4Zn(NO<sub>3</sub>)<sub>2</sub>, 3Zn(OH)<sub>2</sub>+11H<sub>2</sub>O (Bertels)

Zinc nitrate, Zn(NO<sub>3</sub>)<sub>2</sub>

Very deliquescent. Easily sol in H<sub>2</sub>O (alcohol)

Sp gr of Zn(NO<sub>3</sub>)<sub>2</sub>+Aq F= according to Franz (J pr (2) 5 274) at 17.5°, O= according to Oudemans (Z anal 7 410) at 14°

	5	10	15% Zn(NO <sub>3</sub> )
F	1 0496	1 0968	1 1476
O	1 0425	1 087	1 1355
	20	25	30% Zn(NO <sub>3</sub> )
F	1 2024	1 2640	1 3265
O	1 1875	1 245	1 305

	35	40	45	50% Zn(NO <sub>3</sub> )
F	1 906	1 4572	1 5258	1 5984
O				

Calculated for Zn(NO<sub>3</sub>)<sub>2</sub>+6H<sub>2</sub>O

	10	20	30	40	50% sal
1	05361	1 1131	1 1782	1 2496	1 3292

(Oudemans)

Zn(NO<sub>3</sub>)<sub>2</sub>+Aq when heated soon decomposes, with formation of an insol basic salt (Ordway)

Sp gr of  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  at room temp containing

15 955 30 626 44 5%  $\text{Zn}(\text{NO}_3)_2$   
1 1155 1 2291 1 4367

(Wagner, W Ann 1883, 18 270)

Sp gr of  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  at 25°

Concentration of $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$	Sp gr
1-normal	1 0758
$\frac{1}{2}$ - "	1 0404
$\frac{1}{4}$ - "	1 0191
$\frac{1}{8}$ - "	1 0096

(Wagner, Z phys Ch 1890, 5 40)

Sp gr of  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  at 16°

$\frac{1}{2}$ $\text{Zn}(\text{NO}_3)_2$ g per 1000 g of solution	Sp gr 16°/16°
0 0000	1 000000
0 9950	1 000814
2 0061	1 001646
4 1535	1 003413
8 1824	1 006733
17 7760	1 014702
34 5920	1 028890
68 6780	1 058644

(Dijken, Z phys Ch 1897, 24 108)

Sp gr of  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  at 17.3°, when p = per cent strength of solution, d = observed density, w = volume conc in grams per cc  
 $\left(\frac{pd}{100} = w\right)$

p	d	w
47 28	1 5504	0 73310
41 32	1 4579	0 60240
30 86	1 3136	0 40535
29 21	1 2933	0 37780
19 65	1 1830	0 23246
14 39	1 1284	0 16232
11 36	1 0988	0 12478
7 091	1 0597	0 07515
5 923	1 0491	0 06213
1 574	1 0118	0 01593
1 210	1 0087	0 01221

(Barnes, J Phys Chem 1898, 2 545)

Very easily sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 830)

+  $1\frac{1}{2}\text{H}_2\text{O}$  100 pts  $\text{HNO}_3$  dissolve 28 pts at 13°, 55 pts at 55° (Ditte, A ch 1879, (5) 18 335)

+  $2\text{H}_2\text{O}$  (Vasheff, C C 1909, II 1966)

+  $3\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

37° 40° 41° 43° 45 5° mpt  
66 38 67 42 68 21 69 26 77 77%  $\text{Zn}(\text{NO}_3)_2$

(Funk, Z anorg 1899, 20 401)

+  $6\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

—18° —15° —13° —12°  
44 63 45 26 45 51 45 75%  $\text{Zn}(\text{NO}_3)_2$ ,

0° +12 5° 18° 25°  
48 66 52 00 53 50 55 90%  $\text{Zn}(\text{NO}_3)_2$ ,

36 4° (mpt) 36° 33 5°  
63 63 64 73 65 83%  $\text{Zn}(\text{NO}_3)_2$

(Funk, Z anorg 1899, 20 400)

100 g  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  sat at 0° contain 48 7 g  $\text{Zn}(\text{NO}_3)_2$ , at 18°, 53 5 g  $\text{Zn}(\text{NO}_3)_2$  (Mylius, Z anorg 1910, 74 411)

Melts in its crystal  $\text{H}_2\text{O}$  at 36 4° (Ordway), 50° (Pierre), boils at 131° (Ordway)

Sp gr of solution sat at 18° = 1 664, and contains 53 9%  $\text{Zn}(\text{NO}_3)_2$  (Mylius, B 1897, 30 1718)

Sol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

+  $9\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$

Sat solution contains at

—25° —22 5° —20° —18°  
40 12 40 75 42 03 43 59%  $\text{Zn}(\text{NO}_3)_2$

Cryohydrate is formed at —29°

(Funk, Z anorg 1899, 20 401)

**Zinc nitrate ammonia**,  $\text{Zn}(\text{NO}_3)_2 \cdot 4\text{NH}_3$

Ppt (Ephram, B 1915, 48 638)

+  $\frac{2}{3}\text{H}_2\text{O}$

Deliquescent Sol in  $\text{H}_2\text{O}$  (André, C R 100 639)

13ZnO, 3N<sub>2</sub>O<sub>5</sub>, 2NH<sub>3</sub> + 18H<sub>2</sub>O

Insol in cold, decomp by warm  $\text{H}_2\text{O}$  (André, C R 1885, 100 640)

**Zinc nitrate cupric oxide**,

$\text{Zn}(\text{NO}_3)_2 \cdot 3\text{CuO} + 3\text{H}_2\text{O}$

(Mailhe, A ch 1902, (7) 27 169)

**Zinc nitrate hydrazine**,  $\text{Zn}(\text{NO}_3)_2 \cdot 3\text{N}_2\text{H}_4$

Decomp by hot  $\text{H}_2\text{O}$

Sol in  $\text{NH}_4\text{OH}$  (Hunzen, Z anorg 1908, 60 279)

**Zirconium nitrate, basic**,  $3\text{ZrO}_2 \cdot 2\text{N}_2\text{O}_5$

Insol in  $\text{H}_2\text{O}$

$\text{ZrO}_2 \cdot \text{N}_2\text{O}_5$  Easily sol in  $\text{H}_2\text{O}$  and alcohol

+  $\text{H}_2\text{O}$  As above

**Zirconium nitrate**,  $\text{Zr}(\text{NO}_3)_4 \cdot 5\text{H}_2\text{O}$  (?)

Deliquescent, and sol in  $\text{H}_2\text{O}$

**Nitric oxide**, NO

See Nitrogen dioxide

**Nitrilobromosmic acid**

**Ammonium nitriropentabromosmate,**  
 $[\text{OsNBr}_5](\text{NH}_4)_2 + \text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Decomp in dil aq solution

Stable in  $\text{HBr} + \text{Aq}$   
 Insol in organic solvents (Werner, B 1906, 39 501)

**Cæsium hydrogen nitriropentabromosmate,**  
 $[\text{OsNBr}_5]_2\text{Cs}_2\text{H}$

Sl sol in  $\text{H}_2\text{O}$  (Werner)

**Potassium nitrirotetrabromosmate,**  
 $[\text{OsNBr}_4]\text{K} + 2\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Decomp in aq solution  
 Stable in  $\text{HBr} + \text{Aq}$  Insol in organic solvents (Werner)

**Rubidium nitriropentabromosmate,**  
 $[\text{OsNBr}_5]\text{Rb}_2$

Sol in  $\text{H}_2\text{O}$  Decomp in dil aq solution after a short time (Werner)

**Nitriochlorosmic acid**

**Ammonium nitriropentachlorosmate,**  
 $(\text{OsNCl}_5)(\text{NH}_4)_2$

Sol in  $\text{H}_2\text{O}$ , insol in conc  $\text{HCl} + \text{Aq}$   
 (Werner, B 1901, 34 2702)

**Cæsium nitriropentachlorosmate,**  
 $(\text{OsNCl}_5)\text{Cs}_2$

Sol in  $\text{H}_2\text{O}$  (Werner)

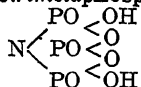
**Potassium nitriropentachlorosmate,**  
 $(\text{OsNCl}_5)\text{K}_2$

Sol in  $\text{H}_2\text{O}$ , pptd by  $\text{HCl}$ , insol in organic solvents (Werner)

**Rubidium nitriropentachlorosmate,**  
 $(\text{OsNCl}_5)\text{Rb}_2$

Sol in  $\text{H}_2\text{O}$ , decomp in dil neutral solution (Werner)

**Nitrilotrimetaphosphoric acid,**  $\text{H}_2\text{NP}_3\text{O}_7 =$



Known only in solution (Mente, A 248 260)

**Aluminum nitrilotrimetaphosphate**

Insol in  $\text{H}_2\text{O}$ , conc  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$   
 Slowly sol in boiling conc  $\text{H}_2\text{SO}_4$  Sol in warm  $\text{NaOH} + \text{Aq}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$  without decomp Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Mente)

**Barium —,  $\text{BaNP}_3\text{O}_7$**

Insol in dil or conc acids Decomp by boiling  $\text{NaOH}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Mente)

**Cadmium nitrilotrimetaphosphate**

Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , or boils  $(\text{NH}_4)_2\text{CO}_3$ , or  $\text{NaOH} + \text{Aq}$  (Mente)

**Calcium —,  $\text{CaNP}_3\text{O}_7 + \text{H}_2\text{O}$**

Sol in conc  $\text{HCl} + \text{Aq}$  by long boiling, or more easily in fuming  $\text{HNO}_3 + \text{Aq}$  Insol  $\text{NH}_4\text{OH}$  or  $\text{NaOH} + \text{Aq}$  (Mente)

**Chromium —**

Slowly sol in dil acids Easily sol ammonia Sol in cold  $\text{NaOH} + \text{Aq}$  (Mente)

**Cobalt —,  $\text{CoNP}_3\text{O}_7 + \text{H}_2\text{O}$**

Insol in  $\text{H}_2\text{O}$  Sl sol in dil acids Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp by  $\text{NaOH}$   $\text{Na}_2\text{CO}_3 + \text{Aq}$  (Mente)

**Copper —**

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp by  $\text{NaOH} + \text{Aq}$  (Mente)

**Ferric —,  $\text{Fe}_2(\text{NP}_3\text{O}_7)_3$**

Insol in conc acids Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  Decomp by  $\text{NaOH}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$  (Mente)

**Lead —**

Insol in dil acids Sol in fuming  $\text{HNC}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in  $\text{NaOH} + \text{Aq}$  (Mente)

**Magnesium —,  $\text{MgNP}_3\text{O}_7 + \text{H}_2\text{O}$**

Slowly sol in  $\text{HCl} + \text{Aq}$  Sol in  $\text{H}_2\text{SO}_4$ , fuming  $\text{HNO}_3$  with addition of  $\text{Br}_2$  Insol in  $\text{NH}_4\text{OH}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Mente)

**Manganous —,  $\text{MnNP}_3\text{O}_7 + \text{H}_2\text{O}$**

Insol in dil acids Very sl sol in  $\text{NaOH}$   $\text{Aq}$  Insol in  $\text{Na}_2\text{CO}_3$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Mente)

**Mercurous —,  $\text{Hg}_2\text{NP}_3\text{O}_7$**

Insol in dil acids,  $\text{NH}_4\text{OH}$ ,  $\text{NaOH}$ ,  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  Easily sol in fuming  $\text{HNO}_3$  (Mente)

**Nickel —,  $\text{NiNP}_3\text{O}_7 + \text{H}_2\text{O}$**

Insol in dil acids,  $\text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Mente)

**Zinc —,  $\text{ZnNP}_3\text{O}_7 + 2\text{H}_2\text{O}$**

Easily sol in  $\text{NH}_4\text{OH}$ ,  $\text{NaOH}$ ,  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Mente)

**Nitrirosulphonic acid,  $\text{N}(\text{SO}_3\text{H})_3$**

Not known in free state (Raschig, A 24 161)

**Potassium nitrirosulphonate,  $\text{N}(\text{SO}_3\text{K})_3 + 2\text{H}_2\text{O}$**

Soluble in  $\text{H}_2\text{O}$  (Raschig, A 241 161)  
 Is identical with "potassium ammonitrisulphonate" of Claus

Insol in cold  $H_2O$  (Claus), sol in 50 pts  $H_2O$  at  $23^\circ$  (Fremy), in  $H_2O$  at scarcely  $40^\circ$  without change Decomp by boiling (Claus)

**Potassium sodium nitrosulphonate**,  
 $N(SO_3K)_2(SO_3Na)$

Nearly insol in cold  $H_2O$  (Raschig, A 241 161)

**Sodium nitrosulphonate**,  $N(SO_3Na)_3$

Not isolated on account of its extreme solubility in  $H_2O$  (Raschig, A 241 161)

**Nitrosulphophosphoric acid**,  
 $NP(SH)_2$

Decomp by  $H_2O$  (Stock, B 1906, 39 2001)

**Ammonium nitrosulphophosphate**,  
 $NP(SNH_4)_2$

Easily sol in  $H_2O$  Not decomp by boiling with alkali Decomp by acid (Stock)

Easily sol in liquid  $NH_3$  (Stock, B 1903, 36 315)

**Ammonium hydrogen nitrosulphophosphate**,  $SHP(SNH_4)N$

Not decomp by boiling with alkali Decomp by acids (Stock, B 1906, 39 1999)

**Barium nitrosulphophosphate**,  $BaNPS_2 + H_2O$

Sol in  $H_2O$  with decomp Decomp by hot  $H_2O$  Not decomp by warming with alkali Decomp by acid (Stock)

**Lead nitrosulphophosphate**,  $NPS_2Pb$

Sol in liquid  $NH_3$  Solution decomp rapidly with separation of  $PbS$  (Stock)

**Sodium nitrosulphophosphate**,  $NPSNa_2$

Not decomp by boiling with alkali Decomp by acid (Stock)

**Nitrosulphuric acid**

**Ammonium nitrosulphate**,  $N(SO_3NH_4)_3 + 2H_2O$

Rather sl sol in  $H_2O$ , but much more sol than K salt (Divers and Haga, Chem Soc 1901, 79 1094)

**Sodium nitrosulphate**,  $N(SO_3Na)_3 + 5H_2O$

Very sol in  $H_2O$  (Divers and Haga, Chem Soc 1901, 79 1097)

**Nitrosulphurous acid**

**Ammonium nitrosulphite**,  $NH(SO_2NH_4)_2$

Somewhat deliquescent Very sol in  $H_2O$  Slowly decomp in solution Decomp by boiling with  $HCl$  (Divers, Proc Chem Soc 1901, 17 163)

**Nitrocobaltic chloride**

Sol in 200 pts cold  $H_2O$  (Jorgensen, Z anorg 5 172)

**Nitroplatin diamine nitrate**,  
 $(NO_2)_2Pt(NH_5NO_3)_2$

Sol in cold  $H_2O$  with decomp, violently decomp on warming (Hadow, Chem Soc (2) 4 345)

**Nitropurpureocobaltic comps**

See Xanthocobaltic comps

**Nitropurpureorhodium comps**

See Xanthorhodium comps

**Nitrocarbamic acid**

**Potassium nitrocarbamate**,  $NO_2NK$  COOK

Decomp by  $H_2O$  (Thiele, B 1894, 27 1909)

**Nitro cobalt**,  $Co_2NO_2$

Decomp by  $H_2O$  (Sabatier and Senderens, C R 115 236)

**Nitro copper**,  $CuNO_2$

Violently decomp by  $H_2O$  (Sabatier and Senderens, C R 116 756)

**Nitroferri cyanhydric acid**

See Nitroprussic acid

**Nitrogen,  $N_2$**

Nearly insol in all known solvents  
1 vol recently boiled  $H_2O$  absorbs 0.0147 vol  $N$  at  $15.5^\circ$  (Henry 1803)

1 vol recently boiled  $H_2O$  absorbs 0.02 vol  $N$  (Dalton)

1 vol recently boiled  $H_2O$  absorbs 0.016 vol  $N$  at ord temp (Dalton)

1 vol  $H_2O$  at  $t^\circ$  and 760 mm absorbs  $V$  vols  $N$  gas reduced to  $0^\circ$  and 760 mm

$t^\circ$	V	t	V	t	V
0	0.02035	7	0.01713	14	0.01500
1	0.01981	8	0.01675	15	0.01475
2	0.01932	9	0.01640	16	0.01458
3	0.01884	10	0.01607	17	0.01441
4	0.01838	11	0.01577	18	0.01426
5	0.01794	12	0.01549	19	0.01413
6	0.01752	13	0.01523	20	0.01403

(Bunsen)

Coefficient of absorption =  $0.020346 - 0.00053887t + 0.000011156t^2$  (Bunsen)

1 l H<sub>2</sub>O absorbs ccm N from atmospheric air  
at 760 mm pressure and t°

t°	ccm N	t°	ccm N
0	19 29	15	13 95
5	17 09	20	12 80
10	15 36	25	11 81

(Dittmar, Challenger Exped Report, vol 1)

t°	ccm N	t°	ccm N
0	19 14	15	13 73
5	16 93	20	12 63
10	15 14	25	11 80

(Hamberg, 1885)

Absorption of N by H<sub>2</sub>O at t° and 760 mm  
β = coefficient of absorption

t°	β	t°	β	t°	β
0	0 02388	18	0 01696	36	0 01252
1	2337	19	1667	37	1233
2	2288	20	1639	38	1215
3	2241	21	1611	39	1198
4	2196	22	1584	40	1182
5	2153	23	1557	41	1166
6	2111	24	1530	42	1151
7	2070	25	1504	43	1137
8	2031	26	1478	44	1124
9	1993	27	1453	45	1111
10	1956	28	1428	46	1099
11	1920	29	1404	47	1088
12	1885	30	1380	48	1078
13	1851	31	1357	49	1069
14	1818	32	1334	50	1061
15	1786	33	1312	60	1000
16	1755	34	1291	100	1000
17	1725	35	1271		

(Bohr and Bock, W Ann 44 318)

Absorption of N by H<sub>2</sub>O at t° and 760 mm  
β = coefficient of absorption, β<sub>1</sub> = "Solubility" (see under Oxygen)

t	β	β <sub>1</sub>
0	0 02348	0 02334
1	2291	2276
2	2236	2220
3	2182	2166
4	2130	2113
5	2081	2063
6	2032	2013
7	1986	1966
8	1941	1920
9	1898	1877
10	1857	1834
11	1819	1795
12	1732	1758
13	1747	1722
14	1714	1687

Absorption of N by H<sub>2</sub>O at t° — *Continue*

t°	β	β <sub>1</sub>
15	0 1682	0 1654
16	1651	1622
17	1622	1591
18	1594	1562
19	1567	1534
20	1542	1507
21	1519	1482
22	1496	1457
23	1473	1433
24	1452	1410
25	1432	1387
26	1411	1365
27	1392	1344
28	1374	1323
29	1356	1303
30	1340	1284
31	1321	1263
32	1304	1243
33	1287	1224
34	1270	1204
35	1254	1185
36	1239	1167
37	1224	1149
38	1210	1131
39	1196	1114
40	1183	1097
41	1171	1082
42	1160	1067
43	1149	1052
44	1139	1037
45	1129	1023
46	1120	1009
47	1111	0995
48	1102	0982
49	1094	0968
50	1087	0955
52	1072	0929
54	1058	0902
56	1045	0876
58	1033	0849
60	1022	0822
62	1011	0794
64	1001	0765
66	0992	0736
68	0983	0707
70	0976	0676
72	0970	0645
74	0965	0614
76	0961	0581
78	0959	0546
80	0957	0510
82	0956	0472
84	0955	0432
86	0954	0388
88	0953	0343
90	0952	0294
92	0951	0242
94	0950	0187
96	0949	0128
98	0948	0066
100	0947	0000

(Winkler, B 24 3606)

Coefficient of absorption for  $\text{H}_2\text{O}=0.01432$  at  $25^\circ$ ,  $0.01621$  at  $20^\circ$ ,  $0.01789$  at  $15^\circ$ ,  $0.02003$  at  $10^\circ$ ,  $0.02173$  at  $5^\circ$  (Braun, Z phys Ch 1900, 33 730)

Solubility in  $\text{H}_2\text{O}$  at various pressures

V=volume of the absorbing liquid

P=Hg-pressure in metres

$\lambda$ =coefficient of solubility

V	$t^\circ$	P	$\lambda$
33 134 ccm	19 4	0 8910	0 01617
		1 0453	0 01616
		1 2488	0 01611
		1 4764	0 01608
		1 8111	0 01602
		2 3961	0 01597
		2 9074	0 01585
		3 3411	0 01579
		4 1382	0 01561
		4 5958	0 01554
32 152 ccm	24 9	5 1103	0 01546
		5 8349	0 01528
		6 2767	0 01515
		7 1059	0 01499
		7 5815	0 01487
		8 1074	0 01473
		0 8977	0 01498
		1 0129	0 01493
		1 1887	0 01491
		1 5573	0 01487
		1 9846	0 01482
		2 5171	0 01478
		2 8781	0 01463
		3 2956	0 01455
		4 0947	0 01440
		4 5581	0 01434
		5 0529	0 01426
		5 5935	0 01413
		6 1956	0 01408
		7 0333	0 01382
		7 5596	0 01377
		74 1846	0 01369

(Cassuto, Phys Zeit 1904, 5 236)

Coefficient of absorption for  $\text{H}_2\text{O}=0.01565$  at  $20.18^\circ$  (Hufner, Z phys Ch 1907, 57 615)

Absorption of  $\text{N}_2$  by distilled  $\text{H}_2\text{O}$  at  $t^\circ$   
 $a$ =ccm of  $\text{N}_2$  absorbed by 1 l of  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm

$t^\circ$	$a$	$t^\circ$	$a$	$t^\circ$	$a$
0	23 00	17	16 29	34	12 93
1	22 50	18	16 03	35	12 79
2	22 02	19	15 78	36	12 65
3	21 55	20	15 54	37	12 52
4	21 09	21	15 29	38	12 39
5	20 64	22	15 06	39	12 27
6	20 20	23	14 84	40	12 15
7	19 77	24	14 63	41	12 04
8	19 35	25	14 43	42	11 92
9	18 94	26	14 23	43	11 80
10	18 54	27	14 04	44	11 68
11	18 16	28	13 87	45	11 57
12	17 80	29	13 71	46	11 46
13	17 46	30	13 55	47	11 35
14	17 14	31	13 39	48	11 24
15	16 84	32	13 23	49	11 13
16	16 56	33	13 08	50	11 02

(Fox, Trans Faraday Soc 1909, 5 73)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ=0.1561$  (Drucker and Moles, Z phys Ch 1910, 75 418)

Solubility of  $\text{N}_2$  in  $\text{H}_2\text{O}$  at  $25^\circ=0.0231$  (Calculated according to special formula, for which see original article) (Findlay and Craghton, Chem Soc 1911, 99 1315)

Coefficient of absorption for  $\text{H}_2\text{O}=0.01689$  at  $15^\circ$ ,  $0.01670$  at  $16.2^\circ$ ,  $0.01622$  at  $17.2^\circ$  (Muller, Z phys Ch 1912, 81 493)

1 l sea water (sp gr 1.027) absorbs ccm N from atmosphere at  $t^\circ$  and 760 mm pressure—

t	According to Tornoe	According to Dittmar	According to Hamburg
0	14 40	15 60	14 85
5	13 25	13 86	13 32
10	12 10	12 47	12 06
15	10 95	11 34	11 04
20		10 41	10 25
25		9 62	9 62

No of ccm of  $\text{N}_2$  (containing 1.185% argon) absorbed by a l of sea-water from a free dry atmosphere of 760 mm pressure at given temperatures

Cl per 1000	0	4	8	12	16	20	24	28
0								
4						2		
8						1		
12						1	2	
16								9 80
20								9 44

(Fox, Trans Faraday Soc 1909, 5 77)

Absorption of  $N_2$  by  $H_2SO_4 + Aq$  at  $t^\circ$  $\alpha$  = coefficient of absorption

Normality of the acid	$t^\circ$	$\alpha$
0	20 9	0 0156
4 9	20 9	0 0091
8 9	20 9	0 0072
10 7	21 2	0 0066
20 3	21 1	0 0049
24 8	21 5	0 0048
29 6	20 8	0 0051
34 3	20 9	0 0100
35 8	21 1	0 0129

(Bohr, Z phys Ch 1910, 71 49)

Absorption of  $N_2$  by  $BaCl_2 + Aq$  $\alpha_{t^\circ}$  = coefficient of absorption at  $t^\circ$ 

Per cent of $BaCl_2$ in the solution	$\alpha_{25^\circ}$	$\alpha_{20^\circ}$	$\alpha_{15^\circ}$	$\alpha_{10^\circ}$	$\alpha_5^\circ$
13 830	0 00783	0 00923	0 01036	0 01166	0 01270
11 927	0 00855	0 00976	0 01139	0 01249	0 01368
6 903	0 01044	0 01184	0 01317	0 01474	0 01598
6 738	0 01036	0 01182	0 01340	0 01494	0 01628
3 870	0 01137	0 01323	0 01480	0 01660	0 01802
3 325	0 01190	0 01346	0 01502	0 01681	0 01826

(Braun, Z phys Ch 1900, 33 733)

Absorption of  $N_2$  by  $NaCl + Aq$  $\alpha_{t^\circ}$  = coefficient of absorption at  $t^\circ$ 

Per cent of $NaCl$ in the solution	$\alpha_{25^\circ}$	$\alpha_{20^\circ}$	$\alpha_{15^\circ}$	$\alpha_{10^\circ}$	$\alpha_5^\circ$
11 732	0 00470	0 00657	0 00810	0 00930	0 01016
10 945	0 00565	0 00703	0 00824	0 00912	0 01052
8 135	0 00749	0 00872	0 01014	0 01131	0 01266
8 033	0 00729	0 00871	0 00995	0 01121	0 01248
6 595	0 00802	0 00972	0 01120	0 01252	0 01380
6 400	0 00826	0 00975	0 01134	0 01259	0 01375
4 196	0 00990	0 01151	0 01294	0 01451	0 01579
3 880	0 01005	0 01168	0 01316	0 01475	0 01615
2 120	0 01131	0 01311	0 01469	0 01638	0 01795
2 100	0 01133	0 01314	0 01467	0 01656	0 01805
0 686	0 01295	0 01477	0 01640	0 01833	0 01994
0 671	0 01304	0 01484	0 01642	0 01845	0 02000

(Braun, l c)

At  $-191.5^\circ$  liquid oxygen dissolves 458 times its vol or 50.7 per cent of its weight of gaseous nitrogen (Erdmann, B 1904, 37 1191)

At  $18^\circ$  and 760 mm 100 vols  $H_2O$  or alcohol of 0.84 sp gr absorb 4.2 vols N gas (de Saussure 1814)

1 vol alcohol at  $t^\circ$  and 760 mm dissolves  $\frac{1}{V}$  vols N gas reduced to  $0^\circ$  and 760 mm

$t^\circ$	V	$t^\circ$	V
0	0 12634	13	0 12192
1	0 12593	14	0 12166
2	0 12553	15	0 12142
3	0 12514	16	0 12119
4	0 12476	17	0 12097
5	0 12440	18	0 12076
6	0 12405	19	0 12056
7	0 12371	20	0 12030
8	0 12338	21	0 12021
9	0 12306	22	0 12005
10	0 12276	23	0 11990
11	0 12247	24	0 11976
12	0 12219		

(Bunsen's Gasometry)

1 vol alcohol absorbs 0.126338-0.000418t - 0.000060t<sup>2</sup> vols N gas (Carius, A 94 13)

Solubility in alcohol at  $25^\circ$ 

Vol $H_2O$	Vol % alcohol	Solubility
100	0	0 01634
80	20	0 01536
67	33	0 01719
0	100	0 1432

(Just, Z phys Ch 1901, 37 361)

1 vol ether absorbs 0.15 vol N (Dobereiner) 1 caoutchouc absorbs 5 vols N in 5 weeks (Himly)

Solubility of  $N_2$  in ether = 0.2580 at  $t^\circ$ , 0.2561 at  $10^\circ$  (Christoff, Z phys Ch 19 79 459)

Solubility in organic solvents

Solvent	Solubility at $25^\circ C$	Solubility at $20^\circ C$	$\frac{ds}{dt}$
Glycerine	Not measurable		
Water	0 01634	0 01705	-0.000 2
Aniline	0 03074	0 02992	+0.000 4
Carbon bisulphide	0 05860	0 05290	+0.001
Nitrobenzene	0 06255	0 06082	+0.000 6
Benzene	0 1159	0 114	+0.000
Glacial acetic acid	0 1190	0 1172	+0.000
Xylene	0 1217	0 1185	+0.000
Amyl alcohol	0 1225	0 1208	+0.000
Toluene	0 1235	0 1186	+0.000
Chloroform	0 1348	0 1282	+0.001
Methyl alcohol	0 1415	0 1348	+0.001
Ethyl alcohol (99.8%)	0 1432	0 1400	+0.000
Acetone	0 1460	0 1383	+0.001
Amyl acetate	0 1542	0 1512	+0.000
Ethyl acetate	0 1727	0 1678	+0.000
Isobutyl acetate	0 1734	0 1701	+0.000

(Just, Z phys Ch 1901, 37 361)

Coefficient of absorption for petroleum 0.117 at  $20^\circ$ , 0.135 at  $10^\circ$  (Gniewasz a 1 Walfisz, Z phys Ch 1 70)

Absorption of  $N_2$  by propionic acid + Aq  
 $\alpha t^\circ$  = coefficient of absorption at  $t^\circ$

Per cent of propionic acid in the solution	$\alpha 25^\circ$	$\alpha 20^\circ$	$\alpha 15^\circ$	$\alpha 10^\circ$	$\alpha 5^\circ$
11 220					
11 023					
9 537					
9 155	0 01329	0 01469	0 01630	0 01845	0 02026
6 066					
5 891					
4 081	0 01365	0 01541	0 01688	0 01919	0 02095
3 816	0 01371	0 01547	0 01674	0 01915	0 02087

(Braun, Z phys Ch 1900, **33** 732)

Solubility of  $N_2$  in isobutyric acid + Aq at  $t^\circ$

P = Corrected pressure at end of experiment in mm Hg at  $0^\circ$

S = Solubility of  $N_2$

Solvent	$t^\circ$	P	S
Pure isobutyric acid	25 05	262 6 388 3 566 1 662 4 783 5 832 2	0 1609(?) 0 1640 0 1647 0 1656 0 1656 0 1656
37 5% solution of isobutyric acid + Aq	23 02	246 2 492 2 563 6 836 3 867 3	0 0393 0 0393 0 0393 0 0400 0 0401
Vapor pressure = 21 6 mm			
"	29 02	231 468 4 480 7 536 656 720	0 0373 0 0384 0 0383 0 0385 0 0384 0 0386
Vapor pressure = 30 6 mm			

(Drucker and Moles, Z phys Ch 1910, **75** 434)

Absorption of  $N_2$  by chloralhydrate + Aq

$t^\circ$  = temp of the solution

P = % chloralhydrate in the solution

$\beta t^\circ$  = coefficient of absorption at  $t^\circ$

$\beta 15^\circ$  = coefficient of absorption at  $15^\circ$

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
15 6	15 8	0 01574	0 01580
15 4	28 2	0 01418	0 01422
16 4	37 25	0 01288	0 01300
16 9	47 0	0 01260	0 01275
17 0	56 52	0 01230	0 01245
15 3	71 5	0 01415	0 01420
14 8	78 8	0 01447	0 01495

(Muller, Z phys Ch 1912, **81** 499)

Absorption of  $N_2$  by organic substances + Aq  
 at  $15^\circ$

P = % of the organic substance in the solvent

$\beta 15^\circ$  = coefficient of absorption at  $15^\circ$

S $15^\circ$  = Solubility at  $15^\circ$

Organic substance used	P	$\beta 15^\circ$	S $15^\circ$
Chloralhydrate	0 0 0 6 9 14 0 15 0 23 6 26 1 37 6 48 9 49 3 61 3 70 9 71 2 78 3 79 1	0 01725 0 01675 0 01706 0 0164 0 0154 0 0152 0 0134 0 0141 0 0123 0 0115 0 0118 0 0114 0 0131 0 0130 0 0152 0 0156	0 01796 0 0173 0 0162 0 0160 0 0141 0 0149 0 0130 0 0121 0 0124 0 0120 0 0138 0 0137 0 0160 0 0165
Glycerine	0 0 15 7 15 7 29 9 46 6 57 6 67 1 72 8 74 7 77 0 85 1 87 3 88 5 99 25	0 01707 0 01708 0 01425 0 01376 0 01087 0 00840 0 00698 0 00635 0 00552 0 00597 0 00527 0 00482 0 00192 0 00536 0 00521	

(Hammel, Z phys Ch 1915, **90** 121)

Absorption of  $N_2$  by glycerine + Aq

$t^\circ$  = temp of the solution

P = % glycerine in the solution

$\beta t^\circ$  = coefficient of absorption at  $t^\circ$

$\beta 15^\circ$  = coefficient of absorption at  $15^\circ$

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
16 1	25 0	0 01240	0 01266
15 6	42 2	0 00966	0 00976
14 7	51 5	0 00759	0 00759
14 9	58 0	0 00703	0 0070
15 9	80 25	0 00520	0 00530
16 2	90 0	0 00570	0 0058
18 0	95 0	0 00578	0 00716

(Muller, Z phys Ch 1912, **81** 196)



Solubility of  $N_2$  in glycerine + Aq at  $25^\circ$   
 G = % by wt of glycerine in the solvent  
 S = solubility of  $N_2$   
 P = corrected pressure at end of experiment  
 in mm Hg at  $0^\circ$

G	P	S
16	598.4	0.0103
"	915.5	0.0103
29.7	556.5	0.0067
"	846.5	0.0068
48.9	617.7	0.0052
"	859.8	0.0051
74.5	588.5	0.0025
84.1	637.3	0.0024
"	757.0	0.0024

(Drucker and Moles, Z phys Ch 1910, 75 418)

Absorption of  $N_2$  by sucrose + Aq

$t^\circ$  = temp of the solution

P = % sucrose in the solution

$\beta_{t^\circ}$  = coefficient of absorption at  $t^\circ$

$\beta_{15^\circ}$  = coefficient of absorption at  $15^\circ$

$t^\circ$	P	$\beta_{t^\circ}$	$\beta_{15^\circ}$
16.2		0.01670	0.01700
17.2		0.01622	0.01688
16.8	11.38	0.01432	0.01480
16.9	20.00	0.01233	0.01280
17	29.93	0.01025	0.01053
17.8	30.12	0.01033	0.01090
18	47.89	0.00742	0.00785
17.7	48.57	0.00658	0.00700

(Muller, Z phys Ch 1912, 81 493)

Absorption of  $N_2$  by organic substances + Aq  
 at  $t^\circ$

V = absorbed volume reduced to  $0^\circ$  and  
 760 mm

$\alpha$  = coefficient of absorption

Solution	Vol of solution ccm	t	V ccm	$\alpha$
N-dextrose	409.94	20.18	4.55	0.01215
$\frac{1}{2}$ N-dextrose	409.94	20.21	5.14	0.01380
$\frac{3}{4}$ N-dextrose	409.94	20.2	5.51	0.01480
N-levulose	409.94	20.25	4.27	0.01221
N-arabinose	409.94	20.21	4.40	0.01203
N-erythritol	409.94	20.25	4.87	0.01321
N-alanine	409.94	20.19	4.445	0.01213
N-glycocol	409.94	20.16	4.47	0.01212
N-urea	409.94	20.18	5.37	0.01477
N-acetamide	409.94	20.22	5.385	0.01475

(Hufner, Z phys Ch 1907, 57 618-621)

**Nitrogen bromide,  $NBr_3$**

Decomp under  $H_2O$

**Nitrogen bromophosphide,  $PBr_2N$**

Insol in  $H_2O$  Sol in ether, less sol in C  
 or  $CHCl_3$  (Besson, C R 114 1479)

**Nitrogen bromosulphide**

See Nitrogen sulphobromide

**Nitrogen chloride,  $NCl_3$**

Very unstable Explodes when heated  
 $93^\circ$  or by contact with other substance  
 Insol in  $H_2O$ , but is decomp thereby (in 4  
 hours by cold  $H_2O$ ) Sol in  $CS_2$ ,  $PCl_3$ , a  
 $S_2Cl_2$  (H Davy, Phil Trans 1813, 1. 24)  
 Sol in  $C_6H_6$ ,  $CS_2$ ,  $CHCl_3$ ,  $CCl_4$  (Hentsch  
 B 1897, 30 1434)

**Nitrogen chlorophosphide,  $N_3P_3Cl_6$**

Insol in  $H_2O$ , but slowly decomp there  
 Insol in hot  $H_2SO_4$ ,  $HCl$ , or  $HNO_3$  +  
 Decomp by hot fuming  $HNO_3$  Sol in  
 alcohol, very sol in ether, but these solut  
 gradually decompose Sol in  $CS_2$ ,  $CHC$   
 $C_6H_6$ , and oil of turpentine  
 Sol in  $POCl_3$  (Gladstone, Chem Soc  
 138)

**Nitrogen chlorosulphide**

See Nitrogen sulphochloride

**Nitrogen fluoride**

Very explosive (Warren, C N 55 289)

**Nitrogen moniodamine,  $NH_2I$**

Very rapidly decomp by  $H_2O$  into  $N_2H$   
 (Raschig, A 230 212)

**Nitrogen diiodamine,  $NHI_2$**

Properties as triioddiamine

**Nitrogen triioddiamine,  $NH_3, NI_3$**

Decomp by  $H_2O$  (Raschig, A 230 21)  
 Insol in absolute alcohol Sol with  
 comp in  $HCl$  + Aq (Bunsen)

**Nitrogen iodide,  $N_3I$**

See Triaziodide

**Nitrogen iodide,  $NI_3$**

Insol in  $H_2O$ , but slowly decomp there  
 Sol in  $HCl$  + Aq Sol in  $KCN$  + Aq (N 1-  
 lon, J pr 17 1)  
 Sol in  $Na_2S_2O_3$  + Aq (Guyard, C R 7  
 526)  
 Sol in  $KSCN$  + Aq (Raschig, A 230 2)

**Nitrogen iodide ammonia,  $NI_3, 3NH_3, I$**   
 $2NH_3$ , and  $NI_3, NH_3$

(Hugot, C R 1900, 130 507)

$NI_3, 12NH_3$  Ppt, insol in ether (R ff,  
 B 1900, 33 3028)

**Nitrogen monoxide, N<sub>2</sub>O**

- (a) *Liquid* Miscible with alcohol or ether  
 (b) *Gas*

1 vol H<sub>2</sub>O absorbs 0.78–0.86 vol N<sub>2</sub>O at ordinary temp (Henry) 0.80 vol at ordinary temp (Dalton)  
 0.76 vol at ordinary temp (de Saussure) 0.708 vol at 18 (Plesch) 0.54 vol (Davy)

1 vol H<sub>2</sub>O at t° and 760 mm absorbs V vols N<sub>2</sub>O, reduced to 0° and 760 mm

t°	V	t°	V
0	1.3052	13	0.8304
1	1.2605	14	0.8034
2	1.2172	15	0.7778
3	1.1752	16	0.7535
4	1.1346	17	0.7306
5	1.0954	18	0.7090
6	1.0575	19	0.6888
7	1.0210	20	0.6700
8	0.9858	21	0.6525
9	0.9520	22	0.6364
10	0.9196	23	0.6216
11	0.8885	24	0.6082
12	0.8588		

(Bunsen's Gasometry)

1 vol H<sub>2</sub>O absorbs 1.30521–0.0453620t + 0.00068430t<sup>2</sup> vols N<sub>2</sub>O at t° and 760 mm (Bunsen)

Coefficient of absorption by H<sub>2</sub>O = 0.01883 at 15° (Steiner, Z phys Ch 1895, 18 14)

Coefficient of absorption by H<sub>2</sub>O = 0.600 at 23.5°, 0.773 at 15.5°, 0.951 at 8.1° (Gordon, Z phys Ch 1895, 18 4)

Absorption of N<sub>2</sub>O by H<sub>2</sub>O at t°

t	Coefficient of absorption
25	0.5752
20	0.6654
15	0.7896
10	0.9479
5	1.1403

(Roth, Z phys Ch 1897, 24 123)

Solubility in H<sub>2</sub>O at 25° = 0.5942, at 20° = 0.6756, at 15° = 0.7784, at 10° = 0.9101, at 5° = 1.067 (For formula for "solubility," see under oxygen) (Geffcken, Z phys Ch 1904, 49 278)

Solubility of N<sub>2</sub>O in H<sub>2</sub>O = 0.592 at 25° and 758–136° mm pressure (Findlay and Creighton, Chem Soc 1910, 97 538)

100 vols H<sub>2</sub>SO<sub>4</sub> (sp gr = 1.84) absorb 75.7 vols N<sub>2</sub>O, 100 vols H<sub>2</sub>SO<sub>4</sub> + Aq (sp gr = 1.80) absorb 66.0 vols N<sub>2</sub>O, 100 vols H<sub>2</sub>SO<sub>4</sub> + Aq (sp gr = 1.705) absorb 39.1 vols N<sub>2</sub>O, 100 vols H<sub>2</sub>SO<sub>4</sub> + Aq (sp gr = 1.45) absorb 41.6 vols N<sub>2</sub>O, 100 vols H<sub>2</sub>SO<sub>4</sub> + Aq (sp gr = 1.25) absorb 33.0 vols N<sub>2</sub>O

CaCl<sub>2</sub> + Aq, and NaCl + Aq absorb considerable amounts of N<sub>2</sub>O (Lunge, B 14 2188)

Absorption by acids + Aq

M = content in gram-equivalents per liter  
 S = solubility (see under Oxygen)

Absorption of N<sub>2</sub>O by HNO<sub>3</sub> + Aq

M	S 25	S 15°
0.610	0.5969	0.7770
0.614	0.5980	0.7766
1.253	0.6045	0.7767
1.254	0.6061	0.7767
2.405	0.6156	0.7735
2.435	0.6149	0.7737

(Geffcken, Z phys Ch 1904, 49 278)

Absorption of N<sub>2</sub>O by HCl + Aq

M	S 25°	S 15°
0.549	0.5775	0.7550
0.550	0.5759	0.7528
1.089	0.5670	0.7360
1.093	0.5657	0.7347
2.300	0.5546	0.7103
2.340	0.5564	0.7122

(Geffcken)

Absorption of N<sub>2</sub>O by  $\frac{\text{H}_2\text{SO}_4}{2}$  + Aq

M	S 25	S 15
0.523	0.5648	0.7328
0.526	0.5657	0.7340
1.050	0.5426	0.6997
1.054	0.5419	0.6984
2.042	0.5083	0.6440
2.047	0.5087	0.6428
2.971	0.4819	0.6024
2.963	0.4820	0.6030
3.897	0.4569	0.5648
3.973	0.4577	0.5640

(Geffcken)

Absorption of N<sub>2</sub>O by H<sub>3</sub>PO<sub>4</sub> + Aq at t°

t	% of H <sub>3</sub> PO <sub>4</sub>				
	3.38%	4.72%	8.84%	9.89%	13.30%
5	1.057	1.0365	0.9883	0.9635	0.9171
10	0.8827	0.8665	0.8296	0.8101	0.7711
15	0.7388	0.7258	0.6977	0.6826	0.6505
20	0.6253	0.6147	0.5926	0.5810	0.5555
25	0.5427	0.5329	0.5143	0.5054	0.4860

(Roth, Z phys Ch 1897, 24 134)

100 vols conc FeSO<sub>4</sub> + Aq absorb 19.5 vols N<sub>2</sub>O

Solubility of N<sub>2</sub>O in a solution containing 47.7 g Fe(OH)<sub>3</sub> per litre at 25° = 0.5799, 47.9 g Fe(OH)<sub>3</sub> per litre at 25° = 0.5787 (Geffcken, Z phys Ch 1904, 49 299)

100 vols KOH+Aq (sp gr = 1.12) absorb 18.7 vols  $N_2O$ , 100 vols KOH+Aq sat with pyrogallol absorb 18.1 vols  $N_2O$ , 100 vols NaOH+Aq (sp gr = 1.1) (7% NaOH) absorb 23.1 vols  $N_2O$ , 100 vols NaOH+Aq sat with pyrogallol absorb 28.0 vols  $N_2O$

Absorption of  $N_2O$  by KOH+Aq

M = content in gram-equivalents per litre

S = solubility (see under oxygen)

M	S 25°	S 15°
0.541	0.5087	0.6591
0.542	0.5093	0.6595
1.074	0.4252	0.5427
1.082	0.4221	0.5392

(Geffcken, Z phys Ch 1904, 49 278)

Coefficient of solubility of  $N_2O$  in salts+Aq at  $t^\circ$

Salt	Concentration of salt		Coeff of absorption at			
	G per 100 g solution	G mol per l	5°	10°	15°	20°
CaCl <sub>2</sub>	5.790 9.860 13.991	0.547 0.964 1.416	0.819 0.608 0.510	0.697 0.586 0.441	0.591 0.509 0.380	0.500 0.435 0.328
LiCl	1.350 3.850 11.482	0.319 0.928 2.853	0.986 0.878 0.606	0.831 0.743 0.512	0.700 0.629 0.437	0.599 0.536 0.382
Li <sub>2</sub> SO <sub>4</sub>	2.370 5.460 8.560	0.219 0.521 0.836	0.934 0.795 0.646	0.792 0.665 0.555	0.670 0.557 0.477	0.569 0.474 0.415
MgSO <sub>4</sub>	5.900 7.660 10.780	0.521 0.687 0.997	0.766 0.708 0.569	0.664 0.586 0.491	0.561 0.486 0.417	0.471 0.414 0.346
KCl	4.900 7.641 14.582 22.083	0.676 1.037 2.187 3.414	0.879 0.799 0.654 0.544	0.751 0.693 0.574 0.459	0.643 0.591 0.500 0.390	0.555 0.494 0.430 0.339
K <sub>2</sub> SO <sub>4</sub>	2.620 4.780	0.154 0.285	0.986 0.918	0.831 0.763	0.701 0.637	0.605 0.542
NaCl	6.201 8.881 12.782	1.107 1.614 2.391	0.800 0.713 0.634	0.682 0.603 0.532	0.585 0.510 0.449	0.509 0.434 0.386
Na <sub>2</sub> SO <sub>4</sub>	5.760 8.530 12.440	0.427 0.646 0.974	0.808 0.692 0.559	0.677 0.574 0.486	0.584 0.482 0.417	0.495 0.416 0.354
SrCl <sub>2</sub>	3.310 5.730 13.240	0.215 0.380 0.939	0.928 0.848 0.644	0.788 0.709 0.547	0.671 0.610 0.463	0.578 0.556 0.390

(Gordon, Z phys. Ch 1895, 18 5)

Absorption of  $N_2O$  by salts+Aq at 15°  
M = number of molecules of salt per litre.  
 $\alpha$  = coefficient of absorption

Salt	M	$\alpha$
KCl	3.554 2.909 1.755 1.051 0.526	0.0892 0.1012 0.1279 0.1489 0.1667
KNO <sub>3</sub>	2.430 1.820 1.541 0.879 0.482	0.1180 0.1311 0.1391 0.1559 0.1683
K <sub>2</sub> CO <sub>3</sub>	4.352 2.939 2.156 1.376 0.690 0.341 0.209	0.0160 0.0285 0.0462 0.0761 0.1183 0.1501 0.1628
NaCl	4.815 2.801 2.049 0.825	0.0595 0.0925 0.1130 0.1548
NaNO <sub>2</sub>	5.711 3.980 2.656 1.413 0.679	0.0578 0.0810 0.1052 0.1370 0.1603
Na <sub>2</sub> CO <sub>3</sub>	1.218 0.819 0.438 0.207	0.0839 0.1082 0.1385 0.1639
Na <sub>2</sub> SO <sub>4</sub>	1.364 0.638 0.335	0.0775 0.1254 0.1519
LiCl	3.734 1.800 0.835	0.0990 0.1370 0.1619
MgSO <sub>4</sub>	2.501 1.631 0.936 0.433	0.0499 0.0797 0.1159 0.1501
ZnSO <sub>4</sub>	2.180 1.277 0.899 0.397	0.0605 0.0961 0.1175 0.1525
CaCl <sub>2</sub>	2.962 2.556 1.827 1.122 0.578 0.321	0.0519 0.0619 0.0839 0.1138 0.1450 0.1619

(Steiner, Z phys Ch 1895, 18 14-5)

Coefficient of absorption of  $N_2O$  by  $NaCl$ +  
Aq at  $t^\circ$ 

$t^\circ$	Per cent of $NaCl$			
	0 990	1 808	3 886	5 865
5	1 0609	1 0032	0 9131	0 8428
10	0 8812	0 8383	0 7699	0 7090
15	0 7339	0 7026	0 6495	0 5976
20	0 6191	0 5962	0 5520	0 5088
25	0 5363	0 5190	0 4775	0 4424

(Roth, Z phys Ch 1897, 24 139)

Absorption of  $N_2O$  by salts+Aq at  $20^\circ$ C=concentration of the solution in terms  
of normal $\alpha$ =coefficient of absorptionAbsorption of  $N_2O$  by  $KNO_3$ +Aq at  $20^\circ$ 

P	C	$\alpha$
0		0 6270
1 063	0 1061	0 6173
2 720	0 2764	0 6002
5 389	0 5630	0 5713
10 577	1 1683	0 5196

Absorption of  $N_2O$  by  $NaNO_3$ +Aq at  $20^\circ$ 

P	C	$\alpha$
0		0 6270
1 124	0 1336	0 6089
2 531	0 3052	0 5876
5 077	0 6286	0 5465
8 701	1 1200	0 4926

(Knopp, Z phys Ch 1904, 48 107)

Absorption of  $N_2O$  by salts+AqM=content in gram-equivalents per litre  
S=solubility

Salt	M	S $25^\circ$	S $1^\circ$
$NH_4Cl$	0 598	0 5532	0 7203
	0 600	0 5504	0 7185
	1 158	0 5223	0 6800
	1 166	0 5200	0 6775
KI	0 550	0 5367	0 6950
	0 557	0 5344	0 6916
	0 886	0 5025	0 6466
	0 913	0 5012	0 6442
	0 514	0 5428	0 7074
	0 545	0 5406	0 7036
LiCl	0 558	0 5276	0 6884
	0 561	0 5278	0 6877
	1 057	0 4760	0 6163
	1 059	0 4773	0 6146

Absorption of  $N_2O$  by salts+Aq—  
*Continued*

Salt	M	S $25^\circ$	S $15^\circ$
KBr	0 546	0 5306	0 6877
	0 550	0 5318	0 6892
	0 937	0 4908	0 6352
	0 959	0 4899	0 6334
RbCl	0 439	0 5399	0 7050
	0 444	0 5386	0 7053
	0 977	0 4873	0 6306
	0 993	0 4846	0 6276
	0 558	0 5218	0 6782
	0 559	0 5217	0 6787
	1 070	0 4673	0 6046
	1 102	0 4639	0 6020

(Geffcken, Z phys Ch 1904, 49 278)

Solubility of  $N_2O$  in a solution containing  
39.6 g  $As_2S_3$  per litre at  $25^\circ$ =0 5819, 42.4 g  
 $As_2S_3$  per litre at  $25^\circ$ =0 5833 (Geffcken)1 vol alcohol at  $t^\circ$  and 760 mm absorbs V  
vols  $N_2O$  gas reduced to  $0^\circ$  and 760 mm

$t^\circ$	V	t	V
0	4 1780	13	3 3734
1	4 1088	14	3 3200
2	4 0409	15	3 2678
3	3 9741	16	3 2169
4	3 9085	17	3 1672
5	3 8442	18	3 1187
6	3 7811	19	3 0714
7	3 7192	20	3 0253
8	3 6585	21	2 9805
9	3 5990	22	2 9368
10	3 5408	23	2 8944
11	3 4838	24	2 8532
12	3 4279		

(Bunsen's Gasometry)

Coefficient of absorption=4 17805—  
0 0698160t+0 0006090t<sup>2</sup> (Carius)At 18 and 760 mm 100 vols  $H_2O$  absorb 76 vols  
 $N_2O$  100 vols alcohol of 0.840 sp gr absorb 153 vols  
100 vols rectified naphtha of 0.754 sp gr absorb 254  
vols 100 vols oil of lavender of 0.880 sp gr absorb  
275 vols 100 vols olive oil of 0.915 sp gr absorb 150  
vols 100 vols sat  $KCl$ +Aq (2%  $KCl$ ) of 1.212 sp  
gr absorb 29 vols (de Saussure 1814)  
1 vol oil of turpentine absorbs 2.5-2.7 vols  $N_2O$   
(de Saussure)Absorption of  $N_2O$  by glycerine+Aq at  $t^\circ$ 

t	% by weight of glycerine			
	3 460%	6 720%	12 12%	16 244%
25	0 5558	0 5415	0 5268	0 5083
20	0 6468	0 6303	0 6050	0 5851
15	0 7672	0 7454	0 7098	0 6857
10	0 9172	0 8871	0 8411	0 8102
5	1 0967	1 0552	0 9990	0 9586

(Roth, Z phys Ch 1897, 24 128)

Absorption of  $N_2O$  by urea+Aq at  $t^\circ$ 

$t^\circ$	% by weight of urea				
	3 312%	4 974%	6 366%	7 296%	9 966%
25	0 5686	0 5669	0 5588	0 7502	0 5689
20	0 6533	0 6558	0 6539	0 6553	0 6508
15	0 7708	0 7732	0 7605	0 7722	0 7614
10	0 9209	0 9201	0 9086	0 9208	0 9007
5	1 1040	1 0964	1 0880	1 1012	1 0685

(Roth, Z phys Ch 1897, 24 124)

Absorption of  $N_2O$  by sugar+Aq at  $15^\circ$ 

Number of molecules of $C_{12}H_{22}O_{11}$ per litre	Coefficient of absorption
1 699	0 0892
0 993	0 1284
0 520	0 1561

(Steiner, Z phys Ch 1895, 18 15)

Absorption of  $N_2O$  by organic substances + Aq

C = concentration of the solution in terms of normal

 $\alpha$  = coefficient of absorptionAbsorption of  $N_2O$  by chloral hydrate+Aq at  $20^\circ$ 

P	C	$\alpha$
0		0 6270
2 947	0 184	0 6182
6 848	0 445	0 6128
13 48	0 942	0 5960
16 15	1 165	0 5891
19 60	1 474	0 5793
24 02	1 911	0 5675

(Knopp, Z phys Ch 1904, 48 106)

Absorption of  $N_2O$  by propionic acid+Aq at  $20^\circ$ 

P	C	$\alpha$
0		0 6270
1 492	0 2045	0 6323
5 702	0 816	0 6369
13 680	2 140	0 6504
15 011	2 385	0 6534
25 589	4 645	0 7219

(Knopp, Z phys Ch 1904, 48 107)

Absorption of  $N_2O$  by oxalic acid+Aq at  $t^\circ$ 

$t^\circ$	Coeff of abs in $H_2C_2O_4$ +Aq of given % strength	
	8 122%	3 699%
25	0 5786	0 5643
20	0 6694	0 6538
15	0 7940	0 7745
10	0 9526	0 9264
5	1 1450	1 1094

(Roth, Z phys Ch 1897, 24 130)

Coefficient of absorption for petroleum = 2.11 at  $20^\circ$ , 2.49 at  $10^\circ$  (Gniewasz and Walfisz, Z phys Ch 1 70)

The solubility of  $N_2O$  in various colloidal solutions has been determined by Findlay and Creighton (Chem Soc 1910, 97 538), for which see original article

## Nitrogen dioxide, NO

1 vol  $H_2O$  absorbs 0.1 vol NO gas at ordinary temp (Davy) 1 vol absorbs 0.05 vol (Henry) 1 vol absorb 1/27 vol (Dalton)

Absorption of NO by  $H_2O$  at 760 mm pressure $\beta$  = Coefficient of absorption $\beta'$  = "Solubility"

$t^\circ$	$\beta$	$\beta'$	$t^\circ$	$\beta$	$\beta'$
0	0 07381	0 07337	55	0 03040	0 0257
5	6461	6406	60	2954	237
10	5709	5640	65	2877	216
15	5147	5061	70	2810	194
20	4706	4599	75	2751	170
25	4323	4189	80	2700	143
30	4004	3838	85	2665	114
35	3734	3529	90	2648	081
40	3507	3254	95	2638	043
45	3311	3000	100	2628	000
50	3152	2771			

(Winkler, B 1901, 34 1414)

205.69 cc  $H_2O$  absorb 9.6798 cc NO at 20 and 760 mm (Hufner, Z phys Ch 190, 59 420)

Sol in conc  $HNO_3$ +Aq

100 vols  $HNO_3$ +Aq of 1.3 sp gr agitate with NO gas take up 20 vols NO. If acid twice as strong or one-half as strong, the quantity NO is proportional to the amount of  $HNO_3$ . Very dil  $HNO_3$ +Aq absorb scarcely more NO than pure  $H_2O$  (Dalton)

100 pts  $HNO_3$ +Aq of 1.4 sp gr absorb 90 pts N (Dalton) sol in Br and very sl sol in conc  $H_2SO_4$  (Berthelot)

1 ccm conc  $H_2SO_4$  of 1.84 sp gr absorb 0.035 ccm NO, of 1.50 sp gr, 0.017 ccm NO (Lunge, B 18 1391)

Absorption of NO by  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $18^\circ$  and 760 mm

$\alpha$  = Coefficient of solubility

$\text{H}_2\text{SO}_4$	$\alpha$	$\text{H}_2\text{SO}_4$	$\alpha$
98%	not constant	70%	0 0118
90%	0 0193	60%	0 0118
80%	0 0117	50%	0 0120

(Tower, Z anorg 1906, 50 387)

Very sol in aqueous solutions of ferrous salts, especially the sulphate (Priestley)

1 vol  $\text{FeSO}_4 + \text{Aq}$  of 1 081 sp gr, containing 1 gram  $\text{FeSO}_4$  to 6 grains  $\text{H}_2\text{O}$ , absorbs 6 vols NO (Dalton)

Absorption by ferrous salts + Aq is proportional to the amount of Fe present, irrespective of the acid or concentration of the solution. Between  $0^\circ$  and  $10^\circ$ , about 2 mols NO are absorbed for each atom of Fe, between  $10^\circ$  and  $15^\circ$ , 1 mol NO for 2 atoms of Fe, and at  $25^\circ$ , only 1 mol NO for  $2\frac{1}{2}$  to 3 atoms of Fe. The amount of NO absorbed also varies with the pressure. The sp gr of the ferrous salt solution is greater after the absorption of NO than before. The solutions are decomp by heat, and at  $100^\circ$  all NO is given off (Gay, A ch (6) 5 145)

Absorption of NO by  $\text{FeSO}_4 + \text{Aq}$  at  $25^\circ$

A = vol  $\text{H}_2\text{O}$  (in litres) containing 1 mol  $\text{FeSO}_4$

V = vol NO (in litres) absorbed

A	V	A	V
1 2	1 47	7 2	5 52
1 8	2 01	12 0	6 46
2 4	2 55	18 6	8 01
4 82	4 40	36 0	10 40

(Kohlschutter, B 1907, 40 877)

Absorption of NO by  $\text{FeSO}_4 + \text{Aq}$  at  $t^\circ$

205 69 cc  $\text{FeSO}_4 + \text{Aq}$  contain 0 0221 g Fe

Coefficient of absorption = 0 06067 at  $20 09^\circ$

$t^\circ$	Pressure mm	NO absorbed ccm
20 1	704 9	14 42
20 1	683 5	14 10
20 1	668 6	13 80
20 2	651 9	13 58
20 05	632 9	13 15
20 0	613 7	12 98

Absorption of NO by  $\text{FeSO}_4 + \text{Aq}$  at  $t^\circ$  —  
*Continued*

205 69 cc of  $\text{FeSO}_4 + \text{Aq}$  contain 0 0296 g Fe

Coefficient of absorption = 0 06505

$t^\circ$	Pressure mm	NO absorbed ccm
20 05	677 5	14 30
20 05	655 3	14 07
20 04	639 1	13 81
20 00	620 2	13 39
20 15	600 5	13 20
20 14	581 2	12 92

205 69 cc of  $\text{FeSO}_4 + \text{Aq}$  contain 0 0409 g Fe

Coefficient of absorption = 0 06684

$t^\circ$	Pressure mm	NO absorbed ccm
20 04	667 6	16 79
20 02	650 6	16 65
20 00	613 1	15 71
20 00	594 6	15 41
20 10	577 1	15 32

205 69 cc of  $\text{FeSO}_4 + \text{Aq}$  contain 0 0513 g Fe

Coefficient of absorption = 0 07981

$t^\circ$	Pressure mm	NO absorbed ccm
20 10	644 8	18 82
20 10	623 8	18 47
20 08	606 4	18 02
20 10	589 7	17 56
20 10	571 1	17 19
20 10	553 1	16 95

205 69 cc of  $\text{FeSO}_4 + \text{Aq}$  contain 0 0663 g Fe

Coefficient of absorption = 0 08059

$t^\circ$	Pressure mm	NO absorbed ccm
20 10	697 3	21 91
20 10	678 9	21 60
20 10	660 4	21 18
20 08	638 2	20 71
20 04	620 7	20 28
20 00	602 5	19 87

205 69 cc of  $\text{FeSO}_4 + \text{Aq}$  contain 0 099 g Fe

Coefficient of absorption = 0 11661

$t^\circ$	Pressure mm	NO absorbed ccm
20 10	649 9	34 26
20 15	631 1	33 82
20 20	618 4	33 26
20 00	603 3	32 76
19 85	588 6	32 34
19 85	574 2	31 95

(Hufner, Z phys Ch 1907, 59 419)

Absorption of NO by  $\text{NiSO}_4 + \text{Aq}$  at  $t^\circ$   
 205 69 cc  $\text{NiSO}_4 + \text{Aq}$  contain 0 0506 g Ni  
 Coefficient of absorption = 0 08311

$t^\circ$	Pressure mm	NO absorbed ccm
20 2	654 7	23 00
20 2	629 8	22 54
20 2	609 5	22 03
20 15	591 7	21 65
20 14	573 4	21 18

(Hufner, *l c*)

Absorption of NO by  $\text{CoSO}_4 + \text{Aq}$  at  $t^\circ$   
 205 69 cc  $\text{CoSO}_4 + \text{Aq}$  contain 0 0598 g Co  
 Coefficient of absorption = 0 09146

$t^\circ$	Pressure mm	NO absorbed ccm
20 15	678 3	23 47
20 16	653 5	23 01
20 20	636 6	22 55
20 30	615 9	21 99
20 40	600 0	21 56

(Hufner, *l c*)

Absorption of NO by  $\text{MnCl}_2 \cdot 4\text{H}_2\text{O} + \text{Aq}$  at  $t^\circ$   
 205 69 cc  $\text{MnCl}_2 \cdot 4\text{H}_2\text{O} + \text{Aq}$  contain 0 0697 g Mn  
 Coefficient of absorption = 0 06111

$t^\circ$	Pressure mm	NO absorbed ccm
20 0	711 96	14 25
20 05	686 5	13 99
20 2	657 4	13 49
20 3	638 9	13 05
20 45	621 0	12 81

(Hufner, *l c*)

Coefficient of absorption for  $\text{FeSO}_4 + \text{Aq}$  of concentration used by Hufner (*Z phys Ch* 1907, 59 417) = 0 180 at  $20^\circ$  Hufner's results are incorrect because he assumed that the absorption-coefficient of NO always had the same value, whereas it does not NO is reduced by  $\text{FeSO}_4 + \text{Aq}$  (Usher, *Z phys Ch* 1908, 62 624)

Coefficient of absorption for  $\text{CoSO}_4 + \text{Aq}$  sat at  $20^\circ$  = 0 0288 (Usher, *Z phys Ch* 1908, 62 624)

Coefficient of absorption for  $\text{NiSO}_4 + \text{Aq}$  of the concentration used by Hufner (*cf Z phys Ch* 1907, 59 422) = 0 048 at  $20^\circ$

Coefficient of absorption for  $\text{NiSO}_4 + \text{Aq}$  sat at  $20^\circ$  = 0 0245 (Usher, *l c*)

Coefficient of absorption for  $\text{MnCl}_2 + \text{Aq}$  sat at  $20^\circ$  = 0 0082 (Usher, *Z phys Ch* 1908, 62 624)

Absorption of NO by  $\text{FeCl}_2 + \text{Aq}$  at  $22^\circ$   
 A = vol  $\text{H}_2\text{O}$  (in litres) containing 1 mol  $\text{FeCl}_2$   
 V = vol NO (in litres) absorbed

A	V
2 5	3 30
5 18	4 83
10 35	6 56
20 7	8 32
51 8	11 89

(Kohlschutter, B 1907, 40 878)

Absorption by  $\text{HCl} + \text{FeCl}_2 + \text{Aq}$   
 10 37 l 30%  $\text{HCl}$  containing 1 mol  $\text{FeCl}_2$  in solution absorb 15 64 l NO  
 10 37 l 10%  $\text{HCl}$  containing 1 mol  $\text{FeCl}_2$  in solution absorb 6 17 l NO

(Kohlschutter, *l c*)

Absorption by salts +  $\text{FeCl}_2 + \text{Aq}$   
 10 37 l sat  $\text{NaCl} + \text{Aq}$  containing 1 mol  $\text{FeCl}_2$  in solution absorb 6 549 l NO  
 10 37 l sat  $\text{NH}_4\text{Cl} + \text{Aq}$  containing 1 mol  $\text{FeCl}_2$  in solution absorb 6 549 l NO

(Kohlschutter, *l c*)

Solubility of NO in  $\text{Fe}(\text{NO}_3)_2 + \text{Aq}$  at  $23^\circ$   
 A = vol  $\text{H}_2\text{O}$  (in litres) containing 1 mol  $\text{Fe}(\text{NO}_3)_2$   
 V = vol NO (in litres) absorbed

A	V
3 25	2 77
6 50	4 16
13 00	5 54
26 00	6 61

(Kohlschutter, *l c*)

Absorption of NO by  $\text{CuCl}_2 + \text{Aq}$   
 A = vol  $\text{H}_2\text{O}$  (in litres) containing 1 mol  $\text{CuCl}_2$   
 V = vol NO (in litres) absorbed

A	V
0 231	0 120
0 277	0 098
0 371	0 052

(Kohlschutter, *l c*)

Absorption of NO by  $\text{CuCl}_2 + \text{conc HCl}$   
 A = vol conc  $\text{HCl}$  (in litres) containing 1 mol  $\text{CuCl}_2$   
 V = vol NO (in litres) absorbed

A	V	A	V
0 389	0 801	7 499	3 931
0 410	0 933	12 500	3 606
0 840	2 838	18 750	3 153
1 230	3 426	28 650	1 976
2 462	3 989		

(Kohlschutter, *l c*)

Absorption of NO by  $\text{CuCl}_2$  + acetic acid  
 A = vol acetic acid (in litres) containing 1 mol  $\text{CuCl}_2$   
 V = vol NO (in litres) absorbed

A	V
252	51 77
504	39 67
1269	81 60

(Kohlschutter, l c)

Absorption of NO by  $\text{CuCl}_2$  + 98% formic acid

A = vol 98% formic acid (in litres) containing 1 mol  $\text{CuCl}_2$   
 V = vol NO (in litres) absorbed

A	V
27 9	12 76
56 0	13 17
140 0	14 34
280 0	18 68
1400 0	27 29

(Kohlschutter, l c)

Absorption of NO by  $\text{CuCl}_2$  + acetone

A = vol acetone (in litres) containing 1 mol  $\text{CuCl}_2$   
 V = vol NO (in litres) absorbed

A	V	A	V
4 667	14 04	291 60	40 99
29 16	24 01	583 20	67 22
58 33	24 60	1166 40	81 96

(Kohlschutter, l c)

Absorption of NO by  $\text{CuCl}_2$  + methyl alcohol

A = vol methyl alcohol (in litres) containing 1 mol  $\text{CuCl}_2$   
 V = vol NO (in litres) absorbed

A	V	A	V
1 60	3 30	20 50	6 15
8 22	5 60	82 25	4 90

(Kohlschutter, l c)

Absorption of NO by  $\text{CuCl}_2$  + ethyl alcohol

A = vol ethyl alcohol (in litres) containing 1 mol  $\text{CuCl}_2$   
 V = vol NO (in litres) absorbed

A	V	A	V
1 50	8 70	38 41	18 15
3 84	12 38	76 83	18 05
12 80	15 43	192 10	15 92

(Kohlschutter, l c)

Absorption of NO by  $\text{CuBr}_2$  + Aq  
 A = vol  $\text{H}_2\text{O}$  (in litres) containing 1 mol  $\text{CuBr}_2$   
 V = vol NO (in litres) absorbed

A	V
0 37	0 515
0 62	0 120
0 925	0 000

(Kohlschutter, l c)

Absorption of NO by  $\text{CuBr}_2$  + ethyl alcohol

A = vol alcohol (in litres) containing 1 mol  $\text{CuBr}_2$   
 V = vol NO (in litres) absorbed

A	V	A	V
2 625	16 02	131 20	22 23
5 25	19 26	262 50	23 46
13 12	20 51	656 10	30 46
43 74	21 13		

(Kohlschutter, l c)

Sol in stannous and chromous salts + Aq (Pelgot)

Not absorbed by  $\text{Fe}_2(\text{SO}_4)_3$  + Aq (Dalton)  
 1 vol absolute alcohol absorbs 0.31606 - 0.003487t + 0.000049t<sup>2</sup> vols NO between 0° and 25° (Bunsen)

1 vol alcohol at t° and 760 mm absorbs V vols NO gas reduced to 0° and 760 mm

t°	V	t°	V
0	0 31606	13	0 27901
1	0 31262	14	0 27685
2	0 30928	15	0 27478
3	0 30604	16	0 27281
4	0 30290	17	0 27094
5	0 29985	18	0 26917
6	0 29690	19	0 26750
7	0 29405	20	0 26592
8	0 29130	21	0 26444
9	0 28865	22	0 26306
10	0 28609	23	0 26178
11	0 28363	24	0 26060
12	0 28127		

(Bunsen's Gasom (try))

Abundantly absorbed by  $\text{CS}_2$  (Friedburg, C N 48 97)

Nitrogen trioxide,  $\text{N}_2\text{O}_3$

Sol in  $\text{H}_2\text{O}$  at 0° If large amt of  $\text{H}_2\text{O}$  is present, the solution is quite stable at ordinary temp (Fremy, C R 79 61)

Sol in  $\text{HNO}_3$  + Aq

Sol in conc  $\text{H}_2\text{SO}_4$  to form  $\text{HNOSO}_4$

Sol in ether



**Nitrogen trioxide stannic chloride**,  $N_2O_3$ ,  $SnCl_4$

Decomp by  $H_2O$  (Weber, Pogg 118 471)

**Nitrogen tetroxide**,  $NO_2$  or  $N_2O_4$

Sol in  $H_2O$  at  $0^\circ$  with decomp Miscible with very conc  $HNO_3$  Absorbed abundantly by  $CS_2$ ,  $CHCl_3$ , and  $C_6H_5Cl$  (Friedburg, C N 47 52)

Sol in  $C_6H_5NO_2$

Sl sol in  $H_2S + Aq$

Sol in  $H_2SO_4$  or conc  $HNO_3 + Aq$

$H_3PO_4$  absorbs some liquid  $NO_2$  (Frankland, Chem Soc 1901, 79 1362)

**Nitrogen pentoxide**,  $N_2O_5$

Very deliquescent Combines with  $H_2O$  to form  $HNO_3$  with evolution of heat

**Nitrogen hexoxide**,  $NO_3$

Decomposes upon air or with  $H_2O$  (Hautefeuille and Chappins, C R 92 80, 134, 94 1111, 1306)

**Nitrogen oxybromide**

See Nitrosyl and Nitroxyl bromide

**Nitrogen oxychloride**

See Nitrosyl and Nitroxyl chloride

**Nitrogen oxyfluoride**

See Nitrosyl fluoride and Nitroxyl fluoride

**Nitrogen phosphochloride**,  $P_3N_3Cl_6$

See Nitrogen chlorophosphide

**Nitrogen selenide**,  $NSe$

Very explosive Insol in  $H_2O$  Sol in  $HNO_3 + Aq$ , and  $NaClO + Aq$  (Espenschued, A 113 101)

Insol in  $H_2O$ , ether, absolute alcohol, very sl sol in  $CS_2$ ,  $C_6H_6$ , and glacial acetic acid Decomp by  $HCl + Aq$  or  $KOH + Aq$  (Verneuil, Bull Soc (2) 38 548)

**Nitrogen sulphide**,  $N_4S_4$

Insol in  $H_2O$  Decomp by hot  $H_2O$  Sl sol in alcohol, ether, wood alcohol, oil of turpentine Easily sol in  $CS_2$  Slowly decomp by  $HCl + Aq$  or  $KOH + Aq$ , rapidly by  $HNO_3 + Aq$  15 g dissolve in 1 kilo of  $CS_2$  (Fordos and Gélis, C R 31 702)

Sol in  $CHCl_3$  (Demarçay, C R 91 854)

Sol in warm glacial acetic acid with decomp on boiling (Ruff and Geisel, B 1904, 37 1591)

**Nitrogen pentasulphide**,  $N_2S_5$

Sol in ether and most organic solvents, insol in  $H_2O$ , fairly stable in ethereal solution, but decomp by light (Muthmann, Z anorg 1897, 13 206)

**Nitrogen sulphobromide**,  $N_3S_4Br$

Decomp by boiling  $H_2O$  and by dil alkali, also by boiling with alcohol (Muthman, B 1897, 30 630)

$N_4S_5Br_4$  Decomp by moist air (Clev, B 1896, 29 340-341)

$N_4S_5Br_5$  Decomp by moist air Very unstable (Clever)

$N_4S_5Br_2$  Insol most solvents, unstable (Clever)

**Nitrogen sulphochloride**,  $N_4S_4Cl_4$

Unstable on air Sol in warm  $CHCl_3$ , crystallizes out on cooling (Demarçay, C R 91 854, 1066)

Demarçay calls this comp thiacyl chloride Sol in hot dry benzene, and in  $CCl_4$ , decomp by moist air (Andreocci, Z anorg 1897, 14 249)

$N_4S_4Cl_2$  Partly sol in  $H_2O$  (Demarçay, C R 92 726)

Demarçay calls this compound dithiotetrazyl dichloride

$N_2S_2Cl_2 = N_2S_2, SCl_2$  Decomp on a (Fordos and Gélis)

Demarçay (C R 92 726) calls this compound thiodithiacyl dichloride

$N_2S_2Cl_2$  Sol in  $H_2O$  with subsequent decomp More sol than S in  $CS_2$  (Soubeiran, A ch 67 71)

Is a mixture of  $S_2Cl_2$  and  $N_4S_4$  (Fordos and Gélis, C R 31 702)

$N_3S_3Cl$  Sl sol in warm, insol in cold  $CHCl_3$  (Demarçay, C R 92 726)

"Thiothiacyl chloride" (Demarçay)

$N_3S_3Cl$  Sol in  $H_2O$  Insol in most solvents Sl sol in  $CHCl_3$  Easily sol in thionyl chloride (Demarçay, C R 91 854, 1066)

Demarçay calls the compound thiothiacyl chloride =  $(NS)_3 \equiv S-Cl$

$N_4S_4Cl_2 = 2N_2S_2, SCl_2$  Decomp on a (Michaelis)

$N_6S_7Cl_2 = 3N_2S_2, SCl_2$  Not decomp on air Decomp by  $H_2O$  containing ammonium

**Nitrogen sulphiodide**,  $N_3S_4I$

Readily decomp by  $H_2O$  (Muthmann and Setter, B 1897, 30 627)

**Nitrohydroxylaminic acid**,  $H_2N'O_3$

Known only in solution (Angeli Gazz ch 1897, 27 (2) 357)

**Barium nitrohydroxylamine**,  $Ba_2N_4O_3 + H_2O$

Ppt More stable in the air than the sodium salt Not decomp by prolonged boiling with  $H_2O$  (Angeli, Gazz ch 1896, 26 17-25)

**Cadmium nitrohydroxylamine**,  $CdN_2O_3 + H_2O$

As Ba salt (Angelico and Fanara, Gazz ch 1901, 31 (2) 21)

**Calcium nitrohydroxylamine**,  $\text{CaN O}_3 + \frac{1}{2}\text{H}_2\text{O}$   
(Angeli, Gazz ch it 1900, 30 (1) 593)

**Calcium nitrohydroxylamine**,  $\text{CaN}_2\text{O}_3 + 3\frac{1}{2}\text{H}_2\text{O}$   
(Angelico and Fanara, Gazz ch it 1901, 31 (2) 15)

**Lead nitrohydroxylamine**,  $\text{PbN}_2\text{O}_3$   
(Angeli, Gazz ch it 1900, 30 (1) 593)

**Potassium nitrohydroxylamine**,  $\text{K}_2\text{N}_2\text{O}_3$   
Like Na salt More hygroscopic (Angeli, Gazz ch it 1897, 27 (2) 357)  
Sol in  $\text{H}_2\text{O}$  (Angeli, Gazz ch it 1900, 30 (1) 593)

**Silver nitrohydroxylamine**,  $\text{Ag}_2\text{N}_2\text{O}_3$   
Ppt (Angeli, C C 1901, I 1192)

**Sodium nitrohydroxylamine**,  $\text{Na}_2\text{N}_2\text{O}_3$   
Very sol in  $\text{H}_2\text{O}$  Pptd by alcohol  
Aqueous solution is readily decomp by boiling (Angeli, Gazz ch it 1896, 26 (2) 17)

**Strontium nitrohydroxylamine**,  $\text{SrN}_2\text{O}_3 + \text{H}_2\text{O}$   
(Angeli, Gazz ch it 1900, 30 (1) 593)  
 $+1\frac{1}{2}\text{H}_2\text{O}$  (Angelico and Fanara, Gazz ch it 1901, 31 (2) 15)

**Nitroiodic acid**,  $\text{I}_2\text{O}_4(\text{NO})_2$   
See Nitrosoiodic acid

**Nitronitrous acid**

**Platinum potassium nitronitrite**,  $\text{K}_2\text{Pt}(\text{NO})_2\text{N}_2\text{O}_4$   
Decomp by heat (Miolati, C C 1896, II 1088)

**Nitroplatinous acid**  
See Platonitrous acid

**Nitroprussic acid**,  $\text{H}_2\text{Fe}(\text{CN})_5\text{NO} + \text{H}_2\text{O} = \text{H}_2\text{Fe}(\text{CN})_5\text{NO} + \text{H}_2\text{O}$   
Deliquescent Easily sol in  $\text{H}_2\text{O}$ , alcohol, or ether (Playfair, A 74 317)

**Nitroprussides**

The alkali and alkali earth nitroprussides are sol in  $\text{H}_2\text{O}$ , and the solutions are not pptd by alcohol The others are mostly insol in  $\text{H}_2\text{O}$

**Ammonium nitroprusside**,  $(\text{NH}_4)_2\text{Fe}(\text{CN})_5\text{NO}$

Deliquescent Very sol in  $\text{H}_2\text{O}$ , not pptd therefrom by alcohol (Playfair)

**Barium nitroprusside**,  $\text{BaFe}(\text{CN})_5\text{NO} + 4\text{H}_2\text{O}$   
Verv sol in  $\text{H}_2\text{O}$   
 $+6\text{H}_2\text{O}$

**Cadmium nitroprusside**,  $\text{CdFe}(\text{CN})_5\text{NO}$   
Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  Insol in dil or conc  $\text{HNO}_3 + \text{Aq}$  even when boiling Not attacked by  $\text{NH}_4\text{OH}$  or  $\text{KOH} + \text{Aq}$  (Norton, Am Ch J 10 222)

**Calcium nitroprusside**,  $\text{CaFe}(\text{CN})_5\text{NO} + 4\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  (Playfair)

**Cobalt nitroprusside**,  $\text{CoFe}(\text{CN})_5\text{NO}$   
Ppt (Norton, Am Ch J 10 222)  
 $+4\text{H}_2\text{O}$

**Copper nitroprusside**,  $\text{CuFe}(\text{CN})_5\text{NO} + 2\text{H}_2\text{O}$   
Insol in  $\text{H}_2\text{O}$  or alcohol

**Ferrous nitroprusside**,  $\text{FeFe}(\text{CN})_5\text{NO} + x\text{H}_2\text{O}(?)$   
Insol in  $\text{H}_2\text{O}$

**Mercurous nitroprusside**,  $\text{Hg}_2\text{Fe}(\text{CN})_5\text{NO}$   
Insol in  $\text{H}_2\text{O}$  Unstable (Norton, Am Ch J 10 222)

**Nickel nitroprusside**,  $\text{NiFe}(\text{CN})_5\text{NO}$   
As the Co salt (Norton)

**Potassium nitroprusside**,  $\text{K}_2\text{Fe}(\text{CN})_5\text{NO} + 2\text{H}_2\text{O}$   
Sl deliquescent Sol in 1 pt  $\text{H}_2\text{O}$  at  $16^\circ$   
 $\text{K}_2\text{Fe}(\text{CN})_5\text{NO}$ ,  $2\text{KOH}$  Very sol in  $\text{H}_2\text{O}$

**Silver nitroprusside**,  $\text{Ag}_2\text{Fe}(\text{CN})_5\text{NO}$   
Insol in  $\text{H}_2\text{O}$ , alcohol, or  $\text{HNO}_3 + \text{Aq}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Sodium nitroprusside**,  $\text{Na}_2\text{Fe}(\text{CN})_5\text{NO} + 2\text{H}_2\text{O}$   
Sol in  $2\frac{1}{2}$  pts  $\text{H}_2\text{O}$  at  $16^\circ$ , and in less hot  $\text{H}_2\text{O}$

**Zinc nitroprusside**,  $\text{ZnFe}(\text{CN})_5\text{NO}$   
Very sl sol in cold, more in hot  $\text{H}_2\text{O}$

**Nitrosulphonic acid**

**Cupric nitrosulphonate**,  $\text{NO} \begin{smallmatrix} \text{O} \\ \diagup \text{SO}_3 \diagdown \end{smallmatrix} \text{Cu}$

Decomp by  $\text{H}_2\text{O}$  (Raschig, B 1907, 40 4583)

**Nitrosobromoruthenic acid**

**Silver nitrosobromoruthenate ammonia**,  $\text{Ag}_2\text{Ru}(\text{NO})\text{Br}_5, \text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  Sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Very sol in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Brizard, Bull Soc 1895, (3) 13 1093)

**Nitrosobromosmic acid**

**Potassium nitrosobromosmate**,  $K_2Os(NO)Br_3$   
Stable in aqueous solution (Wintrebert,  
A ch 1903, (7) 28 132)

**Nitroschloroplatinic acid**

**Potassium nitroschloroplatinate**,  
 $K_2PtCl_5(NO)$   
Sol in  $H_2O$  (Vèzes, C R 110 757)

**Nitroschlororuthenic acid**

**Ammonium nitroschlororuthenate**,  
 $(NH_4)_2Ru(NO)Cl_5$   
Sol in  $H_2O$  (Joly, C R 107 991)  
5 pts are sol in 100 pts  $H_2O$  at 25°  
22 " " " " " " " " 60°  
(Howe, J Am Chem Soc 1894, 16 390)

**Cæsium nitroschlororuthenate**,  
 $Cs_2Ru(NO)Cl_5$   
0 20 pt is sol in 100 pts  $H_2O$  at 25°  
0 56 " " " " " " " " 100°  
(Howe)  
+2 $H_2O$  Very sol in  $H_2O$  105 8 pts are  
sol in 100 pts  $H_2O$  (Howe)

**Potassium nitroschlororuthenate**,  
 $K_2Ru(NO)Cl_5$   
Sol in  $H_2O$  (Joly)  
12 pts are sol in 100 pts  $H_2O$  at 25°  
80 " " " " " " " " 60°  
(Howe)

**Rubidium nitroschlororuthenate**,  
 $Rb_2Ru(NO)Cl_5$   
Sol in boiling  $H_2O$  without decomp  
0 57 pt is sol in 100 pts  $H_2O$  at 25°  
2 13 " " " " " " " " 60°  
(Howe)

**Silver nitroschlororuthenate ammonia**,  
 $Ag_2Ru(NO)Cl_5, NH_3$   
Decomp by  $H_2O$  SI sol in  $NH_4OH + Ag$   
Very sol in  $Na_2S_2O_3 + Aq$  (Brizard, Bull  
Soc 1895, (3) 13 1092)

**Nitrosiodic acid**,  $I_2O_4(NO)_2$  (?)  
Decomp with  $H_2O$ , alcohol, ether, or acetic  
ether Slowly sol in  $H_2SO_4$  (Kammerer, J  
pr 83 65)

**Nitrososulphomic acid**

**Potassium dinitrososulphonate**,  $N_2O OK$   
 $SO_3K$   
Sol in  $H_2O$  Very unstable (Hantzsch,  
B 1894, 27 3268)

**Potassium nitrosodisulphonate**,  $ON(SO_3K)_2$   
Sol in  $H_2O$  Very explosive (Hantzsch,  
B 1895, 28 996 and 2744)

**Potassium nitrosotrisulphonate**,  $ON(SO_3K)_3$   
+ $H_2O$   
Sol in  $H_2O$  (Hantzsch, B 1895, 28 2750)

**Sodium nitrosotrisulphonate**,  $NO_2(SO_3)_3Na$   
Decomp by  $H_2O$  (Traube, B 1913, 4  
2521)

**Nitrososulphuric acid**,  
 $H_2N_2SO_5 = H_2SO_5(NO)_2$   
Not known in free state

**Ammonium dinitrososulphate**,  
 $(NH_4)_2(NO)_2SO_3$   
Sol in  $H_2O$  Insol in hot alcohol (E  
louze, A 15 240)

**Barium —**,  $Ba(NO)_2SO_3$   
Sol in  $H_2O$  (Divers and Haga, Chem Soc  
47 364)

**Barium potassium —**,  $BaK_2(SN_2O_5)_2$   
Sol in much  $H_2O$  to form a clear liquid  
but the solution gradually deposits  $BaSC$   
(Hantzsch, B 1894, 27 3271)

**Cupric nitrosodisulphate**,  $Cu(NO)(SO_3)_2$   
(Sabatier, Bull Soc 1897, (3) 17 787)

**Lead dinitrososulphate**  
Insol in  $H_2O$  (Divers and Haga, Chem  
Soc 47 364)

**Potassium —**,  $K_2(NO)_2SO_3$   
Decomp by  $H_2O$  at ordinary temp Insol  
in alcohol (Pelouze, A ch 60 160)  
Sol in about 8 pts  $H_2O$  at 14 5° Less sol  
in presence of  $KOH$  (Divers and Haga  
Chem Soc 1895, 67 455)

**Sodium —**,  $Na_2(NO)_2SO_3$   
More sol than K salt (Pelouze)  
SI sol in  $H_2O$ , very unstable moist or dr  
decomp by  $H_2O$  (Divers, C N 1895, 7  
266)

**Nitrososulphurous acid**

**Ruthenium sodium nitrososulphite**,  
 $O[Ru(SO_3)_2(NO)Na_2] + 2H_2O$   
SI sol in cold  $H_2O$  (Miolati, Gazz c  
it 1900, 30 511)

**Nitrosulphide of iron**

See *Ferroletranitrososulphonic acid*

**Binitrosulphide of iron**

Roussin's comp is ammonium ferrohept  
nitrososulphonate, which see

**Nitrosulphonic acid**,  $\text{HNSO}_3 = \begin{smallmatrix} \text{HO} \\ \text{NO}_2 \end{smallmatrix} \text{SO}_2$

(*Lead chamber crystals*) Rapidly sol in  $\text{H}_2\text{O}$  with decomp When brought into large amount of  $\text{H}_2\text{O}$ , no gas is evolved (Freymy, C R 70 61)

Sol in  $\text{H}_2\text{SO}_4$  without decomp Sol in cold  $\text{H}_2\text{SO}_4$  + Aq of sp gr 1.7–1.55 (Weber, J pr 100 37)

Sl sol in  $\text{H}_2\text{SO}_4$  + Aq of 1.6 sp gr (Dana) More difficultly sol in dil than conc  $\text{H}_2\text{SO}_4$  + Aq (Muller)

**Potassium nitrosulphonate**,  $\text{KOSO}_2\text{NO}_2(?)$

Decomp by  $\text{H}_2\text{O}$  (Schultz-Sellack, B 4 113)

**Nitrosulphonic anhydride** (?),  $\text{N}_2\text{O}_3$ ,  $2\text{SO}_3 = \text{S}_2\text{O}_5(\text{NO}_2)_2$

Rapidly sol in  $\text{H}_2\text{O}$  with decomp Abundantly sol in cold  $\text{H}_2\text{SO}_4$  (Rose, Pogg 47 605)

Insol in cold, slowly sol in warm  $\text{H}_2\text{SO}_4$  (Prevostaye, A ch 73 362)

**Nitrosulphonic chloride**,  $\text{NO}_4\text{SO}_2\text{Cl} = \text{NO}_2\text{SO}_2\text{Cl} (?)$

Decomp by  $\text{H}_2\text{O}$  Sol in fuming  $\text{H}_2\text{SO}_4$  without decomp Decomp by conc  $\text{H}_2\text{SO}_4$  (Weber, Pogg 123 333)

**Dinitrosulphuric acid**

See Dinitrososulphuric acid

**Nitrosyl bromide**,  $\text{NOBr}$

Decomp with cold  $\text{H}_2\text{O}$  (Landolt, A 116 177)

**Nitrosyl tribromide**,  $\text{NOBr}_3$

Decomp by  $\text{H}_2\text{O}$  or cold alcohol Miscible with ether (Landolt, A 116 177) Mixture of  $\text{NOBr}$  and  $\text{Br}_2$  (Frohlich, A 224 270)

**Nitrosyl platonic bromide**,  $2\text{NOBr}$ ,  $\text{PtBr}_4$

Deliquescent Decomp by  $\text{H}_2\text{O}$  (Topsoe, J B 1868 274)

**Nitrosyl chloride**,  $\text{NOCl}$

Decomp by  $\text{H}_2\text{O}$  Absorbed by fuming  $\text{H}_2\text{SO}_4$  without decomp

**Nitrosyl boron chloride**,  $\text{NOCl}$ ,  $\text{BCl}_3$

See Boron nitrosyl chloride

**Nitrosyl platonic chloride**,  $2\text{NOCl}$ ,  $\text{PtCl}_4$

Very deliquescent, and sol in  $\text{H}_2\text{O}$  with evolution of  $\text{NO}$  (Rogers and Boye, Phil Mag J 17 397)

**Nitrosyl thallium chloride**,  $2\text{NOCl}$ ,  $\text{TlCl}$ ,  $\text{TlCl}_3$

Very deliquescent, and sol in  $\text{H}_2\text{O}$  with decomp (Sudborough, Chem Soc 59 657)

**Nitrosyl stannic chloride**,  $2\text{NOCl}$ ,  $\text{SnCl}_4$

Decomp by  $\text{H}_2\text{O}$ , chloroform, or benzene, not by carbon disulphide (Jorgensen)

**Nitrosyl titanium chloride**,  $2\text{NOCl}$ ,  $\text{TiCl}_4$

Decomp by  $\text{H}_2\text{O}$  (Weber, Pogg 118 476)

**Nitrosyl zinc chloride**,  $\text{NOCl}$ ,  $\text{ZnCl}_2$

Very deliquescent, and sol in  $\text{H}_2\text{O}$  with evolution of  $\text{NO}$  (Sudborough, Chem Soc 59 656)

**Nitrosyl chloride sulphur trioxide**,  $\text{NOCl}$ ,  $\text{SO}_3$

Decomp by  $\text{H}_2\text{O}$  Sol in conc  $\text{H}_2\text{SO}_4$  with evolution of  $\text{HCl}$  (Weber, Pogg 123 233)

**Nitrosyl fluoride**,  $\text{NOF}$

Sol in  $\text{H}_2\text{O}$  Solution decomp on standing with formation of  $\text{NO}$  and  $\text{HNO}_3$  (Ruff and Stauber, Z anorg 1905, 47 190)

**Nitrosyl sulphate, acid**,  $\text{H}(\text{NO})\text{SO}_4$

See Nitrosulphonic acid.

**Nitrosyl sulphate, anhydro**,  $(\text{NO})_2\text{S O}_7$

See Nitrosulphonic anhydride

**Nitrosyl selenic acid**,  $\text{SeO}_2(\text{ONO})_2$

Decomp by  $\text{H}_2\text{O}$  (Lenher and Mathews, J Am Chem Soc 1906, 28 516)

**Nitrosyl sulphuric acid**,  $\text{H}(\text{NO})\text{SO}_4$

See Nitrosulphonic acid

**Nitrous acid**,  $\text{HNO}_2$

Known only in aqueous solution

See Nitrogen trioxide

**Nitrites**

Normal nitrites, except  $\text{AgNO}_2$ , are sol in  $\text{H}_2\text{O}$  and alcohol, but, as a rule, they are less sol than the corresponding nitrates

**Ammonium nitrite**,  $\text{NH}_4\text{NO}_2$

Very deliquescent, and sol in  $\text{H}_2\text{O}$   $\text{H}_2\text{O}$  solution decomp at  $50^\circ$  (Berzelius) Very dil solution can be evaporated on water bath without decomp (Bohlig, A 125 25) Solution containing  $\frac{1}{100,000}$  pt  $\text{NH}_4\text{NO}_2$  can be evaporated to  $\frac{1}{2}$  its vol without decomp Solution containing  $\frac{1}{500}$  pt gives a distillate containing 8.6% of  $\text{NH}_4\text{NO}_2$ , while residue contains 82% of original quantity, 9.4% being lost (Schöyen)

Very deliquescent, sol in  $\text{H}_2\text{O}$ , slowly but easily sol in alcohol, insol in ether (Sörensen, Z anorg 1894, 7 38)

**Ammonium barium cupric nitrite,**

$(\text{NH}_4)_2\text{BaCu}(\text{NO}_2)_6$   
Ppt, decomp readily (Przibylla, Z anorg 1897, 15 424)

**Ammonium bismuth silver nitrite,**

$(\text{NH}_4)_2\text{BiAg}(\text{NO}_2)_6$   
Moderately sol in  $\text{H}_2\text{O}$  Rapidly hydrolyzed by  $\text{H}_2\text{O}$  (Ball and Abram, Chem Soc 1913, 103 2120)

**Ammonium bismuth sodium nitrite,**

$2\text{NH}_4\text{NO}_2, \text{Bi}(\text{NO}_2)_3, \text{NaNO}_2$   
Easily decomp (Ball, Chem Soc 1905, 87 761)

**Ammonium cadmium nitrite ammonia, basic,**

$2\text{NH}_4\text{NO}_2, \text{Cd}(\text{NO}_2)_2, \text{Cd}(\text{OH})_2, 2\text{NH}_3$   
Decomp by  $\text{H}_2\text{O}$  (Morin, C R 100 1497)

**Ammonium calcium cupric nitrite,**

$(\text{NH}_4)_2\text{CaCu}(\text{NO}_2)_6$   
Ppt, decomp easily Sol in  $\text{H}_2\text{O}$  Sl sol in alcohol (Przibylla, Z anorg 1897, 15 423)

**Ammonium cobaltic nitrite,  $3(\text{NH}_4)_2\text{O}, \text{Co}_2\text{O}_3,$** 

$6\text{N}_2\text{O}_5 + 1\frac{1}{2}\text{H}_2\text{O}$   
Sl sol in  $\text{H}_2\text{O}$ , decomp in aq solution on heating (Rosenheim, Z anorg 1898, 17 45)

$+3\text{H}_2\text{O}$   
Somewhat sol in cold  $\text{H}_2\text{O}$ , decomp by boiling Decomp by conc  $\text{H}_2\text{SO}_4$ , not by acetic or dil mineral acids (Erdmann, J pr 97 405)

**Ammonium cupric lead nitrite,**

$\text{CuPb}(\text{NH}_4)_2(\text{NO}_2)_6$   
Stable at ordinary temp, sol in  $\text{HNO}_3$  with decomp  
2 575 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $20^\circ$ , or 2 51% salt in sat solution at  $20^\circ$  (Przibylla, Z anorg 1897, 15 420)

**Ammonium cupric strontium nitrite,**

$(\text{NH}_4)_2\text{CuSr}(\text{NO}_2)_6$   
Ppt, sol in  $\text{H}_2\text{O}$  with decomp (Przibylla, l c)

**Ammonium iridium nitrite**

See Iridonitrite, ammonium

**Ammonium lead nickel nitrite,**

$(\text{NH}_4)_2\text{PbNi}(\text{NO}_2)_6(?)$   
Ppt (Przibylla, Z anorg 1897, 15 433)

**Ammonium osmium nitrite**

See Osmunitrite, ammonium

**Ammonium osmyl oxynitrite**

See Osmyloxynitrite, ammonium

**Ammonium platinum nitrite**

See Platonitrite, ammonium

**Ammonium rhodium nitrite**

See Rhodonitrite, ammonium

**Ammonium ruthenium hydrogen nitri,**

$\text{Ru}_2\text{H}_2(\text{NO}_2)_4, 3\text{NH}_4\text{NO}_2 + 3\text{H}_2\text{O}$   
See Ruthennitrite, ammonium hydrogen

**Barium nitrite,  $\text{Ba}(\text{NO}_2)_2 + \text{H}_2\text{O}$** 

Permanent Very sol in  $\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	G in 100 cc $\text{Ba}(\text{NO}_2)_2$	Sp gr
0	58	1 40
20	63	1 45
25	71	1 50
30	82	1 52
35	97	1 61

(Vogel, Z anorg 1903, 35 389)

100 pts $\text{H}_2\text{O}$ dissolve at			
$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$
63 5	69 5	79 5	93 pts. $\text{Ba}(\text{NO}_2)_2 + \text{H}$
$40^\circ$	$50^\circ$	$60^\circ$	$70^\circ$
113	136	170	202 pts $\text{Ba}(\text{NO}_2)_2 + \text{H}$
$80^\circ$	$90^\circ$	$100^\circ$	$110^\circ$
254	331	461	765 pts $\text{Ba}(\text{NO}_2)_2 + \text{H}$

The sat solution at  $17^\circ$  contains 46%  $\text{Ba}(\text{NO}_2)_2$ , and has sp gr  $17^\circ/0^\circ = 1 48$  (Oswald, A ch 1914, (9) 1 62)

100 g  $\text{H}_2\text{O}$  at  $13 5^\circ$  dissolve 64 g  $\text{Ba}(\text{NO}_2)_2 + 10 2$  g  $\text{AgNO}_2$  with excess of  $\text{AgNO}_2$ , and 75 6 g  $\text{Ba}(\text{NO}_2)_2 + 9 5$  g  $\text{AgNO}_2$ , with excess of  $\text{AgNO}_2$  (Oswald)

Sol in 64 pts 94% alcohol, nearly insol in absolute alcohol (Lang, Pogg 118 28)

Solubility in alcohol + Aq at  $t^\circ$

$t^\circ$	Solvent	100 ccm of the sat solution contain $\text{Ba}(\text{NO}_2)_2 + \text{H}_2\text{O}$
19 5	10% alcohol	49 30
21 0	20% "	29 30
20 5	30% "	18 41
20 5	40% "	13 33
20 5	50% "	9 11
20 0	60% "	4 54
19 0	70% "	2 66
19 5	80% "	0 98
20 0	90% "	0 00
20 0	absolute alcohol	0 00

(Vogel, Z anorg 1903, 35 390)

Insol in acetone (Naumann B 1904, 4329)

Insol in ethyl acetate (Naumann, 1910, 43 314)

**Barium caesium nitrite,  $\text{CsBa}_2(\text{NO}_2)_6$** 

Sol in  $\text{H}_2\text{O}$  (Jamieson, Am Ch J 1907, 38 616)

$\text{Cs}_2\text{Ba}(\text{NO}_2)_4 + \text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Jamieson, Am Ch J 1907, 38 616)

**Barium caesium silver nitrite,  $\text{Cs}_3\text{AgBa}(\text{NO}_2)_6 + 2\text{H}_2\text{O}$** 

Decomp by cold  $\text{H}_2\text{O}$  (Jamieson, Am Ch J 1907, 38 616)

**Barium cobaltic nitrite,  $2\text{BaO}, \text{Co}_2\text{O}_3, 4\text{N}_2\text{O}_5 + 10\text{H}_2\text{O}$** 

Sol in moderately warm  $\text{H}_2\text{O}$  without decomp but not recryst therefrom (Rosenheim, Z anorg 1898, 17 51-54)

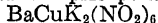
$3\text{BaO}, \text{Co}_2\text{O}_3, 6\text{N}_2\text{O}_5 + \text{H}_2\text{O}$  Ppt, very unstable Nearly insol in  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1898, 17 47)

**Barium cobaltous potassium nitrite,  $\text{Ba}(\text{NO}_2)_2, \text{Co}(\text{NO}_2)_2, 2\text{KNO}_2$** 

Decomp by  $\text{H}_2\text{O}$  (Erdmann, J pr 97 385)

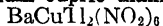
**Barium cupric nitrite,  $\text{Ba}[\text{Cu}(\text{OH})(\text{NO}_2)_2]$** 

Ppt Insol in  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  Insol in alcohol, but slowly decomp by it (Kurtenacker, Z anorg 1913, 82 208)

**Barium cupric potassium nitrite,**

Stable when dry, easily decomp when moist, sol in  $\text{H}_2\text{O}$  with decomp

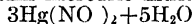
45 86 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $20^\circ$ , or 31 45% salt is contained in sat solution at  $20^\circ$  (Przibylla, Z anorg 1897, 15 424)

**Barium cupric thallium nitrite,**

Sl sol in  $\text{H}_2\text{O}$  (Przibylla, Z anorg 1898, 18 461)

**Barium iridium nitrite**

See Iridonitrite, barium

**Barium mercuric nitrite,  $2\text{Ba}(\text{NO}_2)_2,$** 

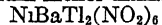
Very sol in  $\text{H}_2\text{O}$  and easily decomp (Rây, Chem Soc 1910, 97 327)

**Barium nickel nitrite,  $2\text{Ba}(\text{NO}_2)_2, \text{Ni}(\text{NO}_2)_2$** 

Somewhat more easily sol in  $\text{H}_2\text{O}$  than nickel potassium nitrite (Lang)

**Barium nickel potassium nitrite,  $\text{Ba}(\text{NO}_2)_2, \text{Ni}(\text{NO}_2)_2, 2\text{KNO}_2$** 

Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  without apparent decomp (Lang)

**Barium nickel thallium nitrite,**

Ppt (Przibylla, Z anorg 1898, 18 462)

**Barium osmium nitrite**

See Osmunitrite, barium

**Barium osmyl oxynitrite**

See Osmyloxynitrite, barium

**Barium potassium nitrite,  $\text{Ba}(\text{NO}_2)_2, 2\text{KNO}_2 + \text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$ , insol in alcohol (Lang, Pogg, 118 293)

**Barium rhodium nitrite,  $3\text{Ba}(\text{NO}_2)_2, \text{Rh}_2(\text{NO}_2)_6$** 

See Rhodonitrite, barium

**Barium silver nitrite,  $\text{Ba}(\text{NO}_2)_2, 2\text{AgNO}_2 + \text{H}_2\text{O}$** 

Resembles the potassium salt (Fischer) Less stable than the Na salt (Oswald)

**Bismuth nitrite, basic,  $(\text{BiO})\text{NO}_2 + \frac{1}{2}\text{H}_2\text{O}$** 

Sol in  $\text{HCl}$  (Vanino, J pr 1906, (2) 74 150)

**Bismuth caesium silver nitrite,  $\text{Cs}_2\text{BiAg}(\text{NO}_2)_6$** 

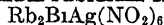
Very sl sol in  $\text{H}_2\text{O}$  Slowly decomp by  $\text{H}_2\text{O}$  (Ball and Abram, Chem Soc 1913, 103 2122)

**Bismuth potassium nitrite,  $\text{Bi}(\text{NO}_2)_3, 3\text{KNO}_2 + \text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  (Ball, Chem Soc 1905, 87 762)

**Bismuth potassium silver nitrite,  $\text{K}_2\text{BiAg}(\text{NO}_2)_6$** 

Less sol in  $\text{H}_2\text{O}$  than  $\text{NH}_4$  salt (Ball and Abram, Chem Soc 1913, 103 2121)

**Bismuth rubidium silver nitrite,**

Sl sol in  $\text{H}_2\text{O}$  with slow hydrolysis (Ball and Abram)

**Bismuth silver thallos nitrite,  $\text{BiAgTl}_2(\text{NO}_2)_6$** 

Insol in  $\text{H}_2\text{O}$ , but decomp thereby (Ball and Abram)

**Cadmium nitrite, basic,  $2\text{CdO}, \text{N}_2\text{O}_5$** 

Insol in  $\text{H}_2\text{O}$  (Hampe, A 125 335)

**Cadmium nitrite,  $\text{Cd}(\text{NO}_2)_2 + \text{H}_2\text{O}$** 

Deliquescent Sol in  $\text{H}_2\text{O}$  (Lang, J B 1862 99)

**Cadmium potassium nitrite,  $\text{Cd}(\text{NO}_2)_2, \text{KNO}_2$** 

Easily sol in  $\text{H}_2\text{O}$  Very difficultly sol in absolute alcohol, and only sl sol in 90% alcohol (Hampe, A 125 334)

$\text{Cd}(\text{NO}_2)_2, 2\text{KNO}_2$  Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol (Lang, J B 1862 99)

$\text{Cd}(\text{NO}_2)_2, 4\text{KNO}_2$  More sol in  $\text{H}_2\text{O}$  than the above salt (Lang)

**Cæsium nitrite, CsNO<sub>2</sub>**

Very hygroscopic Very sol in H<sub>2</sub>O  
(Ball, Chem Soc 1913, 103 2130)

**Cæsium calcium nitrite, Cs<sub>2</sub>Ca(NO<sub>2</sub>)<sub>4</sub>+H<sub>2</sub>O**  
Ppt (Jamieson, Am Ch J 1907, 38 617)**Cæsium cobaltic nitrite, Cs<sub>3</sub>Co(NO<sub>2</sub>)<sub>6</sub>+H<sub>2</sub>O**  
Sol in 20,100 pts H<sub>2</sub>O at 17° (Rosenbladt, B 19 2531)**Cæsium lead nitrite, CsPb(NO<sub>2</sub>)<sub>3</sub>+H<sub>2</sub>O**  
Sol in cold H<sub>2</sub>O without decomp When solution is heated, some basic lead salt separates (Jamieson, Am Ch J 1907, 38 618)**Cæsium lead silver nitrite, Cs<sub>3</sub>AgPb(NO<sub>2</sub>)<sub>6</sub>+2H<sub>2</sub>O**  
Ppt (Jamieson)**Cæsium silver nitrite, CsAg(NO<sub>2</sub>)<sub>2</sub>**  
Decomp by H<sub>2</sub>O (Jamieson)**Cæsium silver strontium nitrite, Cs<sub>2</sub>AgSr(NO<sub>2</sub>)<sub>6</sub>+2H<sub>2</sub>O**  
Partially decomp by H<sub>2</sub>O (Jamieson)**Cæsium strontium nitrite, CsSr(NO<sub>2</sub>)<sub>3</sub>+H<sub>2</sub>O**  
Ppt Sol in H<sub>2</sub>O (Jamieson)**Calcium nitrite, Ca(NO<sub>2</sub>)<sub>2</sub>+H<sub>2</sub>O**  
Very deliquescent Insol in dil alcohol (Fischer, Pogg 74 115)  
100 ccm of the sat solution contain 111.6 g Ca(NO<sub>2</sub>)<sub>2</sub>+H<sub>2</sub>O at 20.5° (Vogel, Z anorg 1903, 35 395)Solubility in H<sub>2</sub>O at t°

t°	%Ca(NO <sub>2</sub> ) <sub>2</sub>	Solid phase
0	38.3	Ca(NO <sub>2</sub> ) <sub>2</sub> , 4H <sub>2</sub> O
18.5	43	
42	51.8	"
44	53.5	" +Ca(NO <sub>2</sub> ) <sub>2</sub> , H <sub>2</sub> O
54	55.2	Ca(NO <sub>2</sub> ) <sub>2</sub> , H <sub>2</sub> O
64	58.4	"
70	60.3	"
73	61.5	"
91	71.2	"

(Oswald, A ch 1914, (9) 1 32)

Sat solution of Ca(NO<sub>2</sub>)<sub>2</sub>+AgNO<sub>2</sub> contains 92.4 g Ca(NO<sub>2</sub>)<sub>2</sub> and 11.2 g AgNO<sub>2</sub> per 100 g H<sub>2</sub>O at 14° (Oswald)

Solubility in alcohol  
100 ccm of sat solution in 90% alcohol contain 39.0 g Ca(NO<sub>2</sub>)<sub>2</sub>+H<sub>2</sub>O at 20°

100 ccm of sat solution in absolute alcohol contain 1.1 g Ca(NO<sub>2</sub>)<sub>2</sub>+H<sub>2</sub>O at 20° (Vogel)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

+4H<sub>2</sub>O The sat solution at 16° contains 42.3% Ca(NO<sub>2</sub>)<sub>2</sub> and has sp gr at 16°/0 1.4205 (Oswald, A ch 1914, (9) 1 66)

**Calcium cobaltous potassium nitrite, Ca(NO<sub>2</sub>)<sub>2</sub>, Co(NO<sub>2</sub>)<sub>2</sub>, 2KNO<sub>2</sub>**  
Decomp by H<sub>2</sub>O (Erdmann)**Calcium cupric potassium nitrite, CaCuK<sub>2</sub>(NO<sub>2</sub>)<sub>6</sub>**

Ppt, insol in alcohol, sol in H<sub>2</sub>O with decomp  
14.97 pts are sol in 100 pts H<sub>2</sub>O at 20° or 13.02 per cent of salt is contained in sat solution (Przibylla, Z anorg 1897, 15 42)

**Calcium mercuric nitrite, Ca(NO<sub>2</sub>)<sub>2</sub>, Hg(NO<sub>2</sub>)<sub>2</sub>+5H<sub>2</sub>O**  
Very sol in H<sub>2</sub>O (Rây, Chem Soc 19), 97 327)**Calcium nickel potassium nitrite, Ca(NO<sub>2</sub>)<sub>2</sub>, Ni(NO<sub>2</sub>)<sub>2</sub>, 2KNO<sub>2</sub>**  
Very sl sol in cold, easily in hot H<sub>2</sub>O Insol in alcohol Sl sol in dil HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq (Erdmann)**Calcium osmium nitrite**  
See Osmium nitrite, calcium**Calcium potassium nitrite, CaK(NO<sub>2</sub>)<sub>2</sub>+3H<sub>2</sub>O**  
Sol in H<sub>2</sub>O (Topsoe, W A B 73, 2 11)  
Deliquescent (Lang)**Cobaltous nitrite**  
Known only in solution**Cobaltic lead nitrite, 3PbO, CoO<sub>3</sub>, 6N<sub>2</sub>O+12H<sub>2</sub>O**  
Insol in H<sub>2</sub>O (Rosenheim, Z anorg 18 3, 17 48)**Cobaltic lead potassium nitrite, 3K<sub>2</sub>O, 3PbO, 2CoO<sub>3</sub>, 10N<sub>2</sub>O+4H<sub>2</sub>O**  
Sol by boiling in much H<sub>2</sub>O Sol in dil acids with evolution of N<sub>2</sub>O<sub>3</sub> (Stromeyer A 96 228)**Cobaltous potassium nitrite, 2Co(NO<sub>2</sub>)<sub>2</sub>+2KNO<sub>2</sub>+H<sub>2</sub>O**  
Ppt (Sadtlir)

Co(NO<sub>2</sub>)<sub>2</sub>, 2KNO<sub>2</sub>+H<sub>2</sub>O Ppt (Sadtlir)  
3Co(NO<sub>2</sub>)<sub>2</sub>, 6KNO<sub>2</sub>+H<sub>2</sub>O Insol in cold, sol in hot H<sub>2</sub>O Sl sol in KC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq (Erdmann, J pr 97 397)

Insol in ethyl acetate (Naumann, B 1904, 37 3602)

**Cobaltic potassium nitrite (cobalt yellow), Co<sub>2</sub>(NO<sub>2</sub>)<sub>6</sub>, 6KNO<sub>2</sub>+3H<sub>2</sub>O**

Very sl sol in cold H<sub>2</sub>O Insol in alcohol and ether Sol in traces in CS<sub>2</sub> (St E e,

- C R 35 552) Insol in boiling conc  $K_2SO_4$ ,  $KCl$ ,  $KNO_3$ , or  $KC_2H_3O_2 + Aq$   
Sol in 1120 pts  $H_2O$  at  $17^\circ$  (Rosenblatt, B 1886, 19 2535)  
Decomp when heated in aq solution (Rosenheim, Z anorg 1898, 17 42)  
More sol in  $NH_4Cl$  or  $NaCl + Aq$  than in  $H_2O$  (Stromeyer)  
Sl decomp by  $KOH + Aq$ , except when very conc, easily decomp by  $NaOH$  or  $Ba(OH)_2 + Aq$   
Very sl sol in  $KC_2H_3O_2 + Aq$ , or  $KNO_3 + Aq$  (Fresenius) Sol in  $HCl + Aq$   
Sol in  $HC_2H_3O_2$ , or  $H_2C_2O_4 + Aq$  (Stromeyer)  
Small quantity of  $HC_2H_3O_2 + Aq$  does not dissolve (Fresenius)
- Cobaltic potassium silver nitrite**,  $KCoAg_2(NO_2)_6$ , and  $K_2CoAg(NO_2)_4$   
Very sl sol in  $H_2O$  Less sol than Na comp (Burgess and Karum, J Am Chem Soc 1912, 34 653)
- Cobaltous potassium strontium nitrite**,  $Co(NO_2)_2$ ,  $2KNO_2$ ,  $Sr(NO_2)_2$   
Decomp by  $H_2O$  (Erdmann, J pr 97 385)
- Cobaltic rubidium nitrite**,  $Rb_3Co(NO_2)_6 + H_2O$   
Sol in 19,800 pts  $H_2O$  (Rosenblatt, B 19 2531)
- Cobaltic silver nitrite**,  $CoAg_3(NO_2)_6$   
Fairly sol in  $H_2O$  (Cunningham and Perkin, Chem Soc 1909, 95 1568)  
 $2Ag_2O$ ,  $Co_2O_3$ ,  $3N_2O_5 + 3H_2O$  Sl sol in  $H_2O$ , decomp by boiling  $H_2O$  (Rosenheim, Z anorg 1898, 17 56)
- Cobaltic silver hydroxynitrite**,  $Co_2Ag_3(OH)_3(NO_2)_6$   
Sl sol in  $H_2O$  (Suzuki, Chem Soc 1910, 97 729)
- Cobaltic silver nitrite ammonia**,  $Co_2O_3$ ,  $Ag_2O$ ,  $4N_2O_5$ ,  $4NH_3$   
See Cobalt ammonium comps
- Cobaltic sodium nitrite**,  $2Na_2O$ ,  $Co_2O_3$ ,  $4N_2O_5$   
Sol in  $H_2O$  and alcohol (Rosenheim, Z anorg 1898, 17 50)  
 $+H_2O$  Ppt (Sadtler, Sil Am J (2) 49 196)  
 $3Na_2O$ ,  $Co_2O_3$ ,  $6N_2O_5 + xH_2O$  Sol in  $H_2O$ , decomp on heating, insol in alcohol (Rosenheim, Z anorg 1898, 17 43)
- Cobaltic strontium nitrite**,  $2SrO$ ,  $Co_2O_3$ ,  $4N_2O_5 + 11H_2O$   
Ppt (Rosenheim, Z anorg 1898, 17 54)
- Cobaltic thallium nitrite**,  $Co_2(NO_2)_6$ ,  $6TlNO_2$   
Sol in 23,810 pts  $H_2O$  at  $17^\circ$  (Rosenblatt, B 19 2531)
- Cobaltic zinc nitrite**,  $2ZnO$ ,  $Co_2O_3$ ,  $3N_2O_5 + 11H_2O$   
Sol in dil acetic acid (Rosenheim, Z anorg 1898, 17 56)
- Cobalt nitrite nitrate**,  $2CoO$ ,  $Co_2O_3$ ,  $3N_2O_5$ ,  $Co(NO_2)_2 + 14H_2O$   
Ppt (Rosenheim, Z anorg 1898, 17. 58)
- Cupric nitrite, basic**,  $2CuO$ ,  $N_2O_5$  (Hampe, A 125 345)  
 $Cu(NO_2)_2$ ,  $3Cu(OH)_2$  Very sl sol in  $H_2O$  or alcohol Easily sol in dil acids or ammonia (van der Meulen, B 12 758)
- Cupric nitrite**  
Known only in solution
- Cupric lead potassium nitrite**,  $CuPbK_2(NO_2)_6$  (van Lessen, R t c 10 13)  
3 056 pts are sol in 100 pts  $H_2O$  at  $20^\circ$ , or 2 51% salt is contained in sat solution at  $20^\circ$  p 429 (Przybylla, Z anorg 1897, 15 429)
- Cupric potassium strontium nitrite**,  $CuSrK_2(NO_2)_6$   
Sol in  $H_2O$  with decomp 10 82 pts are sol in 100 pts  $H_2O$  at  $20^\circ$ , or 9 77 per cent salt is contained in sat solution at  $20^\circ$  (Przybylla, Z anorg 1897, 15 425)
- Cupric rubidium nitrite**,  $Rb_3Cu(NO_2)_6$   
Easily sol in  $H_2O$  Sol in alcohol (Kurténacker, Z anorg 1913, 82 206)
- Cupric nitrite ammonia**,  $Cu(NO_2)_2$ ,  $2NH_3 + 2H_2O$   
Sol in little  $H_2O$  with absorption of much heat Decomp by much  $H_2O$  (Peligot, C R 53 209)  
 $3CuO$ ,  $N_2O_5$ ,  $2NH_3 + H_2O$  As above (Peligot)
- Iridium hydrogen nitrite**,  $Ir_2H_6(NO_2)_{12}$   
See Iridonitrous acid
- Iridium nitrite with  $MNO_2$**   
See Iridonitrite, M
- Iron (ferrous) lead potassium nitrite**,  $FePbK_2(NO_2)_6$   
Ppt, insol in cold  $H_2O$ , stable at ordinary temp (Przybylla, Z anorg 1897, 15 439)
- Iron (ferrous) lead thallos nitrite**,  $FePbTl_2(NO_2)_6$   
Ppt (Przybylla, Z anorg 1898, 18 463)



**Lead nitrite, basic**,  $4\text{PbO}$ ,  $\text{N}_2\text{O}_3 + \text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_2$ ,  $\text{PbO}$

Sol in 143 pts  $\text{H}_2\text{O}$  at  $23^\circ$ , and 33 pts at  $100^\circ$  (Chevreul)

Sol in 1250 pts cold  $\text{H}_2\text{O}$ , and 34.5 pts at  $100^\circ$  (Pelugot)

Sol in cold  $\text{HNO}_3$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$   
Composition is  $3\text{PbO}$ ,  $\text{N}_2\text{O}_3 + \text{H}_2\text{O}$  (Meissner, J B 1876 194)

Composition is as above (v Lorenz, W A B 84, 2 1133)

$3\text{PbO}$ ,  $\text{N}_2\text{O}_3 = \text{Pb}(\text{NO}_2)_2$ ,  $2\text{PbO}$  Sol in  $\text{H}_2\text{O}$  (Bromeis, A 72 38, v Lorenz)

$2\text{PbO}$ ,  $\text{N}_2\text{O}_3 + \text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Bromeis)

$+3\text{H}_2\text{O}$  (Meissner)  
 $4\text{PbO}$ ,  $3\text{N}_2\text{O}_3 + 2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Meissner, J B 1876 195)

**Lead nitrite**,  $\text{Pb}(\text{NO}_2)_2 + \text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Pelugot, A ch 77 87)

**Lead nickel potassium nitrite**,  $\text{Pb}(\text{NO}_2)_2$ ,  $\text{KNO}_2$ ,  $\text{Ni}(\text{NO}_2)_2$

Insol in  $\text{H}_2\text{O}$  (Baubigny, A ch (6) 17 111)

Ppt (Przybylla, Z anorg 1897, 15 432)

**Lead nickel thalious nitrite**,  $\text{NiPbTl}_2(\text{NO}_2)_6$

Ppt (Przybylla, Z anorg 1898, 18 462)

**Lead potassium nitrite**,  $4\text{Pb}(\text{NO}_2)_2$ ,  $6\text{KNO}_2 + 3\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  and in absolute alcohol (Hampe, A 125 334)

$\text{Pb}(\text{NO}_2)_2$ ,  $2\text{KNO}_2 + \text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol (Lang, J B 1862 102)

**Lead potassium silver nitrite**,  $\text{K}_3\text{AgPb}(\text{NO}_2)_6 + 2\text{H}_2\text{O}$

Ppt (Jamieson, Am Ch J 1907, 38 619)

**Lead nitrite nitrate**

See Nitrate nitrite, lead

**Lithium nitrite**,  $\text{LiNO}_2 + \frac{1}{2}\text{H}_2\text{O}$

Deliquescent Easily sol in alcohol and  $\text{H}_2\text{O}$  (Vogel, Z anorg 1903, 35 403)

Sat solution of  $\text{LiNO}_2 + \frac{1}{2}\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  contains at

65°	81.5°	91°	96°	92.5°
63.8	68.7	72.4	91.8	94.3%

$\text{LiNO}_2$  (Oswald)

$+ \text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$ , readily forming supersat solutions Very sol in abs alcohol (Ball, Chem Soc 1913, 103 2133)

100 pts  $\text{H}_2\text{O}$  dissolve at

0°	10°	20°
125	156	189 pts

$\text{LiNO}_2 + \text{H}_2\text{O}$

30°	40°	50°
242	316	459 pts

$\text{LiNO}_2 + \text{H}_2\text{O}$

$\text{LiNO}_2$ ,  $\text{H}_2\text{O} + \text{Aq}$  sat at  $19^\circ$  contains 48.9%  $\text{LiNO}_2$  and has sp gr = 1.3186 (Oswald, J ch 1914, (9) 1.61)

100 g  $\text{H}_2\text{O}$  dissolve 78.5 g  $\text{LiNO}_2 + 10.5 \text{ AgNO}_2$  at  $14^\circ$  (Oswald)

**Lithium mercuric nitrite**,  $\text{LiNO}_2$ ,  $\text{Hg}(\text{NO}_2)_2$ ,  $\text{H}_2\text{O}$

(Ray, Chem Soc 1907, 91 2033)

$4\text{LiNO}_2$ ,  $\text{Hg}(\text{NO}_2)_2 + 4\text{H}_2\text{O}$  Extreme deliquescent (Ray)

**Magnesium nitrite**,  $\text{Mg}(\text{NO}_2)_2 + 2\text{H}_2\text{O}$

Deliquescent, and sol in  $\text{H}_2\text{O}$  Solution decomp by boiling Easily sol in absolute alcohol (Hampe, A 125 334)

Insol in absolute alcohol (Fischer)  
 $+3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  and absolute alcohol

Very deliquescent (Vogel, Z anorg 1903, 35 397)

**Magnesium osmium nitrite**

See Osminitrite, magnesium

**Magnesium potassium nitrite**

Deliquescent, and easily sol in  $\text{H}_2\text{O}$  Insol in alcohol (Lang)

**Magnesium silver nitrite**

Sol in  $\text{H}_2\text{O}$  with decomp (Spiegel, Ch 1895, 19 1423)

**Manganous nitrite**

Deliquescent, and sol in  $\text{H}_2\text{O}$  (Mitschlich) Not obtained in a solid state, as solution decomp on evaporation (Lang, J B 1862 102)

**Mercurous nitrite**,  $\text{Hg}_2(\text{NO}_2)_2$

Sol in  $\text{H}_2\text{O}$  with partial decomp to  $\text{Hg}$  and  $\text{Hg}(\text{NO}_2)_2$  (Ray, A 1901, 316 252)

Sol in cold conc  $\text{HNO}_3$  Very slowly in cold dil  $\text{HNO}_3$  (Ray, Chem Soc 1897, 71 339)

Decomp by boiling  $\text{H}_2\text{O}$  and by cold  $\text{H}_2\text{SO}_4$  (Ray, Z anorg 1896, 12 366)

$+ \text{H}_2\text{O}$  Slowly decomp by  $\text{H}_2\text{O}$  (Ray, Chem Soc 1897, 71 340)

**Mercuric nitrite, basic**,  $\text{Hg}(\text{NO}_2)_2$ ,  $2\text{HgO} + \text{H}_2\text{O}$

Ppt (Lang)

$12\text{HgO}$ ,  $5\text{N}_2\text{O}_3 + 24\text{H}_2\text{O}$  (Ray, Chem Soc 1897, 71 341)

**Mercuric nitrite**,  $\text{Hg}(\text{NO}_2)_2$

Deliquescent Partly sol in boiling  $\text{H}_2\text{O}$ , but the greater part is decomp into  $\text{Hg}$  and  $\text{HNO}_2$  (Ray, Proc Chem Soc 1904, 20)

**Mercuriomercuric nitrite, basic**

$\alpha$   $9\text{Hg}_2\text{O}$ ,  $4\text{HgO}$ ,  $5\text{N}_2\text{O}_3 + 8\text{H}_2\text{O}$

$\beta$   $\text{Hg}_2\text{O}$ ,  $2\text{HgO}$ ,  $\text{N}_2\text{O}_3 + 2\text{H}_2\text{O}$  (Ray, Chem Soc 1897, 71 341)

**Mercuric potassium nitrite**,  $\text{Hg}(\text{NO}_2)_2$ ,  $2\text{KNO}_2$

Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol (Lang, 1860)

$\text{KHg}(\text{NO}_2)_3$  Obtained from  $\text{K}_2\text{Hg}(\text{NO}_2)_6$ ,  $\text{H}_2\text{O} + \text{Aq}$  containing a small excess of  $\text{KNO}_2$ . Decomp by  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1901, 28 173)

$\text{K}_2\text{Hg}(\text{NO}_2)_6 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Formula of Lang is incorrect (Rosenheim, Z anorg 1901, 28 172)

**Mercuric sodium nitrite**,  $\text{Na}_2\text{Hg}(\text{NO}_2)_4$

Very hygroscopic Decomp by hot  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1901, 28 173)

$+2\text{H}_2\text{O}$  Deliquescent (Rây, Chem Soc 1907, 91 2032)

$2\text{Hg}(\text{NO}_2)_2$ ,  $3\text{NaNO}_2$  Decomp by  $\text{H}_2\text{O}$  (Rây, Chem Soc 1907, 91 2032)

**Mercuric strontium nitrite**,  $3\text{Hg}(\text{NO}_2)_2$ ,  $2\text{Sr}(\text{NO}_2)_2 + 5\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Rây, Chem Soc 1910, 97 327)

**Mercuric nitrite hydrazine**,  $\text{Hg}(\text{NO}_2)_2$ ,  $\text{N}_2\text{H}_4$

Ppt Decomp by  $\text{H}_2\text{O}$  (Hofmann and Marburg, A 1899, 305 215)

**Nickel nitrite, basic**,  $2\text{NiO}$ ,  $\text{N}_2\text{O}_3$

Ppt (Hampe, A 125 343)

**Nickel nitrite**,  $\text{Ni}(\text{NO}_2)_2$

Sol in  $\text{H}_2\text{O}$  and alcohol (Lang, J B 1862 100)

**Nickel potassium nitrite**,  $\text{Ni}(\text{NO}_2)_2$ ,  $4\text{KNO}_2$

Moderately sol in  $\text{H}_2\text{O}$  (Fischer, Pogg 74 115) Extremely sol in  $\text{H}_2\text{O}$  (Hampe, A 125 346) Insol in absolute alcohol

**Nickel potassium strontium nitrite**,  $\text{Ni}(\text{NO}_2)_2$ ,  $2\text{KNO}_2$ ,  $\text{Sr}(\text{NO}_2)_2$

Sl sol in cold, easily sol in hot  $\text{H}_2\text{O}$

**Nickel nitrite ammonia**,  $\text{Ni}(\text{NO}_2)_2$ ,  $4\text{NH}_3$

Sol in cold  $\text{H}_2\text{O}$  Decomp on standing or by heating Insol in alcohol Can be recrystallized by dissolving in  $\text{NH}_4\text{OH} + \text{Aq}$ , and adding much absolute alcohol (Erdmann, J pr 97 395)

$\text{Ni}(\text{NO}_2)_2$ ,  $5\text{NH}_3$  Decomp in the air giving  $\text{Ni}(\text{NO}_2)_2$ ,  $4\text{NH}_3$  (Ephraim, B 1913, 46 3110)

**Osmium nitrite**,  $\text{Os}(\text{NO}_2)_3$

Ppt (Wintrebert, C R 1905, 140 587)

**Osmium nitrite with  $\text{MNO}$**

See Osmiumnitrite, M

**Osmyl nitrite with  $\text{MNO}_2$**

See Osmylnitrite, M

**Osmyl oxynitrite with  $\text{MNO}_2$**

See Osmyloxynitrite, M

**Osmyl nitrite ammonia**,  $\text{OsO}_2(\text{NO}_2)_2$ ,  $4\text{NH}_3$

(Wintrebert, A ch 1903, (7) 28 56)

**Palladious nitrite with  $\text{MNO}_2$**

See Palladonitrite, M

**Platinous hydrogen nitrite**,  $\text{H}_2\text{Pt}(\text{NO}_2)_4$

See Platonitrous acid

**Platinous nitrite with  $\text{MNO}_2$**

See Platonitrite, M

**Potassium nitrite**,  $\text{KNO}_2$

Deliquescent Sol in  $\text{H}_2\text{O}$

Pure  $\text{KNO}_2$  is not deliquescent (Oswald, A ch 1914, (9) 1 32)

Sol in about  $1\frac{1}{3}$  its wt of  $\text{H}_2\text{O}$  (Divers, Chem Soc 1899, 75 86)

100 pts  $\text{H}_2\text{O}$  dissolve at

0°	10°	20°	30°	40°
281	291	302	313	325 pts $\text{KNO}_3$

50°	60°	70°	80°	90°
337 5	351	365	380	396 pts $\text{KNO}_3$

100°	110°	120°	130°
413	432	451	473 pts $\text{KNO}_2$

Bpt of sat  $\text{KNO} + \text{Aq}$  is  $132^\circ$  at  $759.5$  mm pressure

(Oswald, A ch 1914, (9) 1 58)

Sp gr of  $\text{KNO}_2 + \text{Aq}$  at  $17.5^\circ$  containing

10	20	30	40% $\text{KNO}_2$
1 049	1 126	1 208	1 295

50	60	70	74.5% $\text{KNO}_2$
1 377	1 491	1 599	1 646

(Oswald)

100 g  $\text{H}_2\text{O}$  at  $13.5^\circ$  dissolve 18 g  $\text{KNO}_2 + 2.36$  g  $\text{AgNO}_2$ , at  $25^\circ$ , 23.1 g  $\text{KNO}_2 + 5.3$  g  $\text{AgNO}_2$  with excess of  $\text{AgNO}_2$

100 g  $\text{H}_2\text{O}$  at  $13.5^\circ$  dissolve 276 g  $\text{KNO}_2 + 26.3$  g  $\text{AgNO}_2$ , at  $25^\circ$ , 279 g  $\text{KNO}_2 + 39.3$  g  $\text{AgNO}_2$  with excess of  $\text{KNO}_2$  (Oswald)

See also under  $\text{AgNO}_2$

Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Deliquesces in 90% alcohol, insol in cold 94% alcohol More sol in  $\text{H}_2\text{O}$  than  $\text{KNO}_3$ , but less sol in alcohol (Fischer)

Ppt from its conc aq solution by the addition of methyl alcohol Addition of ethyl alcohol to a conc aq solution of  $\text{KNO}_2$  causes separation into two layers, of which the lower aq solution contains 71.9%  $\text{KNO}_2$  while the upper alcoholic layer contains 6.9%  $\text{KNO}_2$  (Donath, Ch Z 1911, 35 773)

Very sl sol in acetone (Krug and M'Elroy, J Anal Ch 6 184)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)  
 Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3602)

**Potassium rhodium nitrite**,  $6\text{KNO}_2$ ,  
 $\text{Rh}_2(\text{NO}_2)_6$

See Rhodonitrite, potassium

**Potassium ruthenium nitrite**

See Ruthenonitrite, potassium

**Potassium silver nitrite**,  $\text{KNO}_2$ ,  $\text{AgNO}_2 + \frac{1}{2}\text{H}_2\text{O}$

Completely sol in a little  $\text{H}_2\text{O}$ , but decomp by more  $\text{H}_2\text{O}$  Sol in  $\text{KNO}_2 + \text{Aq}$  without decomp Insol in alcohol (Lang)

**Potassium strontium nitrite**,  $2\text{KNO}_2$ ,  
 $\text{Sr}(\text{NO}_2)_2$

Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Lang, Pogg 118 293)

**Potassium zinc nitrite**,  $2\text{KNO}_2$ ,  $\text{Zn}(\text{NO}_2)_2 + \text{H}_2\text{O}$

Deliquescent Easily sol in  $\text{H}_2\text{O}$  (Lang, J B 1862 101)

$\text{K}_2\text{Zn}(\text{NO}_2)_6 + 3\text{H}_2\text{O}$  Very hygroscopic  
 Decomp by  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1901, 28 174)

**Rhodium nitrite with  $\text{MNO}_2$**

See Rhodonitrite, M

**Rubidium nitrite**,  $\text{RbNO}_2$

Deliquescent, very sol in  $\text{H}_2\text{O}$ , sl sol in hot alcohol, almost insol in acetone (Ball, Chem Soc 1913, 103 2131)

**Ruthenium nitrite with  $\text{MNO}_2$**

See Ruthenonitrite, M

**Silver nitrite**,  $\text{AgNO}_2$

Sol in 120 pts cold  $\text{H}_2\text{O}$  (Mitscherlich), in 300 pts (Fischer), and more abundantly in hot  $\text{H}_2\text{O}$

1 l  $\text{H}_2\text{O}$  dissolves 3 1823 g or 0 02067 g mols at  $18^\circ$  (Naumann and Rucker, B 1905, 38 2294)

1 litre  $\text{H}_2\text{O}$  dissolves at—

$0^\circ$	0 0113 mol $\text{AgNO}_2$
$8^\circ$	0 0159 " "
$14^\circ$	0 0189 " "
$16^\circ$	0 0203 " "
$18^\circ$	0 0216 " "
$25^\circ$	0 0260 " "
$33^\circ$	0 0370 " "

(Pick and Abegg, Z anorg 1906, 51 3)

1 l  $\text{H}_2\text{O}$  dissolves 3 609 g  $\text{AgNO}_2$  at  $21^\circ$   
 (Oswald, A ch 1914, (9) 1 33)

### Solubility in $\text{H}_2\text{O}$ at $t^\circ$

$t^\circ$	% $\text{AgNO}_2$
1	0 1589
15	0 2752
25	0 4125
35	0 6016
51	1 0240
60	1 3625

(Creighton and Ward, J Am Chem Soc 1915, 37 2335)

### Solubility in $\text{AgNO}_3 + \text{Aq}$ at $18^\circ$

Mols $\text{AgNO}_3$ per l of the solution	Mols $\text{AgNO}_2$ dissolved per l
0	0 0207
0 0026	0 0198
0 0052	0 0190
0 0103	0 0169
0 0207	0 0144
0 0413	0 0117
0 0827	0 0096

(Abegg and Pick, B 1905, 38 2573)

1 l 0.2-N  $\text{NaNO}_2 + \text{Aq}$  dissolves 4.91 g  $\text{AgNO}_2$  at  $25^\circ$  (Ley and Schaefer, B 1906, 39 1263)

1 l sat  $\text{KNO}_3 + \text{Aq}$  dissolves 26%  $\text{AgNO}_2$  at  $13.5^\circ$  (Oswald, A ch 1914, (9) 1 3)

### Solubility in salts + $\text{Aq}$ at $25^\circ$

Salt	Conc of the salt mols per l	% $\text{AgNO}_2$
		0 4135
$\text{AgNO}_3$	0 00258	0 3991
	0 00588	0 3735
	0 01177	0 3432
	0 02355	0 294
	0 04710	0 2495
$\text{KNO}_2$	0 00258	0 3974
	0 00588	0 3820
	0 01177	0 3560
	0 02355	0 3110
	0 04710	0 276

(Creighton and Ward, J Am Chem Soc 1915, 37 2336)

See also under  $\text{KNO}_2$

$\text{AgNO}_2 + \text{NaNO}_2$

1 l 0.02 N- $\text{NaNO}_2 + \text{Aq}$  dissolves 3.15 g  $\text{AgNO}_2$  at  $25^\circ$  0.2-N  $\text{NaNO}_2$ , 3.016 g  $\text{AgNO}_2$  (Ley and Schaefer, B 1906, 39 1263)

100 g  $\text{H}_2\text{O}$  sat with  $\text{AgNO}_2$  and  $\text{Sr}(\text{NO}_2)_2$  contain 10.9 g  $\text{AgNO}_2$  and 78.3 g  $\text{Sr}(\text{NO}_2)_2$  at  $14^\circ$  (Oswald)

Very sol in liq<sup>d</sup>  $\text{NH}_3$  (Frankhn, Am Ch J 1893, 20 829)

Insol in alcohol

Sol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4328)

100 pts acetonitrile dissolve 23 pts at ord temp, 40 pts at  $81^\circ$  (Scholl and Steinkopf, B 1906, 39 4393)

Sl sol in methyl acetate (Bezold, Dissert 1906)

Insol in ethyl acetate (Hamers, Dissert 1906, Naumann, B 1910, 43 314)

**Silver sodium nitrite,  $\text{AgNO}_2$ ,  $\text{NaNO}_2$**

Completely sol in a little  $\text{H}_2\text{O}$ , but decomp by more  $\text{H}_2\text{O}$  (Fischer)

$+\frac{1}{2}\text{H}_2\text{O}$  (Oswald, A ch 1914, (9) 1 75)

**Silver nitrite ammonia,  $\text{AgNO}_2$ ,  $\text{NH}_3$**

Sl sol in  $\text{H}_2\text{O}$ , less sol in alcohol, nearly insol in ether (Reychler, B 16 2425)

$\text{AgNO}_2$ ,  $2\text{NH}_3$  (Reychler)

$\text{AgNO}_2$ ,  $3\text{NH}_3$  Deliquescent Sol in  $\text{H}_2\text{O}$  (Reychler)

**Sodium nitrite,  $\text{NaNO}_2$**

Not deliquescent Very sol in  $\text{H}_2\text{O}$

More sol in  $\text{H}_2\text{O}$  than  $\text{NaNO}_3$ , but less in alcohol

6 pts  $\text{H}_2\text{O}$  dissolve 5 pts  $\text{NaNO}_2$  at  $15^\circ$  (Divers, Chem Soc 1899, 75 86)

100 g  $\text{H}_2\text{O}$  dissolve 83.25 g  $\text{NaNO}_2$  at  $15^\circ$  (Niementowski and Roszkowski, J phys Ch 1897, 22 146)

100 pts  $\text{H}_2\text{O}$  dissolve at

$0^\circ$   $10^\circ$   $20^\circ$   $30^\circ$   $40^\circ$   
73 78 94 91.5 98.5 pts  $\text{NaNO}_2$ ,

$50^\circ$   $60^\circ$   $70^\circ$   $80^\circ$   
107 116 125.5 136 pts  $\text{NaNO}_2$ ,

$90^\circ$   $100^\circ$   $110^\circ$   $120^\circ$   
147 160.5 178 198.5 pts  $\text{NaNO}_2$

B-pt of sat  $\text{NaNO}_2 + \text{Aq} = 128^\circ$  at 761.5 mm pressure Sat solution at  $20^\circ$  has a sp gr = 1.3585 (Oswald, A ch 1914, (9) 1 59)

Solubility in  $\text{NaNO}_2 + \text{Aq}$  at  $t^\circ$

$t^\circ$	100 pts $\text{H}_2\text{O}$ dissolve	
	$\text{NaNO}_2$	$\text{NaNO}_3$
0	73	0
	68.5	19
	67.1	36.3
	64.9	41.7*
	50.3	46.8
	30.2	55.4
	0	74.2

Solubility in  $\text{NaNO}_3 + \text{Aq}$  at  $t^\circ$  — *Continued*

$t^\circ$	100 pts $\text{H}_2\text{O}$ dissolve	
	$\text{NaNO}_2$	$\text{NaNO}_3$
21	84.75	0
	81.1	9.6
	79.7	23.5
	73.8	50.8
	73.1	54.5*
	64.2	56.7
	46.8	62.8
	21.6	74.7
	0	89.3
52	108.8	0
	107.9	6.7
	104.3	20.6
	101.8	34.5
	99.5	43.2
	98.0	62.6*
	97.8	82.0
	65.2	88.0
	44.2	92.9
	27.2	101.4
	14.7	109
	0	118
65	120.7	0
	111.5	34.8
	108.5	62.8
	107.8	90.6*
	78.3	96
	49.5	104.1
	28.4	113.4
	14.7	121.4
	0	131
81	137.1	0
	125.7	38.8
	122.7	69.8
	122.6	101.0*
	79.1	111.5
	50.0	121.0
	27.2	131.7
	0	150
92	149.7	0
	141.2	23.6
	134.6	57.6
	132.3	107.8*
	60.2	130.6
	30.3	145.0
	0	163.5
103	166	0
	153.3	33.2
	148.8	58.8
	142.4	116.0*
	100.0	126.8
	60.1	142.9
	0	181.2

\* Both salts in solid phase

(Oswald, A ch 1914, (9) 1 71)

Solubility in  $H_2O$  is decreased by presence of  $Na_2SO_4$ . 100 pts  $H_2O$  dissolve 11.8 pts  $Na_2SO_4 + 53.9$  pts  $NaNO_2$  (Oswald)

Very sol in liquid  $NH_3$  (Franklin, Am Ch J 1898, 20 829)

Neither dissolved nor attacked by liquid  $NO_2$  (Frankland, Chem Soc 1901, 79 1361)

Sol in warm 90% alcohol (Hampe, A 125 336)

100 pts absolute methyl alcohol dissolve 4.43 pts at  $19.5^\circ$ , 100 pts absolute ethyl alcohol dissolve 0.31 pt at  $19.5^\circ$  (de Bruyn, Z phys Ch 10 783)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

### Strontium nitrite, $Sr(NO_2)_2$

Very sol in  $H_2O$ , and very sl sol in boiling alcohol (Lang, Pogg 118 287)

Easily sol in 90% alcohol (Hampe, A 125 340)

+ $H_2O$  Hygroscopic. 100 ccm of the sat solution contain 62.83 g  $Sr(NO_2)_2 + H_2O$  at  $19.5^\circ$  (Vogel, Z anorg 1903, 35 393)

100 pts  $H_2O$  dissolve at

$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$
58.9	67.6	75.5	84 pts

$Sr(NO_2)_2 + H_2O$ ,

$40^\circ$	$50^\circ$	$60^\circ$	$70^\circ$
94	105	116	130 pts

$Sr(NO_2)_2 + H_2O$ ,

$80^\circ$	$90^\circ$	$100^\circ$
145	162	182 pts

$Sr(NO_2)_2 + H_2O$

Bpt of sat solution is  $112.5^\circ$  at 763 mm pressure. The sat solution at  $19^\circ$  contains 39.3%  $Sr(NO_2)_2$  and has sp gr at  $19^\circ/0^\circ = 1.4461$  (Oswald, A ch 1914, (9) 1 64)

Solubility in alcohol. 100 ccm of the solution in 90% alcohol contain 0.42 g  $Sr(NO_2)_2 + H_2O$  at  $20^\circ$ . 100 ccm of the solution in absolute alcohol contain 0.04 g  $Sr(NO_2)_2 + H_2O$  at  $20^\circ$  (Vogel, Z anorg 1903, 35 393)

### Thallous nitrite, $TlNO_2$

Sol in  $H_2O$ . Ppt from solution in  $H_2O$  by absolute alcohol (Vogel, Z anorg 1903, 35 404)

Very sol in  $H_2O$ , insol in alcohol (Ball, Chem Soc 1913, 103 2131)

### Zinc nitrite, basic, $2ZnO, N_2O_3$

(Hampe, A 125 334)

### Zinc nitrite, $Zn(NO_2)_2 + 3H_2O$

Deliquescent. Sol in  $H_2O$  and alcohol (Lang, J B 1862 99)

### Nitrous oxide, $N_2O$

See Nitrogen monoxide

### Nitroxyl bromide, $NO_2Br$

Decomp spontaneously or with  $F_2O$  (Hasenbach, J pr (2) 4 1)

Does not exist (Frolich, A 224 270)

### Nitroxyl chloride, $NO_2Cl$

Decomp by  $H_2O$  without evolution of  $as$

Probably does not exist (Geuther, A 5 98)

### Nitroxyl fluoride, $NO_2F$

Absorbed by  $H_2O$  with formation of  $H_2O_2$  and  $HIF$ . Decomp by  $H_2O$ , alcohol, and ether (Moissan and Lebeau, C R 1 15, 140 1624)

### Nitroxypyrosulphuric acid,

$(HO)S_2O_5(NO_2)_2, H_2O$

Very deliquescent. Sol in  $H_2O$  with lecomp (Weber, Pogg 142 602)

### Nitryl chloride, $NO_2Cl$

See Nitroxyl chloride

### Octamine cobaltic compounds

The formulae of the following octamine cobaltic compounds should be reduced nearly half, and they should be classed with the tetramine cobaltic compounds (Jorge en Z anorg 2 279)

### Octamine cobaltic carbonate,

$Co_2(NH_3)_8(CO_3)_6 + 3H_2O$

Easily sol in  $H_2O$  (Vortmann and las berg, B 22 2654)

See Carbonatotetramine carbonate

$Co_2(NH_3)_8O_8(CO_3)_4 + 3H_2O$ . Rather difficultly sol in  $H_2O$

— — — chloride (?),  $Co(NH_3)_8(OH)_2 + 2H_2O$

Ppt

$Co_2(NH_3)_8(OH)_2Cl_4, 2HgCl_2$   
 $Co_2(NH_3)_8(OH)_2Cl_4, PtCl_4 + H_2O$  (Vortmann and Blasberg, B 22 2654)

— — — mercuric chloride,  $Co_2(NH_3)_8Cl_4 + 3HgCl_2 + H_2O$

$Co_2(NH_3)_8Cl_6, HgCl_2$ . Difficultly sol in cold  $H_2O$ , decomp on warming (Vortmann)

— — — chlorosulphite,  $Co_2(NH_3)_8(SO_3)_2Cl_4 + 4H_2O$

Sol in  $H_2O$  (Vortmann and Magdeburg B 22 2635)

— — — chromate,

$Co_2(NH_3)_8(CrO_4)_3(H_2O)_2 + 2H_2O$

Sol in  $H_2O$  or acetic acid

+ $8H_2O$ . Sol in warm  $H_2O$  or acetic acid

$Co_2(NH_3)_8(CrO_4)_3Cr_2O_7(H_2O)_2 + H_2O$ . Easily sol in  $H_2O$ , from which it is precipitated by dil  $HNO_3 + Aq$  (Vortmann, B 15 95)

**Octamine cobaltic nitrate**,  $\text{Co}_2(\text{NH}_3)_8(\text{NO}_3)_8 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , precipitated by conc  $\text{HNO}_3 + \text{Aq}$  (Vortmann)

— — — **nitratocarbonate**,  
 $\text{Co}_2(\text{NH}_3)_8(\text{NO}_3)_2(\text{CO}_3)_2 + \text{H}_2\text{O}$

Less sol than other octamine carbonates (Vortmann and Blasberg, B 22 2650)

See Carbonatotetramine cobaltic nitrate

— — — **purpureochloride**,  
 $\text{Co}_2(\text{NH}_3)_8\text{Cl}_6(\text{H}_2\text{O})_2$

Easily sol in  $\text{H}_2\text{O}$ , partly precipitated from aqueous solution by conc  $\text{HCl} + \text{Aq}$  (Vortmann, B 10 1451)

= Chlorotetramine cobaltic chloride,  
 $\text{ClCo}(\text{NH}_3)_4(\text{OH}_2)\text{Cl}_2$ , wick see (Jorgensen, J pr (2) 42 211)

— — — **purpureomercuric chloride**,  
 $\text{Co}_2(\text{NH}_3)_8\text{Cl}_6(\text{H}_2\text{O})_2, 6\text{HgCl}_2$

Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  (Vortmann)

= Chlorotetramine cobaltic mercuric chloride (Jorgensen, J pr (2) 42 211)

— — — **purpureomercuric hydroxychloride**,  
 $\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgCl})_4(\text{HgOH})_4\text{Cl}_6$

Ppt (Vortmann and Morgulis, B 22 2647)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_8\text{Cl}_6$  (V and M)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_8\text{Cl}_4(\text{OH})_2$  (V and M)

— — — **purpureomercuriodide, basic**,  
 $\text{Co N}_8\text{H}_{18}(\text{HgOH})_8\text{I}_r$

(Vortmann and Borsbach, B 23 2805)

— — — **purpureochloroplatinate**

Very sl sol in  $\text{H}_2\text{O}$  (Vortmann)

= Chlorotetramine cobaltic chloroplatinate,  
 $\text{ClCo}(\text{NH}_3)_4(\text{OH}_2)\text{PtCl}_6 + 2\text{H}_2\text{O}$  (Jorgensen, J pr (2) 42 215)

— — — **roseochloride**,  $\text{Co}_2(\text{NH}_3)_8\text{Cl}_6(\text{H}_2\text{O})_2 + 2\text{H}_2\text{O}$ , or  $4\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vortmann, B 15 1891)

See Roseotetramine cobaltic chloride

— — — **roseomercuric chloride**,  
 $\text{Co}_2(\text{NH}_3)_8\text{Cl}_r(\text{H O})_2, 6\text{HgCl}_2 + 3\text{H}_2\text{O}$

Ppt (Vortmann)

— — — **roseomercuric hydroxychloride**,  
 $\text{Co}_2\text{N}_8\text{H}_{17}(\text{HgCl})_6(\text{HgOH})_2\text{Cl}_6$

(Vortmann and Morgulis, B 22 2647)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_8\text{Cl}_6$  (V and M)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_8\text{Cl}_4(\text{OH})_2$  (V and M)

— — — **roseomercuric iodide**,

$\text{Co}_2\text{N}_8\text{H}_{21}(\text{HgI})_8\text{I}_6$

Ppt Sol in  $\text{HCl}$  or  $\text{HNO}_3$  (Vortmann and Borsbach, B 23 2806)

$\text{Co}_2\text{N}_8\text{H}_{20}(\text{HgI})_4\text{I}_6$  Ppt (V and B)

$\text{Co}_2\text{N}_8\text{H}_{20}(\text{HgI})_4\text{I}_4(\text{OH})_2$  Ppt (V and B)

**Octamine cobaltic sulphate**,  
 $\text{Co}_2(\text{NH}_3)_8(\text{OH})_2(\text{SO}_4)_2 + 3\text{H}_2\text{O}$  (?)

Insol in  $\text{H}_2\text{O}$  or dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Sol in moderately conc  $\text{HCl} + \text{Aq}$  (Vortmann and Blasberg, B 22 2653)

$\text{Co}_2(\text{NH}_3)_8(\text{SO}_4)_2 + 6\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Vortmann)

$+ 4\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$

See Roseotetramine cobaltic sulphate

— — — **sulphatocarbonate**,  
 $\text{Co}_2(\text{NH}_3)_8\text{SO}_4(\text{CO}_3)_2 + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vortmann, B 10 1458)

See Carbonatotetramine cobaltic sulphate  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_4)_2\text{CO}_3 + 4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ . (Vortmann and Blasberg, B 22 2650)

— — — **ammonium sulphite**,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3\text{NH}_4)_6 + 10\text{H}_2\text{O}$

See Octamine cobaltisulphite, ammonium

**Octamine cobaltisulphurous acid**

**Ammonium octamine cobaltisulphite**,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3\text{NH}_4)_6 + 10\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vortmann and Magdeburg, B 22 2632)

$\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_2(\text{SO}_3\text{NH}_4)_2 + 4\text{H}_2\text{O}$

**Ammonium barium** — — —  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_6\text{Ba}_2(\text{NH}_4)_2 + 7\text{H}_2\text{O}$   
Ppt (V and M)

**Barium** — — —,  $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_6\text{Ba}_2 + 7\text{H}_2\text{O}$

Ppt (V and M)

**Cobaltic** — — —,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_6\text{Co}_2 + 36\text{H}_2\text{O}$ , and  $24\text{H}_2\text{O}$

**Luteocobaltic** — — —,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_6(\text{NH}_3)_{12}\text{Co}_2 + 8\text{H}_2\text{O}$   
Ppt (V and M)

**Octamine iridium chloride**,  
 $\text{Ir}_2(\text{NH}_3)_8\text{Cl}_6$   
Very sol in  $\text{H}_2\text{O}$  (Palmaer, B 22 16)

**Octamine iridium chlorosulphate**,  
 $\text{Ir}_2(\text{NH}_3)_8\text{Cl}_4\text{SO}_4 + 4\text{H}_2\text{O}$   
(Palmaer)

**Osmiamic acid**,  $\text{H}_2\text{N}_2\text{Os}_2\text{O}_8$ , or  $\text{H}_2\text{N}_2\text{Os}_2\text{O}_8(?)$   
Known only in aqueous solution, which is unstable

**Ammonium osmiumate**

Easily sol in  $\text{H}_2\text{O}$  or alcohol (Fritzsche and Struve, J pr 41 97)

**Barium osmiumate,  $\text{BaN}_2\text{Os}_2\text{O}_5$** 

Moderately sol in  $\text{H}_2\text{O}$

**Lead osmiumate**

Ppt Sol in acids without decomp

**Lead osmiumate chloride**

Ppt

**Mercurous osmiumate**

Ppt

**Mercuric osmiumate**

Ppt

**Potassium osmiumate,  $\text{K}_2\text{N}_2\text{Os}_2\text{O}_5$ , or  $\text{K}_2\text{N}_2\text{Os}_2\text{O}_6$** 

Sl sol in cold, much more easily in hot  $\text{H}_2\text{O}$  Sl sol in alcohol Insol in ether

**Silver osmiumate,  $\text{Ag}_2\text{N}_2\text{Os}_2\text{O}_5$** 

Extremely sl sol in  $\text{H}_2\text{O}$  or cold  $\text{HNO}_3$  + Aq Sol in  $\text{NH}_4\text{OH}$  + Aq

**Sodium osmiumate**

Easily sol in  $\text{H}_2\text{O}$  or alcohol

**Zinc osmiumate,  $\text{ZnN}_2\text{Os}_2\text{O}_5$** 

Decomp by  $\text{H}_2\text{O}$  Nearly insol in  $\text{NH}_4\text{OH}$  + Aq

**Osmic acid,  $\text{H}_2\text{OsO}_4$** 

Stable in  $\text{H}_2\text{O}$  containing alcohol Sol in  $\text{HNO}_3$  or  $\text{HCl}$  + Aq Not attacked by  $\text{H}_2\text{SO}_4$  + Aq (Moraht and Wischin, Z anorg 3 153)

100 g  $\text{H}_2\text{O}$  dissolve 5.88 g  $\text{H}_2\text{OsO}_4$  at  $15^\circ$  (Squire and Cains, Pharm J 1905, 74 720) Attacked by liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 828)

**Barium osmate,  $\text{BaOsO}_4 + \text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Claus, Pogg 65 205)

**Calcium osmate,  $\text{CaOsO}_4$** 

Insol in  $\text{H}_2\text{O}$  (Fremy, J pr 33 411)

**Lead osmate**

Insol in  $\text{H}_2\text{O}$  (Fremy)

**Potassium osmate,  $\text{K}_2\text{OsO}_4 + 2\text{H}_2\text{O}$** 

Sl sol in cold, much more sol in hot  $\text{H}_2\text{O}$ , but is decomp thereby Sl sol in  $\text{KNO}_3$  + Aq Insol in dil or conc alcohol and ether (Fremy, A ch (3) 12 516)

Insol in conc saline solutions (Gibbs, Am J Sci (2) 31 70)

**Sodium osmate,  $\text{Na}_2\text{OsO}_4$** 

Sol in  $\text{H}_2\text{O}$ , insol in alcohol and ethyl alcohol (Fremy, l c)

**Perosmic acid**

See Perosmic acid

**Osminitrous acid****Ammonium osminitrite,  $(\text{NH}_4)_2\text{Os}(\text{NO}_2)_5 + 2\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  Decomp when solution is warmed (Wintrebert, C R 1905, 140 56)

**Barium osminitrite,  $\text{BaOs}(\text{NO}_2)_5$** 

+  $\text{H}_2\text{O}$ , +  $4\text{H}_2\text{O}$  (Wintrebert)

**Calcium osminitrite,  $\text{CaOs}(\text{NO}_2)_5 + 4\text{H}_2\text{O}$** 

(Wintrebert)

**Magnesium osminitrite,  $\text{MgOs}(\text{NO}_2)_5 + 4\text{H}_2\text{O}$** 

(Wintrebert)

**Potassium osminitrite,  $\text{K}_2\text{Os}(\text{NO}_2)_5$** 

Very hygroscopic Very sol in  $\text{H}_2\text{O}$  Decomp by  $\text{HCl}$ ,  $\text{HBr}$  and  $\text{HI}$  (Wintrebert, A ch 1903, (7) 28 135)

**Silver osminitrite,  $\text{Ag}_2\text{Os}(\text{NO}_2)_5 + 2\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  with partial decomp (Wintrebert, C R 1905, 140 586)

**Sodium osminitrite,  $\text{Na}_2\text{Os}(\text{NO}_2)_5 + 2\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Wintrebert)

**Strontium osminitrite,  $\text{SrOs}(\text{NO}_2)_5 + 2\text{H}_2\text{O}$** 

(Wintrebert)

**Zinc osminitrite,  $\text{ZnOs}(\text{NO}_2)_5 + \frac{1}{2}\text{H}_2\text{O}$** 

(Wintrebert)

**Osmyloxynitrous acid****Ammonium osmyloxynitrite,**

$(\text{NH}_4)_2\text{OsO}_3(\text{NO}_2)_2$

Decomp by boiling conc  $\text{HCl}$  and by  $\text{KOH}$  + Aq (Wintrebert, A ch 1903, (7) 28 10)

**Barium osmyloxynitrite,  $\text{BaOsO}_3(\text{NO}_2)_2 + 4\text{H}_2\text{O}$** 

(Wintrebert)

**Potassium osmyloxynitrite,  $\text{K}_2\text{OsO}_3(\text{NO}_2)_2 + 3\text{H}_2\text{O}$** 

Sl sol in cold  $\text{H}_2\text{O}$  Aqueous solution decomp slowly Sol with decomp in dil  $\text{KOH}$  + Aq (Wintrebert)

**Silver osmyloxynitrite,  $\text{Ag}_2\text{OsO}_3(\text{NO}_2)_2 + \text{H}_2\text{O}$** 

(Wintrebert)

**Strontium osmyloxynitrite**,  $\text{SrOsO}_5(\text{NO}_2)_2 + 3\text{H}_2\text{O}$  (Wintrebert)

### Osmynitrous acid

**Potassium osmylnitrite**,  $\text{K}_2\text{OsO}_5(\text{NO}_2)_4$

Decomp by  $\text{H}_2\text{O}$  and by excess of  $\text{KOH} + \text{Aq}$  (Weinland, A ch 1903, (7) 28 54)

### Osmisulphurous acid

**Potassium osmisulphite**,  $[\text{Os}(\text{H}_2\text{O})(\text{SO}_3)_3]\text{K}_6 + 4\text{H}_2\text{O}$

Ppt (Rosenheim, Z anorg 1899, 21 144)

**Potassium hydrogen osmisulphite**,  $[\text{Os}_2(\text{H}_2\text{O})(\text{SO}_3)_{11}]\text{K}_{11}\text{H}_3 + 5\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  without decomp (Rosenheim)  
 $[\text{Os}(\text{SO}_3)_6]\text{K}_6\text{H}_2 + 2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  without decomp (Rosenheim)

**Sodium osmisulphite**,  $[\text{Os}(\text{SO}_3)_3]\text{Na}_6 + 8\text{H}_2\text{O}$

Only sl sol in  $\text{H}_2\text{O}$

$[\text{Os}(\text{H}_2\text{O})(\text{SO}_3)_3]\text{Na}_6 + 4\text{H}_2\text{O}$  Ppt

$[\text{OsO}(\text{SO}_3)_4]\text{Na}_6 + 3\text{H}_2\text{O}$  Ppt (Rosenheim)

### Osmium, Os

When finely divided and not ignited to a very high temperature, Os is sol in  $\text{HNO}_3 + \text{Aq}$  or aqua regia. When ignited it is not attacked by any acid.

Insol in liquid  $\text{NH}_3$  (Gore, Am ch J 1898, 20 828)

### Osmium ammonium comps

See—

**Oxyosmiumamine comps**,  $\text{OsO}(\text{NH}_3)_2\text{X}$

**Oxyosmiumdiamine comps**,  $\text{OsO}_2(\text{NH}_3)_4\text{X}_2$

### Osmium bromide with MBr

See Bromosmate, M

### Osmium dichloride, $\text{OsCl}_2$

Deliquescent. Sol in little, but decomp by more  $\text{H}_2\text{O}$ , with pptn of Os. Sol in conc alkali chlorides +  $\text{Aq}$  with combination and partial decomp (Berzelius)

Sol in alcohol and ether

Insol in  $\text{H}_2\text{O}$  Insol in  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$   
 Sl sol in  $\text{HNO}_3$  and aqua regia. Slowly sol in strong alkali. Insol in liquid  $\text{Cl}_2$ . Insol in alcohol and formaldehyde (Ruff, Z anorg 1910, 65 455)

### Osmium trichloride, $\text{OsCl}_3$

Hygroscopic. Sol in conc  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and conc  $\text{HNO}_3$ . Sol in alkali and in  $\text{NH}_4\text{OH}$ . Insol in liquid  $\text{Cl}_2$ . Easily sol in alcohol. Sl sol in ether (Ruff, Z anorg 1910, 65 453)

$+3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Moraht and Wischin, Z anorg 3 153)

### Osmium tetrachloride, $\text{OsCl}_4$

Sol in a little  $\text{H}_2\text{O}$ , but decomp by further addition of that solvent. Sol in conc  $\text{HCl} + \text{Aq}$

### Osmium trichloride with MCl

See Chlorosmate, M

### Osmium tetrachloride with MCl

See Chlorosmate, M

### Osmium sodium chloride, $\text{Na}_2\text{OsCl}_6 + 2\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  and in alcohol (Rosenheim, Z anorg 1899, 21 133)

### Osmium tetrafluoride, $\text{OsF}_4$

Sol in  $\text{H}_2\text{O}$  (Ruff, B 1913, 46 948)

### Osmium hexafluoride, $\text{OsF}_6$

Decomp by  $\text{H}_2\text{O}$  and conc  $\text{H}_2\text{SO}_4$ . Sol in  $\text{NaOH} + \text{Aq}$  (Ruff, B 1913, 46 945)

### Osmium octafluoride, $\text{OsF}_8$

Sol in  $\text{H}_2\text{O}$ , but is somewhat hydrolyzed. Sol in conc  $\text{H}_2\text{SO}_4$  with decomp. Sol in  $\text{NaOH} + \text{Aq}$  (Ruff, B 1913, 46 944)

### Osmium monohydroxide, $\text{OsO}, x\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ . Sl sol in  $\text{KOH} + \text{Aq}$ . Slowly but completely sol in acids (Berzelius)

### Osmium dihydroxide, $\text{OsO}_2, \text{H}_2\text{O}$

Sol in  $\text{HCl} + \text{Aq}$  while still moist. Insol in  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$ .  
 $+2\text{H}_2\text{O}$  Sol in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  while still moist (Claus and Jacoby)

### Osmium sesquihydroxide, $\text{Os}_2\text{O}_5\text{H}_6$

Sol in acids, and partly sol in  $\text{KOH} + \text{Aq}$  (Claus and Jacoby)

### Osmium iodide, $\text{OsI}_4$

Extremely deliquescent. Sol in  $\text{H}_2\text{O}$  of alcohol, but solution is unstable (Moraht and Wischin, Z anorg 3 153)

### Osmium potassium nitrosochloride,

$\text{K}_2\text{Os}(\text{NO})\text{Cl}_5$

Stable in aqueous solution. Only sl attacked by hot  $\text{HNO}_3$  (Wintrebert, A ch 1903, (7) 28 132)

### Osmium monoxide, $\text{OsO}$

Insol in  $\text{H}_2\text{O}$  or acids (Claus and Jacoby)

### Osmium dioxide, $\text{OsO}_2$

Insol in  $\text{H}_2\text{O}$  or acids

### Osmium sesquioxide, $\text{Os}_2\text{O}_5$

Insol in acids (Claus and Jacoby)



**Osmium trioxide, "Osmic acid,"**  $\text{OsO}_3$

See **Osmic acid**

**Osmium tetroxide, "Perosmic acid,"**  $\text{OsO}_4$

Slowly but abundantly sol in  $\text{H}_2\text{O}$  Sol in alcohol and ether with gradual decomposition  
Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , the solution undergoing decomposition on heating

**Osmium oxide ammonia,**  $\text{OsO}_3 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$

See **Oxyosmiumamine hydroxide**

**Osmium oxysulphide,**  $\text{Os}_3\text{S}_7\text{O}_5 + 2\text{H}_2\text{O}$

Unstable

$\text{OsSO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (v Meyer, J pr (2) 16 77)

$\text{Os}_2\text{O}_3\text{S}_2 + \text{H}_2\text{O}$  Decomp and dissolved by  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Moraht and Wischin, Z anorg 3 153)

**Osmium sulphide,**  $\text{Os}_2\text{S}_3$  (?)

(Berzelius)

Min *Laurite* Insol in all acids, even in aqua regia

**Osmium disulphide,**  $\text{OsS}_2$

Sl sol in  $\text{H}_2\text{O}$ , not more sol in alkali hydrates or carbonates +  $\text{Aq}$  Insol in alkalies after drying (Fremy, A ch (3) 12 521)

**Osmium tetrasulphide,**  $\text{OsS}_4 + x\text{H}_2\text{O}$

Insol in alkali sulphides, carbonates, or hydroxides +  $\text{Aq}$  Sol in cold dil  $\text{HNO}_3 + \text{Aq}$  (Claus)

**Osmocyanhydric acid,**  $\text{H}_4\text{Os}(\text{CN})_6$

Easily sol in  $\text{H}_2\text{O}$  and alcohol Insol in ether (Martius, A 117 361)

**Barium osmocyanide,**  $\text{Ba}_2\text{Os}(\text{CN})_6 + 6\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  and dil alcohol (M)

**Barium potassium osmocyanide,**

$\text{BaK}_2\text{Os}(\text{CN})_6 + 3\text{H}_2\text{O}$

Efflorescent Sl sol in cold, easily in hot  $\text{H}_2\text{O}$

**Ferric osmocyanide,**  $\text{Fe}_4[\text{Os}(\text{CN})_6]_3 + x\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$

**Potassium osmocyanide,**  $\text{K}_4\text{Os}(\text{CN})_6 + 3\text{H}_2\text{O}$

Moderately sol in boiling, less in cold  $\text{H}_2\text{O}$   
Insol in alcohol and ether

**Osmosyl ammonium comps**

See **Oxyosmium amine comps**

**Osmyl potassium bromide,**  $\text{K}_2\text{OsO}_2\text{Br}_4 + 2\text{H}_2\text{O}$

Same properties as the chloride (Wintrebert, A ch 1903, (7) 28 94)

**Osmyl potassium chloride,**  $\text{K}_2\text{OsO}_2\text{Cl}_4$

Very sol in  $\text{H}_2\text{O}$  Solution is stable only in the presence of a small amt of  $\text{HCl}$  comp by hot conc  $\text{HCl}$

$+ 2\text{H}_2\text{O}$  As the anhydrous salt (Winbert, A ch 1903, (7) 28 86)

**Osmyl ditetramine comps**

See **Oxyosmium diamine comps**

**Oxamidodisulphonic acid**

See **Hydroxylamine monosulphonic acid**

**Oximidosulphonic acid**

See **Hydroxylamine disulphonic acid**

**Oxyamidodisulphonic acid**

See **Hydroxylamine sulphonic acid**

**Oxyammonium salts**

See **Hydroxylamine salts**

**Oxycobaltamines, acid comps**

(Maquenne, C R 96 344)

Are anhydrooxycobaltamine comps, with see (Vortmann, M ch 6 404)

**Oxycobaltamine chloride,**

$\text{Co}_2(\text{NH}_3)_{10}\text{O} \begin{smallmatrix} \text{OH} \\ \text{(OH)} \end{smallmatrix} \text{Cl}_4$

(Vortmann, M ch 6 404)

$\text{Co}_2(\text{NH}_3)_{10}\text{O}_2\text{Cl}_4$ ,  $\text{HCl} + 3\text{H}_2\text{O}$  Is anhydrooxycobaltamine chloride, which see

— **chloronitrate hydrochloride,**

$\text{Co}_2(\text{NH}_3)_{10}(\text{OH})(\text{O OH})(\text{NO}_2)_2\text{Cl}_2$ ,  $4\text{HCl} + 3\text{H}_2\text{O}$

Is anhydrooxycobaltamine chloronitrate, which see

— **chlorosulphate,**

$\text{Co}_2(\text{NH}_3)_{10} \begin{smallmatrix} \text{OH} \\ \text{(O(OH))} \end{smallmatrix} (\text{SO}_4)\text{Cl}_2$ ,  $4\text{HCl}$

Easily decomp

— **iodide,**  $\text{Co}_2(\text{NH}_3)_{10} \begin{smallmatrix} \text{OH} \\ \text{(O(OH))} \end{smallmatrix} \text{I}_4$

Sl sol in  $\text{H}_2\text{O}$  Decomp by much  $\text{H}_2\text{O}$  (Vortmann)

— **nitrate,**  $\text{Co}_2(\text{NH}_3)_{10}(\text{OH})(\text{O OH})(\text{NO}_3)_2 + \text{H}_2\text{O}$

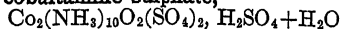
Decomp by  $\text{H}_2\text{O}$

$\text{Co}_2(\text{NH}_3)_{10}(\text{OH})(\text{O OH})(\text{NO}_3)_4$ ,  $\text{HNO}_3$   
 $2\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$

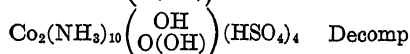
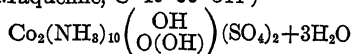
— **nitratodisulphate,**

$\text{Co}_2(\text{NH}_3)_{10}(\text{OH})(\text{O OH})(\text{SO}_4)(\text{NO}_3)_2$ ,  $4\text{HNO}_3$

Decomp at once by  $\text{H}_2\text{O}$

**Oxycobaltamine sulphate,**

Verv sl sol in  $\text{H}_2\text{O}$  with decomp, more easily sol in acidified  $\text{H}_2\text{O}$  Sol in acids (Maquenne, C R 96 344)



violently by  $\text{H}_2\text{O}$

**Oxygen,  $\text{O}_2$** 

100 vols  $\text{H}_2\text{O}$  absorb 4.6 vols O gas at ord temp (Otto Graham)

Sol in 27 pts  $\text{H}_2\text{O}$  at ord temp (Pelouze and Fremy)

100 vols  $\text{H}_2\text{O}$  dissolve 0.925 vol O (Gay Lussac)

1 vol  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm absorbs V vols O gas, reduced to  $0^\circ$  and 760 mm

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	0 04114	7	0 03465	14	0 03034
1	0 04007	8	0 03389	15	0 02989
2	0 03907	9	0 03317	16	0 02949
3	0 03810	10	0 03250	17	0 02914
4	0 03717	11	0 03189	18	0 02884
5	0 03628	12	0 03133	19	0 02858
6	0 03544	13	0 03082	20	0 02838

(Bunsen's Gasometry)

Coefficient of absorption of O by  $\text{H}_2\text{O}$  = 0.04115 - 0.0010899t + 0.000022563t<sup>2</sup> (Bunsen and Paul, A 93 21)

Coefficient of absorption of O in  $\text{H}_2\text{O}$  at  $64^\circ$  = 0.041408, at  $126^\circ$  = 0.036011 (Timofejew, Z pays Ch 6 148)

Absorption of O by  $\text{H}_2\text{O}$   $\beta_1$  = "solubility," i.e., the amount of gas (reduced to  $0^\circ$  and 760 mm) which is absorbed by 1 vol of the liquid when the barometer indicates 760 mm pressure,  $\beta$  = coefficient of absorption, i.e., amount absorbed by the liquid when the pressure of the gas itself without the tension of the liquid amounts to 760 mm,  $\beta_1 = \beta \frac{760-f}{760}$ , when f = vapour tension of solvent at  $t^\circ$

$t^\circ$	$\beta$	$\beta_1$
0	0 04890	0 04860
1	4759	4728
2	4633	4601
3	4512	4479
4	4397	4362
5	4286	4250
6	4181	4142
7	4080	4040
8	3983	3941
9	3891	3847
10	3802	3756
11	3718	3670
12	3637	3587
13	3560	3507

Absorption of O by  $\text{H}_2\text{O}$  — Continued

$t^\circ$	$\beta$	$\beta_1$
14	0 3486	0 3431
15	3415	3358
16	3347	3288
17	3283	3220
18	3220	3155
19	3161	3093
20	3102	3031
21	3044	2970
22	2988	2911
23	2934	2853
24	2881	2797
25	2831	2743
26	2783	2691
27	2736	2641
28	2691	2592
29	2649	2545
30	2608	2500
31	2572	2459
32	2537	2419
33	2503	2380
34	2471	2342
35	2440	2306
36	2410	2270
37	2382	2236
38	2355	2203
39	2330	2171
40	2306	2140
41	2280	2107
42	2256	2075
43	2232	2043
44	2209	2012
45	2187	1981
46	2166	1952
47	2145	1922
48	2126	1894
49	2108	1865
50	2090	1837
52	2057	1782
54	2026	1728
56	1998	1674
58	1971	1619
60	1946	1565
62	1921	1508
64	1897	1450
66	1874	1392
68	1853	1332
70	1833	1270
72	1815	1208
74	1799	1144
76	1785	1078
78	1772	1010
80	1761	0939
82	1752	0865
84	1743	0788
86	1736	0707
88	1729	0622
90	1723	0532
92	1717	0437
94	1712	0337
96	1708	0231
98	1704	0119
100	7001	0000

(Winkler B 24 3609)

Absorption of O by H<sub>2</sub>O at t° and 760 mm $\beta$  = coefficient of absorption

t°	$\beta$	t°	$\beta$	t°	$\beta$
0	0 04961	23	0 03006	46	0 02163
1	4838	24	2956	47	2139
2	4720	25	2904	48	2115
3	4606	26	2855	49	2092
4	4496	27	2808	50	2070
5	4389	28	2762	51	2049
6	4286	29	2718	52	2029
7	4186	30	2676	53	2009
8	4089	31	2635	54	1990
9	3994	32	2596	55	1972
10	3903	33	2558	56	1955
11	3816	34	2521	57	1938
12	3732	35	2486	58	1922
13	3651	36	2452	59	1907
14	3573	37	2419	60	1893
15	3497	38	2387	65	1832
16	3425	39	2356	70	1787
17	3357	40	2326	75	1752
18	3292	41	2297	80	1726
19	3230	42	2269	85	1707
20	3171	43	2241	90	1693
21	3114	44	2214	95	1684
22	3059	45	2188	100	1679

(Bohr and Bock, W Ann (2) 44 318)

Coefficient of absorption of O by H<sub>2</sub>O between 0° and 30° = 0 04890—0 0013413t + 0 0000283t<sup>2</sup>—0 00000029534t<sup>3</sup> (Winkler, l c)Solubility in H<sub>2</sub>O at 25° = 0 03080, at 15° = 0 03630 (Geffcken, Z phys Ch 1904, 49 269)Absorption of O<sub>2</sub> by distilled H<sub>2</sub>O at t°a = ccm of O<sub>2</sub> absorbed by 1 l of H<sub>2</sub>O at t° and 760 mm

t°	a	t°	a	t°	a
0	49 24	17	33 21	34	25 19
1	47 94	18	32 58	35	24 85
2	46 65	19	32 01	36	24 52
3	45 45	20	31 44	37	24 20
4	44 31	21	30 91	38	23 89
5	43 21	22	30 38	39	23 59
6	42 15	23	29 86	40	23 30
7	41 15	24	29 38	41	23 02
8	40 19	25	28 90	42	22 75
9	39 28	26	28 42	43	22 49
10	38 37	27	27 94	44	22 24
11	37 51	28	27 51	45	22 00
12	36 75	29	27 08	46	21 77
13	35 98	30	26 65	47	21 55
14	35 26	31	26 27	48	21 34
15	34 55	32	25 90	49	21 14
16	33 88	33	25 54	50	20 95

(Fox, Trans Faraday Soc 1909, 5 74)

Solubility in H<sub>2</sub>O at various pressures

V = volume of the absorbing liquid

P = Hg-pressure in metres

 $\lambda$  = coefficient of solubility

V	t°	P	$\lambda$
33 320 ccm	23°	0 9595	0 0296
		1 0941	0 0296
		1 2883	0 0296
		1 4976	0 0296
		1 7638	0 0296
		2 0838	0 0296
		2 5011	0 0296
		3 0402	0 0296
		3 8675	0 0288
		4 2504	0 0287
		4 6301	0 0285
32 003 ccm	25 9°	5 1360	0 0285
		5 6973	0 0281
		6 1857	0 0276
		6 7343	0 0274
		7 3051	0 0274
		7 7138	0 0272
		8 1406	0 0270
		0 8611	0 0284
		0 9808	0 0284
		1 0833	0 0284
		1 2039	0 0284
		1 4112	0 0284
		1 6602	0 0284
		2 3854	0 028
		2 6482	0 0284
		2 8995	0 0281
		3 2883	0 0280
		3 9133	0 0276
		4 2720	0 0278
		4 6905	0 0274
		5 0559	0 0276
		5 6141	0 0274
		6 0120	0 027
		6 5687	0 0271
		7 1056	0 0268
		7 4729	0 0267
		8 1889	0 0264

(Cassuto, Phys Zeit 1904, 5 236)

Solubility of O in H<sub>2</sub>O at 25° = 0 029 (Findlay and Creighton, Bioch J 1911, 294)Coefficient of absorption for H<sub>2</sub>O = 0 0336 at 15°, 0 03375 at 15 3°, 0 03330 at 16 2° (Müller, Z phys Ch 1912, 81 494)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ 

$l_{760}$  = solubility of atmospheric  $\text{O}_2$  in  $\text{H}_2\text{O}$  at 760 mm and  $t^\circ$

$t^\circ$	$l_{760}$	$t^\circ$	$l_{760}$
0	10 26	13	7 51
1	9 99	14	7 36
2	9 73	15	7 21
3	9 48	16	7 07
4	9 25	17	6 93
5	9 02	18	6 80
6	8 80	19	6 67
7	8 59	20	6 55
8	8 39	21	6 43
9	8 20	22	6 32
10	8 02	23	6 21
11	7 84	24	6 10
12	7 67	25	6 00

(Carlson, Zeit angew Ch 1913, 26 714)

Solubility of atmospheric  $\text{O}_2$  in mixtures of distilled  $\text{H}_2\text{O}$  with sea water diminishes regularly with the proportion of sea water present (Clowes, J Soc Chem Ind 1904, 23 359)

No of ccm of  $\text{O}_2$  absorbed by 1 l of sea water from a free dry atmosphere of 760 mm pressure

Cl per 1000	$t=0^\circ$	$4^\circ$	8	12°	16	20°	24°	28°
0	10 29	9 26	8 40	7 68	7 08	6 57	6 14	5 75
4	9 83	8 85	8 04	7 36	6 80	6 33	5 91	5 53
8	9 36	8 45	7 68	7 04	6 52	6 07	5 67	5 31
12	8 90	8 04	7 33	6 74	6 24	5 82	5 44	5 08
16	8 43	7 64	6 97	6 43	5 96	5 56	5 20	4 86
20	7 97	7 23	6 62	6 11	5 69	5 31	4 95	4 62

(Fox, Trans Faraday Soc 1909, 5 77)

For  $\text{O}$  absorbed from the air, see also air, atmospheric, p 1

Absorption of  $\text{O}_2$  by acids + Aq

M = content in gram-equivalents per litre  
S = solubility

 $\text{HNO}_3 + \text{Aq}$ 

M	S $25^\circ$	S $15^\circ$
0 492	0 03021	0 03473
0 494	0 03016	0 03490
1 00	0 02954	0 03354
1 008	0 02963	0 03365
1 88	0 02853	0 03175
1 901		0 03166

Absorption of  $\text{O}_2$  by acids + Aq — Continued $\text{HCl} + \text{Aq}$ 

M	S $25^\circ$	S $15^\circ$
0 578	0 02963	0 03431
0 579	0 02960	0 03410
1 170	0 02817	0 03217
1 176	0 02833	0 03109
1 736	0 02733	0 03069
1 982	0 02674	0 02988

 $\frac{\text{H}_2\text{SO}_4}{2} + \text{Aq}$ 

M	S $25^\circ$	S $15^\circ$
0 489	0 02887	0 03366
0 527	0 02875	0 03375
0 977	0 02757	0 03210
1 017	0 02745	0 03217
1 896	0 02545	0 02886
1 829	0 02577	0 02930
2 947	0 02285	0 02584
3 512	0 02198	0 02399
4 951		0 02174
5 293	0 01918	0 02067

(Geffcken, Z phys Ch 1904, 49 269)

Absorption of  $\text{O}$  by  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $t^\circ$ 

$\alpha$  = coefficient of absorption

Normality of the acid	$t^\circ$	$\alpha$
0	20 9	0 0310
4 9	20 9	0 0195
8 9	20 9	0 0155
10 7	21 2	0 0143
20 3	21 1	0 0119
24 8	21 5	0 0103
29 6	20 8	0 0117
34 3	20 9	0 0201
35 8	21 2	0 0275

(Bohr, Z phys Ch 1910, 71 49)

Absorption of  $\text{O}$  by  $\text{NaOH} + \text{Aq}$ 

M = content in gram-equivalents per litre  
S = solubility

M	S $25^\circ$	S $15^\circ$
0 559	0 02434	0 02777
0 601	0 02424	0 02784
1 033	0 02020	0 02291
1 059	0 01991	0 02262
2 077	0 01295	0 01479
2 089	0 01272	0 01456

Absorption of O<sub>2</sub> by KOH+Aq

M	S 25°	S 15°
0 577	0 02447	0 02791
0 579	0 02435	0 02791
1 157	0 01920	0 02191
1 170	0 01914	0 02181

(Geffcken, Z phys Ch 1904, **49** 270)

NaCl+Aq with a chlorine content of 1,930 per 100,000 dissolved 82.9% of the amount of O<sub>2</sub> dissolved by distilled H<sub>2</sub>O alone (Clowes, J Soc Chem Ind 1904, **23** 359)

Absorption of O<sub>2</sub> by salts+Aq

M=content in gram-equivalents per litre  
S=solubility

Absorption of O = by  $\frac{K_2SO_4}{2}$  + Aq

M	S 25	S 15°
0 499	0 02528	0 02944
0 506	0 02530	0 02922
0 968		0 02395
0 970	0 02096	0 02377

Absorption of O<sub>2</sub> by NaCl+Aq

M	S 25	S 15
0 530	0 02598	0 03045
0 535	0 02604	0 03052
1 020	0 02226	0 02601
1 034	0 02202	0 02557
1 880		0 01898
1 890	0 01663	0 01904
1 921	0 01654	0 01869

(Geffcken, Z phys Ch 1904, **49** 270)Solubility of O<sub>2</sub> in NaCl+Aq

Data indicate cc O<sub>2</sub> dissolved per l at 760 mm and 0°

t°	NaCl+Aq 1 g mol per l	NaCl+Aq 2 g mol per l	NaCl+Aq sat at 20°
0	6 50	3 14	1 27
5	5 80	2 84	1 22
10	5 25	2 59	1 17
15	4 77	2 41	1 12
20	4 39	2 25	1 07
25	4 06	2 13	1 02
30	3 76	2 01	0 97

(Winkler, Z anorg 1911, **24** 342)Solubility of O<sub>2</sub> in KCN+Aq at 20°

% KCN      1      10      20      30      50  
Coeff of abs 0.029 0.018 0.013 0.008 0.003  
(McLaurin, J S C I 1893, **63** 737)

1 vol alcohol absorbs 0.28397 vol O at all temperatures between 0° and 24° (Bunsen)

## Absorption by alcohol (99.7%) at t°

$\beta$  = coefficient of absorption,  
 $\beta_1$  = solubility (See p 635)

t°	$\beta$	$\beta_1$
0	0 23370	0 22978
1	0 23296	0 22878
2	0 23222	0 22777
3	0 23149	0 22675
4	0 23077	0 22572
5	0 23005	0 22469
6	0 22934	0 22365
7	0 22863	0 22260
8	0 22793	0 22155
9	0 22724	0 22047
10	0 22656	0 21937
11	0 22588	0 21827
12	0 22521	0 21715
13	0 22455	0 21601
14	0 22389	0 21484
15	0 22324	0 21365
16	0 22259	0 21245
17	0 22195	0 21122
18	0 22132	0 20994
19	0 22069	0 20862
20	0 22007	0 20733
21	0 21946	0 20600
22	0 21886	0 20459
23	0 21826	0 20317
24	0 21767	0 20172

(Timofejew, Z phys Ch **6** 151)Solubility of O<sub>2</sub> in alcohol at 20° and 760 mm

Wt % alcohol	Vol % abs O <sub>2</sub>	Wt % alcohol	Vol % abs O <sub>2</sub>
0 0	2 98	33 33	2 67
9 09	2 78	50 0	3 50
16 67	2 63	66 67	4 95
23 08	2 52	80 0	5 66
28 54	2 49		

(Lubarsch, W Ann 1889, (2) **37** 525)Solubility of O<sub>2</sub> in methyl alcohol at t°

t	l	t	l
0	0 31864	25	0 23642
5	0 30506	30	0 21569
10	0 29005	40	0 16990
15	0 27361	50	0 11840
20	0 25574		

(Levi, Gazz ch it 1901, **31** II, 513)

Solubility of O<sub>2</sub> in ether at 0° = 0.4235, a  
10° = 0.4215 (Christoff, Z phys Ch 1912  
**79** 459)

Solubility of O<sub>2</sub> in acetone at t°

t°	l	t°	l
0	0 2997	25	0 2127
5	0 2835	30	0 1935
10	0 2667	40	0 1533
15	0 2493	50	0 1057
20	0 2313		

(Levi, Gazz ch it 1901, 31 II, 513)

Absorption of O<sub>2</sub> by chloralhydrate+Aq

t° = temp of the solution

P = % chloralhydrate in the solution

β t° = coefficient of absorption at t°

β 15° = coefficient of absorption at 15°

β 20° = coefficient of absorption at 20°

t°	P	β t°	β 15°
18 3	22 9	0 02759	0 02940
16 9	28 0	0 02690	0 02800
15 4	36 6	0 02590	0 02560
16 6	38 6	0 02402	0 02477
12 8	51 3	0 02439	0 02339
16 2	58 44	0 02350	0 02407
15 9	70 0	0 02659	0 02710
17 2	80 85	0 03200	0 03300
16 9	80 9	0 03140	0 03250

			β 20°
20 0	16 9	0 02795	0 02795
21 0	32 0	0 02443	0 02495
21 0	52 9	0 02375	0 02325
20 4	61 08	0 02390	0 02410
21 8	65 5	0 02500	0 02580
21 0	71 4	0 02680	0 02730
22 2	78 0	0 03090	0 03280

(Muller, / phys Ch 1912, 81 499)

## Absorption of O by glycercine+Aq

t° = temp of the solution

P = % glycercine in the solution

β t° = coefficient of absorption at t°

β 15° = coefficient of absorption at 15°

t°	P	β t°	β 15°
12 2	20 5	0 02904	0 02742
12 5	25 0	0 02654	0 02521
14 6	37 3	0 02038	0 02022
13 5	45 0	0 01800	0 01744
12 4	52 0	0 01623	0 01570
12 1	71 5	0 01010	0 00950
13 3	88 5	0 00906	0 00886

(Muller)

Absorption of O<sub>2</sub> by glucose+Aq

t° = temp of the solution

P = % glucose in the solution

β t° = coefficient of absorption at t°

β 20° = coefficient of absorption at 20°

t°	P	β t°	β 20°
21 2	10 84	0 02650	0 02690
21 5	20 7	0 02202	0 02250
19 9	33 8	0 01814	0 01815
20 5	51 9	0 01378	0 01390
21 7	58 84	0 01221	0 01250

(Muller)

Absorption of O<sub>2</sub> by sucrose+Aq

t° = temp of the solution

P = % sucrose in the solution

β t° = coefficient of absorption at t°

β 15° = coefficient of absorption at 15°

t°	P	β t°	β 15°
15 3		0 03375	0 03400
16 2		0 03330	0 03397
16 0	12 1	0 02911	0 02969
15 6	24 38	0 02367	0 02396
16 6	28 44	0 02113	0 02181
15 6	42 96	0 01582	0 01600
16 2	49 25	0 01348	0 01380
17 2	50 0	0 01302	0 01359

(Muller)

Abundantly absorbed by oil of turpentine  
Oil of turpentine absorbs its own vol O when exposed two weeks to the air, but does not give it off on boiling (Brandes)

Absorbed by other oils, but this is decomposition rather than absorption, as the oils are oxidized (See Storer's Diet)

100 vols arterial blood dissolve 10-13 vols O (Magnus)

Coefficient of absorption for petroleum = 0 202 at 20°, 0 229 at 10° (Gniewasz and Walfisz, Z phys Ch 1 70)

The author examined the solubility of O and N<sub>2</sub> at low temp in alcohols ethers, acetone, CHCl<sub>3</sub>, petroleum, benzene and various organic liquids, at low temp the solubility of the N<sub>2</sub> increases at the same rate as that of the O<sub>2</sub> (Claude, C R 1900, 131 448)

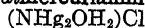
## Oxydmercuriammonium bromate,

(NH<sub>2</sub>OH<sub>2</sub>)BrO<sub>3</sub>

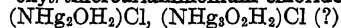
(Rammelsberg, Pogg 55 82)

— carbonate, (NH<sub>2</sub>OH<sub>2</sub>)<sub>2</sub>CO<sub>3</sub> + ½H<sub>2</sub>O

Insol in H<sub>2</sub>O Decomp by HCl+Aq only when conc Not decomp by boiling KOH+Aq Decomp by KI or K<sub>2</sub>S+Aq (Hirzel)  
+H<sub>2</sub>O As above (Hirzel)

**Oxydimercuri ammonium chloride,**

Is *di*mercuriammonium chloride,  $\text{NHg}_2\text{Cl} + \text{H}_2\text{O}$ , which see

**— oxytrimercuriammonium chloride,**

Insol in  $\text{H}_2\text{O}$  Easily sol in dil  $\text{HCl} + \text{Aq}$   
More difficultly sol in very dil  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$  Insol in conc  $\text{H}_2\text{SO}_4$  Sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ , or  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  Decomp by  $\text{KOH} + \text{Aq}$  (Schmieder)

**— chromate,  $(\text{NHg}_2\text{OH}_2)_2\text{CrO}_4$** 

Not decomp by  $\text{KOH} + \text{Aq}$  (Hirzel, J B 1852 421)

**— mercuric chromate,  $(\text{NHg}_2\text{OH}_2)_2\text{CrO}_4$ ,  $4\text{HgO}, 3\text{CrO}_3$** 

Decomp by  $\text{HNO}_3$  without going into solution Easily sol in  $\text{HCl}$  (Hirzel)

Composition is  $(\text{NHg}_2\text{OH}_2)_2\text{O}, 2\text{CrO}_3, 3[(\text{NH}_4)_2\text{O}, 2\text{Cr}_2\text{O}_3] = (\text{NHg}_2\text{OH}_2)_2\text{Cr}_2\text{O}_7, 3(\text{NH}_4)_2\text{Cr}_2\text{O}_7$  (Hensgen, R t c 5 187)

Probably  $(\text{NHg}_2)_2\text{Cr}_2\text{O}_7, 3(\text{NH}_4)_2\text{Cr}_2\text{O}_7 + 2\text{H}_2\text{O}$

**— fluoride, acid,  $(\text{NHg}_2\text{OH}_2)\text{F}, \text{HF}$** 

(Finkener, Pogg 110 632)

Probably  $\text{NHg}_2\text{F}, \text{HF} + \text{H}_2\text{O}$

**— hydroxide,  $(\text{NHg OH}_2)\text{OH} = \text{NHg}_2\text{OH} + \text{H O}$** 

(Millon's base) Sl sol in  $\text{H}_2\text{O}$ , especially if warm Sol in 13,000 pts  $\text{H}_2\text{O}$  at  $17^\circ$ , and 1700 pts at  $80^\circ$  Insol in alcohol or ether (Gerresheim, A 195 373)

$+ \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  or alcohol Sol in traces in  $\text{NH}_4\text{OH} + \text{Aq}$  Not decomp by cold  $\text{KOH} + \text{Aq}$ , sl decomp if hot (Millon)

**— ammonium iodate,  $(\text{NHg}_2\text{OH}_2)\text{IO}_3$ ,  $2\text{NH}_4\text{IO}_3$** 

Insol in  $\text{H}_2\text{O}$  (Millon, A ch (3) 18 410)

**— iodide,  $(\text{NHg}_2\text{OH}_2)\text{I}$** 

Sol in warm  $\text{HCl} + \text{Aq}$  Not decomp by boiling  $\text{KOH} + \text{Aq}$  Sol in warm  $\text{KI} + \text{Aq}$  (Rammelsberg, Pogg 48 170)

Correct formula is  $\text{NHg}_2\text{I} + \text{H}_2\text{O}$  (Rammelsberg)

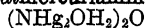
**— nitrate,  $(\text{NHg}_2\text{OH}_2)\text{NO}_3$** 

Insol in  $\text{H}_2\text{O}$ , not decomp by boiling  $\text{KOH} + \text{Aq}$  Sol in cold  $\text{HCl} + \text{Aq}$ , from which it is precipitated by  $\text{H}_2\text{O}$  Sl sol without decomp in  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$  Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Souberan)

Is *di*mercuriammonium nitrate,  $\text{NHg}_2\text{NO}_3$  (Pesci, Gazz ch it 20 485)

**— ammonium nitrate,  $\text{NHg}_2\text{OH}_2\text{NO}_3$ ,  $2\text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  Kane, A ch 72 242)  
Is *di*mercuriammonium ammonium nitrate,  $\text{NHg}_2\text{NO}_3, 2\text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$  (Pesci)

**Oxydimercuri ammonium oxide,**

Insol in  $\text{H}_2\text{O}$  or alcohol, not attacked by boiling conc  $\text{KOH} + \text{Aq}$  Sol in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ ,  $\text{NH}_4\text{Cl} + \text{Aq}$ ,  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ ,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ ,  $(\text{NH}_4)_2\text{C}_2\text{O}_4 + \text{Aq}$  (Hirzel, A ch (3) 18 397)

**— mercuric phosphate,  $\text{Hg}(\text{NHg}_2\text{OH}_2)\text{I}$** 

Insol in  $\text{H}_2\text{O}$  Slowly sol in hot  $\text{HNC} + \text{Aq}$ , not decomp by boiling with  $\text{KOH} + \text{Aq}$ , but by  $\text{KI}$  or  $\text{K}_2\text{S} + \text{Aq}$  Sol in  $\text{HCl} + \text{Aq}$  or much hot  $(\text{NH}_4)_2\text{HPO}_4 + \text{Aq}$  (Hirzel)

**— mercuric sulphate,  $(\text{NHg}_2\text{OH}_2)_2\text{SO}_3$ ,  $\text{HgSO}_3$** 

Insol in  $\text{H}_2\text{O}$  Sol in much  $(\text{NH}_4)_2\text{SC} + \text{Aq}$  Sol in  $\text{HCl} + \text{Aq}$  with decomposition Insol in boiling  $\text{KOH} + \text{Aq}$  (Hirzel)

**— sulphate,  $(\text{NHg}_2\text{OH}_2)_2\text{SO}_4$** 

Sol in traces in  $\text{H}_2\text{O}$  Easily sol in  $\text{HC} + \text{HNO}_3 + \text{Aq}$  (Kane)

Insol in  $\text{HNO}_3 + \text{Aq}$  (Hirzel)

Slowly sol in boiling conc  $\text{H}_2\text{SO}_4$  (Hirzel)

Insol in conc, easily sol in dil  $\text{H}_2\text{SC} + \text{Aq}$  (Schmieder, J pr 75 147)

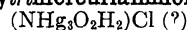
Moderately sol in much  $(\text{NH}_4)_2\text{SO}_4$ , or boiling  $\text{NH}_4\text{Cl} + \text{Aq}$  Not decomp by boiling  $\text{KOH} + \text{Aq}$  (Hirzel)

Easily decomp by boiling with dil  $\text{KOH} + \text{Aq}$  (Schmieder)

Does not exist (Pesci)

$2\text{NH}_3, 2\text{HgO}, \text{SO}_3$

See *Di*mercuriammonium sulphate

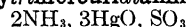
**Oxytrimercuriammonium chloride,**

Insol in  $\text{H}_2\text{O}$

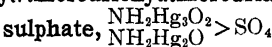
**— nitrate,  $(\text{NHg}_3\text{O}_2\text{H}_2)\text{NO}_3$** 

Sol in cold  $\text{HCl} + \text{Aq}$ , from which it is precipitated by  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp Not decomp by boiling or warm  $\text{KOH} + \text{Aq}$  (Pagenstecher)

Does not exist (Pesci, Gazz ch it 20 485)

**Oxytrimercuriammonium sulphate,**

See *Tri*mercuriammonium sulphate

**Oxytrimercurioxydi mercuriammonium**

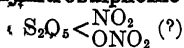
Completely sol in  $\text{NH}_4\text{Cl} + \text{Aq}$ , or  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  Sol in dil or conc  $\text{HC} + \text{Aq}$ , and very dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Insol in  $\text{HNO}_3 + \text{Aq}$  or conc  $\text{H}_2\text{SO}_4$  (Schmieder)

Does not exist (Pesci)

**Oxytetramercuriammonium mercuric nitrate** (?),  $2(\text{NH}_4\text{O}_2)\text{NO}_3, \text{HgNO}_3$  (?)

Completely insol in  $\text{HNO}_3 + \text{Aq}$  Sol in warm  $\text{HCl} + \text{Aq}$  Slowly decomp by boiling  $\text{KOH} + \text{Aq}$  Gradually sol in hot conc  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Hirzel)  
Does not exist (Pesci, Gazz ch it 20 485)

**Oxyantrosulphonic anhydride,**



Sol in  $\text{H}_2\text{O}$  with decomp (Weber, Pogg 123, 339)

**Oxysmiumamine hydroxide (Osmosyldiamine hydroxide),**



Insol in  $\text{H}_2\text{O}$  Sl sol in acids Sol in  $\text{KOH} + \text{Aq}$  When moist, sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Oxysmiumdiamine chloride (Osmyltetramine chloride),**  $\text{OsO}_2(\text{N}_2\text{H}_5\text{Cl})_2$

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Gibbs, Am Ch J 3 233)

— chloroplatinate,  $\text{OsO}_2(\text{N}_2\text{H}_5\text{Cl})_2, \text{PtCl}_4$

Sl sol in  $\text{H}_2\text{O}$  (Gibbs)

— hydroxide,  $\text{OsO}_2(\text{N}_2\text{H}_5\text{OH})_2$

Known only in solution

— nitrate,  $\text{OsO}_2(\text{N}_2\text{H}_5\text{NO}_3)_2$

— sulphate,  $\text{OsO}_2(\text{N}_2\text{H}_5)_2\text{SO}_4 + \text{H}_2\text{O}$   
(Gibbs, Am Ch J 3 233)

**Oxyphosphuretted hydrogen** (?),  $\text{P}_4\text{H}(\text{OH})$

$\text{P}_4\text{O}$  of I V C V R I C I, and Goldschmidt has this formula according to Frank (J pr (2) 35 341) Decomp slowly by  $\text{H}_2\text{O}$  or alkalis Forms potassium salt,  $\text{P}_4\text{H}(\text{OK})$ , sol in  $\text{H}_2\text{O}$

— hydriodide,  $\text{P}_4\text{H}(\text{OH}), \text{HI}$

Decomp at  $80^\circ$

**Sesquioxypylatsulphuric acid,**  $\text{Pt}_2\text{O}_3, 3\text{SO}_3, 5\text{O}_4\text{H}_2 + 11\frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Blondel, A ch 1905, (S) 6 113)

**Barium sesquioxypylatsulphate,**  $\text{Pt}_2\text{O}_3, 3\text{SO}_3, \text{SO}_4\text{Ba} + 8\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Blondel)

**Potassium sesquioxypylatsulphate,**  $\text{Pt}_2\text{O}_3, 3\text{SO}_3, \text{SO}_4\text{K}_2 + 2\text{H}_2\text{O}$

(Blondel)

**Sodium sesquioxypylatsulphate,**  $\text{Pt}_2\text{O}_3, 3\text{SO}_3, \text{SO}_4\text{Na}_2 + 8\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Blondel)

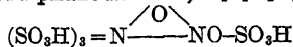
**Oxysulphantimonic acid**

See Sulphoxyantimonic acid

**Oxysulpharsenic acid**

See Sulphoxyarsenic acid

**Oxysulphazotic acid,**  $\text{H}_4\text{S}_4\text{N}_2\text{O}_{14} =$



Known only in its salts (Claus, A 158 52, 194)

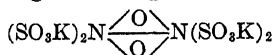
Has formula  $(\text{SO}_3\text{H})_2\text{N} \begin{array}{c} \diagup \text{O} \diagdown \\ \text{NO} \end{array} \text{N}(\text{SO}_3\text{H})_2$

(Raschig, A 241 161)

**Potassium oxysulphazotate,**  $\text{NO}(\text{SO}_3\text{K})_2$

Insol in alcohol (Fremy, A ch (3) 15 451)

According to Raschig the formula is



Very sol in water, with rapid decomposition (Raschig)

See also Peroxylammesulphonate, potassium

**Oxysulphotungstic acid**

See Sulphotungstic acid

**Oxysulphovanadic acid**

See Sulphoxyvanadic acid

**Ozone,  $\text{O}_3$**

Not appreciably sol in  $\text{H}_2\text{O}$  (Schonbein)  
Imparts its taste and properties to  $\text{H}_2\text{O}$  (Williamson)

Later, Carius (B 5 520) found that 1000 vols  $\text{H}_2\text{O}$  at 1–2 5° absorb 5 11 vols  $\text{O}_3$  (red to 0° and 760 mm) He also still later (A 174 1) found, by conducting the gas for 9–12 hours through  $\text{H}_2\text{O}$ , that 1000 vols  $\text{H}_2\text{O}$  absorb a maximum of 28 160 vols  $\text{O}_3$  The ozonized oxygen used contained 3 44 vols  $\text{O}_3$  in 100 vols  $\text{O}_2$  Since gases are absorbed in proportion to their partial pressure, which is very small for the  $\text{O}_3$ , the amount of absorption of water for the gas is very considerable Carius calculated the coefficient of absorption at  $+1^\circ$  to be 0 834

Ozone is *not at all* absorbed by  $\text{H}_2\text{O}$ , the  $\text{H}_2\text{O}$  through which ozone had been passed gave no reactions for ozone (Rammelsberg, B 6 603)

Schone (B 6 1224) corroborates Carius, and finds 8 81 vols to 1000 vols  $\text{H}_2\text{O}$  as a maximum amount absorbed

Sol in  $\text{H}_2\text{O}$  (Leeds, B 12 1831)



H<sub>2</sub>O takes up  $\frac{2}{3}$  of its vol of O<sub>2</sub> at 0° and 760 mm pressure and  $\frac{1}{2}$  of its vol at 12°, or about 15 times that of oxygen at the same pressure and temp (Mailfert, C R 1894, 119 951)

### Solubility in H<sub>2</sub>O at t°

Temp	Wt O <sub>2</sub> dissolved in 1 l H <sub>2</sub> O	Wt O <sub>2</sub> in gaseous mixture above the solution	Coefficient of solubility of O <sub>2</sub>
0	39 4 mgr	61 5 mgr	0 641
6	34 3	61	0 562
11 8	29 9	59 6	0 500
13	28	58 1	0 482
15	25 9	56 8	0 456
19	21	55 2	0 381
27	13 9	51 4	0 270
32	7 7	39 5	0 195
40	4 2	37 6	0 112
47	2 4	31 2	0 077
55	0 6	19 2	0 031
60	0 0	12 3	0 000

(Mailfert, C R 1894, 119 952)

### Solubility of ozone in acidulated H<sub>2</sub>O

Temp	Coefficient of solubility of ozone	Composition of solution
30°	0 240	} 1 l H <sub>2</sub> O + 0 7 cc H <sub>2</sub> SO <sub>4</sub>
33	0 224	
42 7	0 174	
49	0 156	1 l H <sub>2</sub> O + 0 9 cc "
57	0 096	1 l " + 0 3 cc "

(Mailfert)

0 00002 pt by weight is sol in 1 pt by weight H<sub>2</sub>O at ordinary temp and pressure (Ladenburg, B 1898, 31 2510)

The solution of O<sub>3</sub> in H<sub>2</sub>O cannot be brought into equilibrium, because when the gas is blown through the liquid, a portion is continually decomposed, although the concentration remains constant (Ingles, Chem Soc 1903, 83 1012)

About 10 mg ozone are sol in 1 l H<sub>2</sub>O at +2°, 1 5 mg ozone are sol at +28° (Moufang, C C 1911, II 1674)

Solubility in 0 1-N H<sub>2</sub>SO<sub>4</sub>

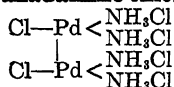
C solution C gas = 0 23 at 20°, 0 44 at 0° (Luther, Z Elektrochem 1905, 11 833)

The absorption coefficient of the gas in 0 1 N H<sub>2</sub>SO<sub>4</sub> solution is 0 487 (Rothmund, C C 1912 I, 1261)

Sol in H<sub>2</sub>C<sub>2</sub>O<sub>4</sub> + Aq (Jeremin, B 11 988)

Completely absorbed by oil of turpentine and oil of cinnamon (Soret, A ch (4) 17 113)

**Dipalladamine chloride**, Cl<sub>2</sub>Pd<sub>2</sub>(NH<sub>3</sub>)<sub>4</sub>Cl =



Sl sol in H<sub>2</sub>O (Deville and Debray, C R 86 296)

### Palladium, Pd

Not attacked by H<sub>2</sub>O Sl attacked by HC + Aq, but Pd sponge or filings are easily dissolved in warm HCl + Aq, with access of air HNO<sub>3</sub> + Aq of 1 2 sp gr dissolves slightly, but it is easily sol in HNO<sub>3</sub> + Aq of 1 35 sp gr (Rose)

Easily sol in aqua regia Sl sol in conc but insol in dil HI + Aq Sol in conc boiling H<sub>2</sub>SO<sub>4</sub> Sol in boiling FeCl<sub>3</sub> + Aq Sol in HBr + Aq with a little HNO<sub>3</sub>

Insol in liquid NH<sub>3</sub> (Gore, Am Ch 1898, 20 828)

### Palladium ammonium compounds

See—

**Dipalladamine comp**s, Cl<sub>2</sub>Pd<sub>2</sub>(NH<sub>3</sub>)<sub>4</sub>Cl<sub>4</sub>

**Palladodamine** " Pd(NH<sub>3</sub>)<sub>4</sub>Cl<sub>2</sub>

**Palladosamine** " Pd(NH<sub>3</sub>)<sub>2</sub>Cl<sub>2</sub>

### Palladium dibromide

Not known in pure state

### Palladium bromide with MBr

See Bromopalladite, M

### Palladium tetrabromide with MBr

See Bromopalladate, M

### Palladous phosphorus bromide, Pd<sub>2</sub>P<sub>2</sub>Br<sub>10</sub>

Properties as the corresponding chloride (Strecker, B 1909, 42 1776)

### Palladium subchloride, Pd<sub>2</sub>Cl<sub>2</sub>

Deliquescent Decomps by H<sub>2</sub>O, NH<sub>3</sub>, KI, or NH<sub>4</sub>OH + Aq (Kane)

Sol in acetone (Naumann, B 1904, 4328)

### Palladium dichloride, PdCl<sub>2</sub>

Slowly but completely sol in H<sub>2</sub>O

+ 2H<sub>2</sub>O Not deliquescent when pure Slowly sol in H<sub>2</sub>O Much more sol in H<sub>2</sub>O containing HCl

Sol in acetone (Eidmann, C C 1899, I 1014)

Sol in ethyl acetate (Naumann B 1903, 37 3601)

### Palladium dichloride with MCl

See Chloropalladite, M

### Palladium tetrachloride with MCl

See Chloropalladate, M

### Palladous phosphorus chloride, PdCl<sub>2</sub>, P<sub>2</sub>O<sub>5</sub>

Decomp by H<sub>2</sub>O into deliquescent P(O)<sub>3</sub>, PdCl<sub>2</sub> Decomp by alcohol (Fink, C R 115 176)

Decomp by H<sub>2</sub>O Sol in CHCl<sub>3</sub> and C<sub>2</sub>H<sub>5</sub>I Insol in ligroin and CCl<sub>4</sub> (Strecker, B 1 19, 42 1775)

PdCl<sub>2</sub>, 2PbCl<sub>2</sub> Sol in C<sub>6</sub>H<sub>6</sub>, and decomps by H<sub>2</sub>O (Fink)

**Palladous chloride carbon monoxide**,  $\text{PdCl}_2$ ,  $2\text{CO}$

Decomp by heat (Fink, C R 1898, 126 648)

$2\text{PdCl}_2$ ,  $3\text{CO}$  Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{CCl}_4$  (Fink)

**Palladium difluoride**,  $\text{PdF}_2$

Sl sol in  $\text{H}_2\text{O}$  or  $\text{HF} + \text{Aq}$  Sl sol while moist, in  $\text{NH}_4\text{OH} + \text{Aq}$ , insol after drying, in  $\text{NH}_4\text{OH} + \text{Aq}$  Insol in boiling  $\text{NaF}$  or  $\text{NaHF}_2 + \text{Aq}$  (Berzelius)

**Palladium hydride**,  $\text{Pd}_2\text{H}$  (?)

**Palladous hydroxide**,  $\text{PdO}$ ,  $x\text{H}_2\text{O}$  (?)

Easily sol in acids or excess of alkali hydrates, and carbonates +  $\text{Aq}$  Sol in hot  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rose)

Insol in  $\text{Na}_2\text{B}_4\text{O}_7$ , and  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  (Claus)

**Palladic hydroxide**,  $\text{PdO}_2$ ,  $x\text{H}_2\text{O}$

Slowly sol in acids Sol in conc  $\text{HCl} + \text{Aq}$  without decomp With dil  $\text{HCl} + \text{Aq}$ ,  $\text{Cl}_2$  is evolved (Berzelius)

**Palladous hydroxide hydroxylamine**,  $\text{Pd}(\text{NH}_2\text{O})_4(\text{OH})_2$

Sl sol in  $\text{H}_2\text{O}$  Sol in dil  $\text{HCl}$  and in dil  $\text{H}_2\text{SO}_4$  (Zeisel, A 1907, 351 445)

**Palladous iodide**,  $\text{PdI}_2$

Insol in  $\text{H}_2\text{O}$  Can be detected as a brown coloration in presence of 400,000 pts  $\text{H}_2\text{O}$  (Lassaigne)

Sl sol in  $\text{HI} + \text{Aq}$  Easily sol in  $\text{KI} + \text{Aq}$  (Lassaigne, J ch med 11 57)

Insol in dil  $\text{HCl} + \text{Aq}$ , but slightly sol in saline solutions (Frcsenius)

Sl sol in hot conc  $\text{HNO}_3 + \text{Aq}$  Sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$ ,  $\text{Cl}_2 + \text{Aq}$ ,  $\text{Br}_2 + \text{Aq}$ ,  $\text{I} + \text{Aq}$ , and  $\text{CN} + \text{Aq}$ , also in  $\text{HCN}$ , and  $\text{MCN} + \text{Aq}$  Insol in dil  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{HNO}_3$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , or in the  $\text{K}$ ,  $\text{Na}$ , or  $\text{NH}_4$  salts of those acids Insol in  $\text{CuCl}_2$ ,  $\text{ZnCl}_2$ , or  $\text{Pb}(\text{C H}_3\text{O})_2 + \text{Aq}$  Insol in  $\text{KBr} + \text{Aq}$  except in presence of a free mineral acid, but not  $\text{HC}_2\text{H}_3\text{O}_2$  Insol in sugar or starch +  $\text{Aq}$ , uric acid, alcohol, ether, or oil of lemon Somewhat sol in urine Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , even when dil with evolution of heat and decomposition (Kersten, A 87 28)

Insol in alcohol or ether  
Sol in methyl acetate (Naumann, B 1909, 42 3790)

**Palladous potassium iodide**

See Iodopalladite, potassium

**Palladium suboxide**,  $\text{Pd}_2\text{O}$

Decomp by acids into palladious salt and  $\text{Pd}$  (Kane, Phil Trans 1842, 1 276)

Insol in acids, even boiling aqua regia (Willm B 25 220)

**Palladous oxide**,  $\text{PdO}$

Slowly sol in acids by boiling (Wohler, A 174 160)

**Palladic oxide**,  $\text{PdO}_2$

Very sl attacked by acids

**Palladopalladic oxide**,  $4\text{PdO}$ ,  $\text{PdO}_2$

Not attacked by aqua regia (Schneider, Pogg 141 528)

**Palladous oxychloride**,  $3\text{PdO}$ ,  $\text{PdCl}_2 + 4\text{H}_2\text{O}$  (?)

Sol in dil acids (Kane)

**Palladous oxychloride ammonia**,  $\text{PdO}$ ,  $\text{PdCl}_2$ ,  $6\text{NH}_3$  (?)

Sol in  $\text{HCl} + \text{Aq}$   
 $3\text{PdO}$ ,  $\text{PdCl}_2$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$  (?) Ppt (Kane)

**Palladium selenide**,  $\text{PdSe}$

Insol in  $\text{HNO}_3$  and aqua regia (Rossler, A 180 240)

**Palladium subsulphide**,  $\text{Pd}_2\text{S}$

Not attacked by acids except aqua regia, which attacks slightly (Schneider, Pogg 141 530)

**Palladium monosulphide**,  $\text{PdS}$

Insol in  $\text{H}_2\text{O}$  or  $(\text{NH}_4)_2\text{S} + \text{Aq}$  Sol in  $\text{HCl} + \text{Aq}$  Pptd in presence of 10,000 pts  $\text{H}_2\text{O}$  (Fellenberg, Pogg 50 65)

Sol in potassium thiocarbonate +  $\text{Aq}$  (Rosenblatt, Z anal 26 15)

A sol colloidal form was obtained in very dilute solution (Winnsinger, Bull Soc (2) 49 452)

Does not exist (Kritschenko, Z anorg 4 247)

**Palladium disulphide**,  $\text{PdS}_2$

$\text{HNO}_3$  dissolves out part of the  $\text{S}$  Easily sol in aqua regia without separation of  $\text{S}$  (Schneider)

**Palladium sulphide with M S**

See Sulphopalladate, M

**Palladoamine bromide**,  $\text{Pd}(\text{N}_2\text{H}_6\text{Br})_2$

Easily sol in  $\text{H}_2\text{O}$

— bromopalladite,  $\text{Pd}(\text{N}_2\text{H}_6\text{Br})_2$ ,  $\text{PdBBr}_2$

Properties as the corresponding chloropalladite

— carbonate

Sol in  $\text{H}_2\text{O}$

— chloride,  $\text{Pd}(\text{N}_2\text{H}_6\text{Cl})_2$

Easily sol in  $\text{H}_2\text{O}$

**Palladoamine chloropalladite**,  $\text{Pd}(\text{N}_2\text{H}_5\text{Cl})_2$ ,  $\text{PdCl}_2$

"Vauquehn's red salt" Insol in cold  $\text{H}_2\text{O}$  (Fischer)

Sol in boiling  $\text{H}_2\text{O}$  with decomp Sol in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$

— **fluoride**

Easily sol in  $\text{H}_2\text{O}$  (Muller)

— **fluosilicate**

Sl sol in cold easily in warm  $\text{H}_2\text{O}$  Insol in alcohol

**hydroxide**,  $\text{Pd}(\text{N}_2\text{H}_5\text{OH})_2$

sl in  $\text{H}_2\text{O}$

**iodide**,  $\text{Pd}(\text{N}_2\text{H}_5\text{I})_2$

sl in  $\text{H}_2\text{O}$

**nitrate**,  $\text{Pd}(\text{N}_2\text{H}_5\text{NO}_3)_2$

easily sol in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq}$   
Insol in alcohol

— **palladous nitrite**,  $\text{Pd}(\text{N}_2\text{H}_5\text{NO}_2)_2$ ,  $\text{Pd}(\text{NO}_2)_2$

Easily sol in  $\text{H}_2\text{O}$

— **sulphate**,  $\text{Pd}(\text{N}_2\text{H}_5)_2\text{SO}_4 + \text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol

— **sulphite**,  $\text{Pd}(\text{N}_2\text{H}_5)_2\text{SO}_3$

Sl sol in  $\text{H}_2\text{O}$

### Palladochloronitrous acid

**Potassium palladochloronitrite**,  $\text{Pd}(\text{NO}_2)_2\text{Cl}_2\text{K}_2$

Sol in 2 pts hot, and 3 pts cold  $\text{H}_2\text{O}$  (Vezes, C R 115 111)

### Palladocyanhydric acid

**Ammonium palladocyanide**,  $(\text{NH}_4)_2\text{Pd}(\text{CN})_4$  (?)

Sol in hot  $\text{H}_2\text{O}$  (Rossler, Z ch 1866 175)

**Barium** —,  $\text{BaPd}(\text{CN})_4 + 4\text{H}_2\text{O}$

Not efflorescent Sol in  $\text{H}_2\text{O}$

**Calcium** —,  $\text{CaPd}(\text{CN})_4 + 4\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$

**Cupric** —,  $\text{CuPd}(\text{CN})_4$

Ppt

**Lead** —,  $\text{PbPd}(\text{CN})_4$

Ppt

**Magnesium** —,  $\text{MgPd}(\text{CN})_4$

Very sol in  $\text{H}_2\text{O}$

**Magnesium — platinumocyanide**,  $\text{MgPd}(\text{C})_4$ ,  $\text{MgPt}(\text{CN})_4 + 14\text{H}_2\text{O}$

Extremely sol in  $\text{H}_2\text{O}$

**Potassium** —,  $\text{K}_2\text{Pd}(\text{CN})_4 + 3\text{H}_2\text{O}$

Efflorescent Sol in  $\text{H}_2\text{O}$

+  $\text{H}_2\text{O}$  Not efflorescent

**Silver** —,  $\text{Ag}_2\text{Pd}(\text{CN})_4$

Ppt

**Sodium** —,  $\text{Na}_2\text{Pd}(\text{CN})_4$

Not efflorescent Sol in  $\text{H}_2\text{O}$

+  $\text{H}_2\text{O}$

### Palladoiodonitrous acid

**Potassium palladoiodonitrite**,

$\text{Pd}(\text{NO}_2)_2\text{I}_2\text{K}_2 + 3\text{H}_2\text{O}$

Effloresces in the air

Decomp by  $\text{H}_2\text{O}$  and dil acids (Ro nheim, Z anorg 1900, 23 28)

### Palladonitrous acid

**Potassium palladonitrite**,  $\text{K}_2\text{Pd}(\text{NO}_2)_4$ ,  $2\text{H}_2\text{O}$

Efflorescent, sol in  $\text{H}_2\text{O}$  (Lang, J pr 13 415)

**Silver palladonitrite**,  $\text{Ag}_2\text{Pd}(\text{NO}_2)_4$

Easily sol in hot  $\text{H}_2\text{O}$  (Lang)

**Sodium** —,  $\text{Na}_2\text{Pd}(\text{NO}_2)_4$

(Fischer)

**Palladosamine bromide**,  $\text{Pd}(\text{NH}_3\text{Br})_2$

Insol in cold, sl sol in hot  $\text{H}_2\text{O}$  Easily sol in  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{H}_2\text{SO}_3$ ,  $\text{KOH}$ ,  $\text{NH}_4\text{OH}$  or alkali carbonates +  $\text{Aq}$  (Muller, A 86 1)

— **carbonate**,  $\text{Pd}(\text{NH}_3)_2\text{CO}_3$

Moderately sol in  $\text{H}_2\text{O}$

— **chloride**,  $\text{Pd}(\text{NH}_3\text{Cl})_2$

Insol in  $\text{H}_2\text{O}$  but very gradually decomp by boiling therewith

Sol in warm  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  Sol in cold  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in  $\text{KOH} + \text{Aq}$  without evolution of  $\text{NH}_3$

+  $2\text{H}_2\text{O}$  Efflorescent Insol in  $\text{H}_2\text{O}$  (Baubigny, A Suppl 4 253)

— **cyanide**,  $\text{Pd}(\text{NH}_3\text{CN})_2$

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

— **fluoride**

Known only in solution

— **hydroxide**,  $\text{Pd}(\text{NH}_3\text{OH})_2$

Easily sol in  $\text{H}_2\text{O}$  Slowly decomp by boiling with  $\text{H}_2\text{O}$  (Muller, A 86, 341)

**Palladosamine iodide,  $\text{Pd}(\text{NH}_3\text{I})_2$** 

Insol in  $\text{H}_2\text{O}$  Sol in boiling  $\text{HNO}_3$  with evolution of  $\text{I}_2$  (Fehling, A 39 106)

**— nitrate**

Known only in solution, which decomp on evaporation

**— nitrite,  $\text{Pd}(\text{NH}_3\text{NO}_2)_2$** 

Moderately sol in  $\text{H}_2\text{O}$  (Lang)

**— palladous nitrite,  $\text{Pd}(\text{NH}_3\text{NO}_2)_2$ ,  $\text{Pd}(\text{NO}_2)_2$** 

Slowly sol in cold, easily in hot  $\text{H}_2\text{O}$  (Lang)

**— sulphate,  $\text{Pd}(\text{NH}_3)_2\text{SO}_4$** 

Moderately sol in  $\text{H}_2\text{O}$  (Muller)

**— sulphite,  $\text{Pd}(\text{NH}_3)_2\text{SO}_3$** 

Easily sol in  $\text{H}_2\text{O}$  (Muller)

**Pentamine chromium compounds**

See—

Bromopurpureochromium compounds

Chloropurpureochromium compounds

Iodopurpureochromium compounds

Xanthochromium compounds

Roseochromium compounds

**Pentamine cobaltic compounds**

See—

Bromopurpureocobaltic compounds,

Chloropurpureocobaltic compounds

Nitratopurpureocobaltic compounds

Nitritocobaltic compounds,

Purpureocobaltic compounds

Roseocobaltic compounds

Sulphatopurpureocobaltic compounds

Xanthocobaltic compounds

**Pentamine dicobaltic sulphite**

See Roseocobaltic cobaltic sulphite

**Pentamine iridium compounds**

See Iridopentamine, and Iridoquo-pentamine compounds

**Pentamine rhodium compounds**

See—

Bromopurpureorhodium compounds

Chloropurpureorhodium compounds

Iodopurpureorhodium compounds

Nitratopurpureorhodium compounds

Roseorhodium compounds

Xanthorhodium compounds

**Pentathionic acid,  $\text{H}_2\text{S}_5\text{O}_8$** 

Known only in aqueous solution  
Conc solution is decomp by boiling, but made stable by addition of acids

Sp gr of aqueous solution of pentathionic acid at  $22^\circ$

Sp gr	1 233	1 320	1 474	1 506
% $\text{H}_2\text{S}_5\text{O}_8$	32 1	41 7	56	59 7

(Kessler, Pogg 74 279)

Does not exist (Spring, Bull Acad roy Belg)

Existence proven by Smith (Chem Soc 43 355)

**Barium pentathionate,  $\text{BaS}_5\text{O}_8 + 2\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  Aqueous solution is precipitated by alcohol

Contains  $3\text{H}_2\text{O}$  (Lewes, C N 43 41)

**Barium pentathionate tetrathionate,  $\text{BaS}_4\text{O}_8 + 6\text{N}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  Not precipitated from aqueous solution by two vols alcohol (Ludwig, Arch Pharm (2) 51 264)

**Cupric pentathionate,  $\text{CuS}_5\text{O}_8 + 4\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  (Debus, Chem Soc 53 360)

**Lead pentathionate,  $\text{PbS}_5\text{O}_8 + 4\text{H}_2\text{O}$** 

Ppt

**Potassium pentathionate,  $\text{K}_2\text{S}_5\text{O}_8$** 

Sol in  $\text{H}_2\text{O}$  (Rammelsberg, J B 1857 136)

Solution decomposes very quickly when neutral, but is more stable in presence of salts or acids

Sol in about 2 pts  $\text{H}_2\text{O}$

Insol in alcohol (Debus, Chem Soc 53 295)

+  $\text{H}_2\text{O}$  (Shaw, Chem Soc 43 351)

+  $1\frac{1}{2}\text{H}_2\text{O}$  (Debus, A 244 76)

+  $2\text{H}_2\text{O}$  (Lewes, C N 43 41)

**Perarsenic acid****Sodium perarsenate,  $\text{Na}_2\text{AsO}_4$** 

(Alvarez, C N 1906, 94 270)

**Perboric acid****Ammonium perborate,  $\text{NH}_4\text{BO}_3$** 

(Constam and Bennett, Z anorg 1900, 25 265)

+  $\frac{1}{2}\text{H}_2\text{O}$  Stable in dry air 100 pts  $\text{H}_2\text{O}$  at  $17.5^\circ$  dissolve 1.55 g anhydrous salt

Decomp in aqueous solution at ord temp

Decomp by dil and conc  $\text{H}_2\text{SO}_4$  and by  $\text{HCl}$  (Melikoff, B 1898, 31 953)

+  $\text{H}_2\text{O}$  (Bruhat, C R 1905, 140 508)

Much more sol in  $\text{H}_2\text{O}$  than the  $\text{Na}$  salt (Tanatar, Z phys Ch 1898, 26 133)

+  $3\text{H}_2\text{O}$  (Melikoff, B 1898, 31 954)

$\text{NH}_4\text{BO}_3$ ,  $\text{NH}_4\text{BO}_4 + \text{H}_2\text{O}$  (Petienko, C C 1902, I 1192)

**Barium perborate**,  $\text{Ba}(\text{BO}_3)_2 \cdot 7\text{H}_2\text{O}$ 

Difficultly sol in  $\text{H}_2\text{O}$  (Melikoff, B 1898, 31 954)

**Cæsium perborate**,  $\text{CsBO}_3 + \text{H}_2\text{O}$ 

As  $\text{NH}_4$  salt (Christensen)

**Calcium perborate**

Sl sol in  $\text{H}_2\text{O}$  Decomp in water much more rapidly than the Ba salt (Melikoff, B 1898, 31 954)

**Copper perborate**

Very unstable Insol in  $\text{H}_2\text{O}$  (Melikoff, B 1898, 31 954)

**Nickel perborate**

Very unstable Insol in  $\text{H}_2\text{O}$  (Melikoff)

**Potassium perborate**,  $2\text{KBO}_3 + \text{H}_2\text{O}$ 

125 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $0^\circ$ , 25 pts, at  $15^\circ$

Insol in alcohol and ether (Girsewald, B 1909, 42 867)

**Potassium perborate hydrogen peroxide**,  $2\text{KBO}_3, \text{H}_2\text{O}_2$ 

0.70 pt is sol in 100 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Girsewald, B 1909, 42 868)

**Potassium perdisborate**,  $\text{KB}_2\text{O} + 2\text{H}_2\text{O}$ 

Ppt (Bruhat, C R 1905, 140 508)

**Rubidium perborate**,  $\text{RbBO}_3 + \text{H}_2\text{O}$ 

As Na salt (Christensen)

**Sodium perborate**,  $\text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$ 

100 g  $\text{H}_2\text{O}$  dissolve 4.2 g at  $11^\circ$ , 7.1 g at  $22^\circ$ , 13.8 g at  $32^\circ$  (Jaubert C R 1904, 134 796)

+4 $\text{H}_2\text{O}$  Slowly decomp in cold solution, rapidly when boiled (Tanatar, Z phys Ch 1898, 26 132)

Sol in  $\text{H}_2\text{O}$  100 g  $\text{H}_2\text{O}$  dissolve 1.17 g Aq solution decomp on warming (Melikoff, B 1898, 31 679)

100 g  $\text{H}_2\text{O}$  dissolve 2.55 g at  $15^\circ$ , 2.69 g at  $21^\circ$ , 2.85 g at  $26^\circ$ , 3.78 g at  $32^\circ$  (Jaubert and Lion, Rev gén Chim 1905, (7) 8 163)

**Uranyl perborate**,  $\text{UBO}_3$ 

(Bruhat, C R 1905, 140 508)

**Perbromic acid**,  $\text{HBrO}_4$ 

Known only in aqueous solution, which can be concentrated to a thick liquid on water bath Not decomp by  $\text{HCl}$ ,  $\text{SO}_2$ , or  $\text{H}_2\text{S}$  (Kammerer, J pr 85 452, 90 190)

Does not exist (Murr, C N 33 256, MacIvor, C N 33 35)

**Barium perbromate**,  $\text{Ba}(\text{BrO}_4)_2$ 

Very sl sol in boiling  $\text{H}_2\text{O}$  (Kammerer, J pr 90 190)

Does not exist (Wolfram, A 198 95)

**Potassium perbromate**,  $\text{KBrO}_4$ 

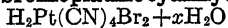
Less sol in  $\text{H}_2\text{O}$  than  $\text{KBrO}_3$ , but more sol than  $\text{KClO}_4$  (Kammerer, J pr 90 190)

Does not exist (Wolfram, A 198 95)

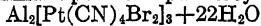
**Silver perbromate**,  $\text{AgBrO}_4$ 

Sl sol in cold, more abundantly in hot  $\text{H}_2\text{O}$  (Kammerer, J pr 90 190)

Does not exist (Wolfram, A 198 95)

**Perbromoplatinocyanhydric acid**,

Deliquescent Easily sol in  $\text{H}_2\text{O}$ , alcohol, and ether (Holst, Bull Soc (2) 22 347)

**Aluminum perbromoplatinocyanide**,

Deliquescent Very sol in  $\text{H}_2\text{O}$

**Ammonium —**,  $(\text{NH}_4)_2\text{Pt}(\text{CN})_4\text{B}_2$ 

Sol in  $\text{H}_2\text{O}$

**Barium —**,  $\text{BaPt}(\text{CN})_4\text{Br}_2 + 5\text{H}_2\text{O}$ 

Very sol in  $\text{H}_2\text{O}$  or alcohol

**Cadmium —**,  $\text{CdPt}(\text{CN})_4\text{Br}_2 + x\text{H}_2\text{O}$ 

Very sol in  $\text{H}_2\text{O}$

**Calcium —**,  $\text{CaPt}(\text{CN})_4\text{Br}_2 + 7\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$

**Cobaltous —**,  $\text{CoPt}(\text{CN})_4\text{B}_1 + 5\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  Sl sol in alcohol

**Glucinum —**,  $\text{GlPt}(\text{CN})_4\text{B}_1$ 

Deliquescent Sol in  $\text{H}_2\text{O}$

**Ferrous —**

Very sl sol in  $\text{H}_2\text{O}$

**Lead —**,  $\text{PbPt}(\text{CN})_4\text{B}_1 + 2\text{H}_2\text{O}$ 

Sl sol in  $\text{H}_2\text{O}$

**Lithium —**,  $\text{Li}_2\text{Pt}(\text{CN})_4\text{B}_1$ 

Deliquescent Sol in  $\text{H}_2\text{O}$

**Magnesium —**,  $\text{MgPt}(\text{CN})_4\text{B}_1 + 11\text{H}_2\text{O}$ 

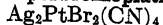
Sol in  $\text{H}_2\text{O}$

**Nickel —**,  $\text{NiPt}(\text{CN})_4\text{B}_1 + r\text{H}_2\text{O}$ 

Sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Potassium —**,  $\text{K}_2\text{Pt}(\text{CN})_4\text{Br}_2$ 

Sol in  $\text{H}_2\text{O}$   
+2 $\text{H}_2\text{O}$  Efflorescent

**Silver perbromoplatinocyanide,**

Ppt (Miolati, Gazz ch it 1900, 30 588)

**Sodium —,  $\text{Na}_2\text{Pt}(\text{CN})_4\text{Br}_2$** Deliquescent Sol in  $\text{H}_2\text{O}$ **Strontium —,  $\text{SrPt}(\text{CN})_4\text{Br}_2 \cdot 7\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$ **Zinc —,  $\text{ZnPt}(\text{CN})_4\text{Br}_2 \cdot 5\text{H}_2\text{O}$** Not very sol in  $\text{H}_2\text{O}$ **Percarbonic acid****Ammonium percarbonate,  $(\text{NH}_4)_2\text{CO}_4 \cdot 2\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  with evolution of  $\text{NH}_3$  Insol in alcohol and ether (Kasanezky, C C 1902, I 1263)**Barium percarbonate,  $\text{BaCO}_4$** Insol in  $\text{H}_2\text{O}$  (Merck, C C 1906, II 1743)Decomp slowly in the air Not rapidly decomp by  $\text{H}_2\text{O}$  Rapidly decomp by acids (Wolfenstein, B 1908, 41 280)**Potassium percarbonate,  $\text{K}_2\text{CO}_4$** Sol in  $\text{H}_2\text{O}$  with decomp Sl sol in alcohol (v Hansen, Z Elektrochem 1897, 3 448) $\text{K}_2\text{C}_2\text{O}_6$  Sol in  $\text{H}_2\text{O}$  at  $0^\circ$  with only slight decomp but is decomp at ord temp Sl sol in alcohol (Treadwell, Ch Z 1901, 25 1008)**Rubidium percarbonate,  $\text{Rb}_2\text{CO}_4 \cdot 2\text{H}_2\text{O}_2 + \text{H}_2\text{O}$** Hydroscopic, decomp by  $\text{H}_2\text{O}$ , pptd by alcohol $\text{Rb}_2\text{CO}_4 \cdot \text{H}_2\text{O} + 2\text{H}_2\text{O}$  Hydroscopic, decomp by  $\text{H}_2\text{O}$ , pptd by alcohol $\text{Rb}_2\text{CO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$  Hydroscopic, decomp by  $\text{H}_2\text{O}$ , pptd by alcohol (Peltner, B 1909, 42 1782) $\text{Rb}_2\text{C}_2\text{O}_6$  Very deliquescent (Constam und Hunsen, Z Elektrochem 1897, 3 144)**Sodium percarbonate,  $\text{Na}_2\text{CO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  with gradual decomp (Tanatar, B 1899, 32 1544)**Sodium hydrogen percarbonate,  $4\text{Na}_2\text{CO}_4 \cdot \text{H}_2\text{CO}_3$** 

Ppt (Merck, Chem Soc 1908, 94 (2) 180)

**Perchloric acid,  $\text{HClO}_4$** Combines with  $\text{H}_2\text{O}$  with a hissing sound and evolution of much heatSolution in  $\text{H}_2\text{O}$  is very stableWhen dil  $\text{HClO}_4 + \text{Aq}$  is distilled,  $\text{H}_2\text{O}$  and  $\text{HClO}_4$  distil off until a temp of  $203^\circ$  is reached, when an acid of constant composition containing 71.6–72.2%  $\text{HClO}_4$  ( $=\text{HClO}_4 + 2\text{H}_2\text{O}$ ) is obtained Forms hydrate  $\text{HClO}_4 \cdot \text{H}_2\text{O}$ , which is deliquescent, and dissolves in  $\text{H}_2\text{O}$  with evolution of much heat  $\text{HClO}_4$  is very unstable,  $\text{HClO}_4 + \text{H}_2\text{O}$  more stable, and  $\text{HClO}_4 + 2\text{H}_2\text{O}$  is very stable (Roscoe, A 121 346)Sp gr of  $\text{HClO}_4 + \text{Aq}$  at  $15^\circ/4^\circ$ 

Sp gr	% $\text{HClO}_4$	Sp gr	% $\text{HClO}_4$	Sp gr	% $\text{HClO}_4$
1 005	1 00	1 235	33 29	1 465	54 50
1 010	1 90	1 240	33 85	1 470	54 89
1 015	2 77	1 245	34 40	1 475	55 18
1 020	3 61	1 250	34 95	1 480	55 56
1 025	4 43	1 255	35 49	1 485	55 95
1 030	5 25	1 260	36 03	1 490	56 32
1 035	6 07	1 265	36 56	1 495	56 69
1 040	6 88	1 270	37 08	1 500	57 06
1 045	9 68	1 275	37 60	1 505	57 44
1 050	8 48	1 280	38 10	1 510	57 81
1 055	9 28	1 285	38 60	1 515	58 17
1 060	10 06	1 290	39 10	1 520	58 54
1 065	10 83	1 295	39 60	1 525	58 91
1 070	11 58	1 300	40 10	1 530	59 28
1 075	12 33	1 305	40 59	1 535	59 66
1 080	13 08	1 310	41 08	1 540	60 04
1 085	13 83	1 315	41 56	1 545	60 41
1 090	14 56	1 320	42 03	1 550	60 78
1 095	15 28	1 325	42 49	1 555	61 15
1 100	16 00	1 330	42 97	1 560	61 52
1 105	16 72	1 335	43 43	1 565	61 89
1 110	17 45	1 340	43 89	1 570	62 26
1 115	18 16	1 345	44 35	1 575	62 63
1 120	18 88	1 350	44 81	1 580	63 00
1 125	19 57	1 355	45 26	1 585	63 37
1 130	20 26	1 360	45 71	1 590	63 74
1 135	20 95	1 365	46 16	1 595	64 12
1 140	21 64	1 370	46 61	1 600	64 50
1 145	22 32	1 375	47 05	1 605	64 88
1 150	22 99	1 380	47 49	1 610	65 26
1 155	23 65	1 385	47 93	1 615	65 63
1 160	24 30	1 390	48 37	1 620	66 01
1 165	24 94	1 395	48 80	1 625	66 39
1 170	25 57	1 400	49 23	1 630	66 76
1 175	26 20	1 405	49 68	1 635	67 13
1 180	26 82	1 410	50 10	1 640	67 51
1 185	27 44	1 415	50 51	1 645	67 89
1 190	28 05	1 420	50 91	1 650	68 26
1 195	28 66	1 425	51 31	1 655	68 64
1 200	29 26	1 430	51 71	1 660	69 02
1 205	29 86	1 435	52 11	1 655	69 40
1 210	30 45	1 440	52 51	1 670	69 77
1 215	31 04	1 445	52 91	1 675	70 15
1 220	31 61	1 450	53 31		
1 225	32 18	1 455	53 71		
1 230	32 74	1 460	54 11		

(Emster, Z anorg 1907, 52 278)

Sp gr of $\text{HClO}_4 + \text{Aq}$			
$\text{HClO}_4$	Sp gr at $15^\circ/4^\circ$	Sp gr at $30^\circ/4^\circ$	Sp gr at $50^\circ/4^\circ$
11 14	1 0670		1 0507
35 63	1 2569	1 2451	1 2292
55 63	1 4807	1 4637	1 4421
69 81	1 6708		1 6284

(Emster, Z anorg 1907, 52 279)

Sp gr of HClO <sub>4</sub> +Aq				
Sp gr				% by wt HClO <sub>4</sub> in the liquid
corrected		uncorrected		
20°	50°	20°	50°	
7676	1 7098	1 7716	1 7312	100
7817	1 7259	1 7858	1 7475	98 62
8059	1 7531	1 8100	1 7751	94 67
	1 7690		1 7912	90 80
	1 7756		1 7979	84 81
	1 7619		1 7840	81 07
7386	1 7023	1 7425	1 7237	75 59
6471	1 6110	1 6508	1 6311	68 42
5353	1 5007	1 5386	1 5194	60 38
4078	1 3779	1 4108	1 3949	50 51
2901	1 2649	1 2927	1 2804	39 73
1778	1 1574	1 1800	1 1715	27 07

(v Wyk, Z anorg 1905, 48 45)

pt of  $\text{HClO}_4 + \text{Aq}$  at atmospheric pressure

% by wt $\text{HClO}_4$ in the liquid	% by wt $\text{HClO}_4$ in the vapor	Initial bpt
72 4	72 4	203°
70 06	40 11	198 7
65 2	6 06	181 2
61 2	0 9	162 3
56 65		148 0
50 67		132 4
38 90		114 8
24 23		105 8
0 0	0 0	100

(v Wyk, Z anorg 1905, 48 33)

pt of  $\text{HClO}_4 + \text{Aq}$  at 18 mm pressure

% by wt $\text{HClO}_4$ in the liquid	Bpt
100	16 0°
94 8	24 8
92 0	35
84 8	70
79 8	92
70 5	107

(v Wyk, Z anorg 1905, 48 36)

+ $\text{H}_2\text{O}$  Deliquescent (Roscoe, A 121 6)  
 + $2\text{H}_2\text{O}$   $\text{HClO}_4 + 2\text{H}_2\text{O}$  has 1 65 sp gr

and boils at  $200^\circ$  (Serullas), has 1 72–1 82 sp gr and boils at  $200^\circ$  (Nativelle, J pr 26 405)

Sol in alcohol with decomp, often explosive

+ $2\frac{1}{2}\text{H}_2\text{O}$  (v Wyck)+ $3\text{H}_2\text{O}$  (v Wyck)+ $3\frac{1}{2}\text{H}_2\text{O}$  (v Wyck)**Perchlorates**

All perchlorates are sol in  $\text{H}_2\text{O}$ ,  $\text{KClO}_4$ ,  $\text{RbClO}_4$ , and  $\text{CsClO}_4$  somewhat difficultly. They are all deliquescent, and sol in alcohol, excepting  $\text{NH}_4\text{ClO}_4$ ,  $\text{KClO}_4$ ,  $\text{Pb}(\text{ClO}_4)_2$ , and  $\text{Hg}_2(\text{ClO}_4)_2$  (Serullas, A ch (2) 46 296)

**Aluminum perchlorate**,  $\text{Al}(\text{ClO}_4)_3 + 6\text{H}_2\text{O}$ 

Very deliquescent (Weinland, Z anorg 1913, 84 370)

**Aluminum sodium perchlorate**,  $\text{AlNa}(\text{ClO}_4)_4 + 12\text{H}_2\text{O}$ 

Sl hygroscopic (Weinland, Z anorg 1913, 84 370)

Sol in acetone (Naumann, B 1904, 37 4328)

**Ammonium perchlorate**,  $\text{NH}_4\text{ClO}_4$ 

Permanent Sol in 5 pts  $\text{H}_2\text{O}$ , somewhat sol in alcohol (Mitscherlich, Pogg 25 300)

Solubility of  $\text{NH}_4\text{ClO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	G per l solution	Sp gr
0	115 63	1 059
20	208 45	1 098
40	305 77	1 128
60	390 50	1 158
80	481 86	1 193
100	570 06	1 216
107	591 15	1 221

(Carlson, Festsck Stockholm 1911 262)

100 g  $\text{H}_2\text{O}$  dissolve 18 5 g  $\text{NH}_4\text{ClO}_4$  (Hofmann, Hobald and Quoos, A 1912, 386 304)

100 g sat solution in  $\text{H}_2\text{O}$  contain 1 735 (17 35°) g  $\text{NH}_4\text{ClO}_4$  at  $14.2^\circ$  (Thin and Cumming, Chem Soc 1915, 107 361)

Insol in conc  $\text{HClO}_4 + \text{Aq}$

100 g sat solution in 98 8% ethyl alcohol contain 1 96 g  $\text{NH}_4\text{ClO}_4$  at  $25.2^\circ$  (Thin and Cumming)

Sol in acetone Eidmann, C C 1899, II 1014)

**Barium perchlorate**,  $\text{Ba}(\text{ClO}_4)_2 + 4\text{H}_2\text{O}$ 

Deliquescent Easily sol in  $\text{H}_2\text{O}$  and alcohol

**+3H<sub>2</sub>O** Solubility of Ba(ClO<sub>4</sub>)<sub>2</sub>+3H<sub>2</sub>O in H<sub>2</sub>O at t°

t°	G per 100 g H <sub>2</sub> O	Sp gr
0	206	1 782
20	289	1 912
40	358	2 009
60	432	2 070
80	497	2 114
100	564	2 155
120	645	2 195
140	758	2 230

(Carlson, Festsck Stockholm, 1911 262)

**Bismuth perchlorate, (BiO)ClO<sub>4</sub>**

Insol in H<sub>2</sub>O Easily sol in HCl or HNO<sub>3</sub>  
 +Aq, less easily in H<sub>2</sub>SO<sub>4</sub>+Aq (Mur, C N 33 15)

**Cadmium perchlorate, Cd(ClO<sub>4</sub>)<sub>2</sub>**

Very deliquescent Sol in H<sub>2</sub>O and alcohol (Serullas, A ch 46 305)  
 +4H<sub>2</sub>O (Salvadori, C C 1912, II 414)  
 +6H<sub>2</sub>O (S)

**Cadmium perchlorate ammonia, Cd(ClO<sub>4</sub>)<sub>2</sub>, 6NH<sub>3</sub>**

Cd(ClO<sub>4</sub>)<sub>2</sub>, 4NH<sub>3</sub> (Salvadori, C C 1912, II 414)

**Cæsium perchlorate, CsClO<sub>4</sub>**

Very sl sol in H<sub>2</sub>O (Retgers, Z phys Ch 8. 17)

Solubility in H<sub>2</sub>O 100 g H<sub>2</sub>O dissolve at  
 8 5° 14° 33 7° 42° 50°  
 O 91 1 19 2 99 4 09 5 47 g CsClO<sub>4</sub>,

60° 70° 84° 99°  
 7 30 9 79 16 51 28 57 g CsClO<sub>4</sub>  
 (Calzolari, Acc Sc Med Ferrara, 1911, 85 150)

Solubility in H<sub>2</sub>O at t°

t	C per 100 g H <sub>2</sub> O	Sp gr
5	0 97	1 007
25	2 05	1 010
80	17 05	1 084

(Carlson, Festsck Stockholm, 1911 262)

**Calcium perchlorate, Ca(ClO<sub>4</sub>)<sub>2</sub>**

Very deliquescent Very sol in H<sub>2</sub>O and alcohol (Serullas, A ch 46 304)

**Cerous perchlorate, Ce(ClO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O**

Very deliquescent (John)

**Chromic perchlorate, Cr(ClO<sub>4</sub>)<sub>3</sub>+6H<sub>2</sub>O**

Very hygroscopic (Weinland, Z anorg 1913, 84 371)  
 +9H<sub>2</sub>O Can be cryst from H<sub>2</sub>O (Weinland)

**Cobaltous perchlorate, Co(ClO<sub>4</sub>)<sub>2</sub>+9H<sub>2</sub>O**

Solubility in H<sub>2</sub>O at t°

t°	G anhydrous salt in 100 cem	Sp gr of sat solution at t /4°
-30 7	83 14	
-21 3	90 57	
0	100 13	1 5639
+ 7 5	101 92	1 5658
18	103 80	1 5670
26	113 45	1 5811
45	115 10	1 5878

(Golblum and Terlikowsky, Bull Soc 1912, (4) 11 146)

**+6H<sub>2</sub>O** (Salvadori, Gazz ch it 1912, 42 (1) 458)

**Cobalt perchlorate ammonia, Co(ClO<sub>4</sub>)<sub>2</sub>, 6NH<sub>3</sub>**

Co(ClO<sub>4</sub>)<sub>2</sub>, 5NH<sub>3</sub>  
 Co(ClO<sub>4</sub>)<sub>2</sub>, 4NH<sub>3</sub>, and +2H<sub>2</sub>O  
 Co(ClO<sub>4</sub>)<sub>2</sub>, 3NH<sub>3</sub>, and +3H<sub>2</sub>O  
 Co(ClO<sub>4</sub>)<sub>2</sub>, 3NH<sub>3</sub>+2H<sub>2</sub>O  
 (Salvadori, Gazz ch it 1912, 42 (1) 458)

**Cupric perchlorate, basic, Cu(ClO<sub>4</sub>)<sub>2</sub>, Cu(OH)<sub>2</sub>**  
 Ppt (Salvadori, C C 1912, II 414)

**Cupric perchlorate, Cu(ClO<sub>4</sub>)<sub>2</sub>**

Deliquescent Sol in H<sub>2</sub>O and alcohol (Serullas, A ch 46 306)  
 +4H<sub>2</sub>O (Salvadori, C C 1912, II 414)

**Cupric perchlorate ammonia, Cu(ClO<sub>4</sub>)<sub>2</sub>, 4NH<sub>3</sub>+2H<sub>2</sub>O**

Not deliquescent Sol in NH<sub>4</sub>OH+Aq (Roscoe, A 121 346)

Cu(ClO<sub>4</sub>)<sub>2</sub>, NH<sub>3</sub>+H<sub>2</sub>O  
 Cu(ClO<sub>4</sub>)<sub>2</sub>, 2CuO+2H<sub>2</sub>O, NH<sub>3</sub>  
 Cu(ClO<sub>4</sub>)<sub>2</sub>, 2CuO+2H<sub>2</sub>O, 2NH<sub>3</sub>  
 Cu(ClO<sub>4</sub>)<sub>2</sub>, Cu(OH)<sub>2</sub>+2H<sub>2</sub>O, 6NH<sub>3</sub>  
 Cu(ClO<sub>4</sub>)<sub>2</sub>, Cu(OH)<sub>2</sub>+2H<sub>2</sub>O, 4NH<sub>3</sub>  
 (Salvadori, C C 1912, II 414)

**Didymium perchlorate, Di(ClO<sub>4</sub>)<sub>3</sub>+9H<sub>2</sub>O**

Very deliquescent Very sol in H<sub>2</sub>O and alcohol (Clvcc)

**Erbium perchlorate, Er(ClO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O**

Very deliquescent

**Gluconium perchlorate, Gl(ClO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O**

Very deliquescent, and sol in H<sub>2</sub>O (Attberg)

**Hydrazine perchlorate, (N<sub>2</sub>H<sub>4</sub>)(HClO<sub>4</sub>)+3H<sub>2</sub>O**

1 l of sat solution in H<sub>2</sub>O contains 417 2 g at 18°, sp gr = 1 264, 669 g at 35°, sp gr = 1 391 (Carlson, Festsck Stockholm, 1911 262)



**Indium perchlorate**,  $\text{In}(\text{ClO}_4)_3 \cdot 8\text{H}_2\text{O}$ 

Deliquescent  $\text{H}_2\text{O}$  solution decomp at  $40^\circ$  with separation of basic salt Sol in  $\text{H}_2\text{O}$  and easily forms sat solutions Sol in abs alcohol, but much less sol in ether (Mathers, J Am Chem Soc 1908, 30 212)

**Iodine perchlorate**,  $\text{I}(\text{ClO}_4)_3 \cdot 2\text{H}_2\text{O}$ 

Decomp by  $\text{H}_2\text{O}$  Indifferent toward organic solvents (Fichter, Z anorg 1915, 91 135)

**Iron (ferrous) perchlorate**,  $\text{Fe}(\text{ClO}_4)_2$ 

Tolerably permanent, sol in  $\text{H}_2\text{O}$  (Serullas, A ch 46 335)

**Iron (ferric) perchlorate**,  $\text{Fe}(\text{ClO}_4)_3$ 

Sol in  $\text{H}_2\text{O}$  (Serullas)

**Iron (ferric) sodium perchlorate**,  $[\text{Fe}(\text{ClO}_4)_4]\text{Na} \cdot 6\text{H}_2\text{O}$ 

Hygroscopic Can be cryst from  $\text{H}_2\text{O}$  (Weinland, Z anorg 1913, 84 366)

**Lanthanum perchlorate**,  $\text{La}(\text{ClO}_4)_3 \cdot 9\text{H}_2\text{O}$ 

Extremely deliquescent Sol in  $\text{H}_2\text{O}$  and absolute alcohol (Cleve)

**Lead perchlorate, basic**,  $2\text{PbO}, \text{Cl}_2\text{O}_7 + 2\text{H}_2\text{O}$ 

Decomp by  $\text{H}_2\text{O}$  into an insol more basic salt, and sol  $\text{Pb}(\text{ClO}_4)_2$  (Marignac)

**Lead perchlorate**,  $\text{Pb}(\text{ClO}_4)_2 \cdot 3\text{H}_2\text{O}$ 

Permanent, extremely easily sol in  $\text{H}_2\text{O}$  (Roscoe, A 121 356)

Sol in about 1 pt  $\text{H}_2\text{O}$  (Serullas)

**Lithium perchlorate**,  $\text{LiClO}_4$ 

Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol (Serullas)

+  $3\text{H}_2\text{O}$  (Wyruboff, Zeit Kryst 10 626)

**Magnesium perchlorate**,  $\text{Mg}(\text{ClO}_4)_2$ 

Deliquescent, and sol in  $\text{H}_2\text{O}$  and alcohol (Serullas)

+  $6\text{H}_2\text{O}$  (Weinland, Z anorg 1913, 84 372)

**Manganous perchlorate**,  $\text{Mn}(\text{ClO}_4)_2$ 

Very deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol (Serullas, A ch 46 335)

+  $6\text{H}_2\text{O}$  Sol in 0.342 pts  $\text{H}_2\text{O}$  (Salvadori, C C 1912, II 414)

**Manganous perchlorate ammonia**,  $\text{Mn}(\text{ClO}_4)_2 \cdot 5\text{NH}_3 \cdot \text{H}_2\text{O}$ 

Sol in  $\text{HCl}$  insol in  $\text{HNO}_3$  (Salvadori, C C 1912, II 414)

**Mercurous perchlorate**,  $(\text{HgClO}_4)_2 \cdot 4\text{H}_2\text{O}$ 

Very sol in  $\text{H}_2\text{O}$  Gradually decomp by

$\text{H}_2\text{O}$  Decomp by alcohol (Chikashigé, Chem Soc 1895, 67 1016)

+  $6\text{H}_2\text{O}$  Very deliquescent (Roscoe, A 121 356)

Permanent (Serullas)

**Mercuric perchlorate, basic**,  $\text{HgO}, 2\text{Hg}(\text{ClO}_4)_2$ 

Anhydrous Ppt Insol in either  $\text{HCl}$  or  $\text{HNO}_3$  Decomp and dissolved by a mixture of the two (Chikashigé, Chem Soc 1905, 87 824)

+  $12\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Chikashigé)  $2\text{HgO}, \text{Hg}(\text{ClO}_4)_2$

$\alpha$ -salt Decomp by  $\text{H}_2\text{O}$  Sol in acids (Chikashigé, Chem Soc 1895, 67 1015)

$\beta$  salt Insol in  $\text{H}_2\text{O}$ , insol in  $\text{HCl}$  or  $\text{HNO}_3$  (Chikashigé, Chem Soc 1905, 87 825)

**Mercuric perchlorate**,  $\text{Hg}(\text{ClO}_4)_2$ 

Very deliquescent Sol in  $\text{H}_2\text{O}$ , sl sol with decomp in alcohol (Serullas, A ch 34 243)

+  $6\text{H}_2\text{O}$  Very hygroscopic Very sol in  $\text{H}_2\text{O}$  Slowly decomp by  $\text{H}_2\text{O}$ , more easily by alcohol (Chikashigé, Chem Soc 1895, 67 1014)

**Mercuric perchlorate bromide**,  $\text{HgClO}_4\text{Br}$ 

Decomp by  $\text{H}_2\text{O}$  (Borelli, Gazz ch it 1908, 38 (2) 421)

**Mercuric perchlorate cyanide**,  $\text{Hg}(\text{ClO}_4)_2, \text{Hg}(\text{CN})_2$ 

Very sol in  $\text{H}_2\text{O}$  Sol in alcohol (Borelli)

**Mercuric perchlorate iodide**,  $\text{Hg}(\text{ClO}_4)_2\text{I}$ 

Deliquescent Decomp by  $\text{H}_2\text{O}$  Sol in much alcohol Decomp by  $\text{HNO}_3$  Completely sol in  $\text{KI}$  or  $\text{KCN} + \text{Aq}$  (Borelli)

**Mercuric perchlorate sulphocyanide**,

$\text{Hg}(\text{ClO}_4)_2, \text{Hg}(\text{SCN})_2$

Insol in  $\text{H}_2\text{O}$  and conc acids Sol in aqua regia (Borelli)

+  $6\text{H}_2\text{O}$  (Salvadori, C C 1912, II 414)

**Nickel perchlorate**,  $\text{Ni}(\text{ClO}_4)_2$ 

Deliquescent easily sol in alcohol and  $\text{H}_2\text{O}$  (Groth, Pogg 133 226)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	C anhydrous salt in 100 cc	Sp gr of the sat solution
-30 7	89 98	
-21 3	92 48	
0	104 55	1 5726
+7 5	106 76	1 5755
18	110 05	1 5760
26	112 15	1 5841
45	118 60	1 5936

(Golblum and Terlikowsky, Bull Soc 1912, (4) 11 147)

- +5H<sub>2</sub>O (Golblum and Terlikowsky)  
 -6H<sub>2</sub>O (Salvadori, C C 1912, II 414)  
 +9H<sub>2</sub>O (Golblum and Terlikowsky)

Nickel perchlorate, ammonia, Ni(ClO<sub>4</sub>)<sub>2</sub>,  
 6NH<sub>3</sub>  
 Ppt (Salvadori)

Nitrosyl perchlorate, NO O ClO<sub>3</sub>+H<sub>2</sub>O  
 Ppt, sl hygroscopic, decomp by H<sub>2</sub>O  
 (Hofmann, B 1909, 42 2032)

Platinum perchlorate, Pt<sub>6</sub>ClO<sub>3</sub>+15H<sub>2</sub>O  
 Insol in H<sub>2</sub>O (Prost, Bull Soc (2) 46  
 156)

Potassium perchlorate, KClO<sub>4</sub>

Sol in 57.9 pts H<sub>2</sub>O at 21.3° (Longuine A 121  
 123) in 65 pts H<sub>2</sub>O at 15° (Serullas A ch (2) 46 297)  
 in 88 pts H<sub>2</sub>O at 10° in 55 pts H<sub>2</sub>O at 100° (Hutstein  
 J B 1851 331)

Solubility in H<sub>2</sub>O

1 pt KClO<sub>4</sub> dissolves in 142.9 pts H<sub>2</sub>O at  
 6°, and solution has sp gr = 1.0005, in 52.5  
 pts H<sub>2</sub>O at 25°, and solution has sp gr =  
 1.0123, in 15.5 pts H<sub>2</sub>O at 50°, and solution  
 has sp gr = 1.0181, in 5.04 pts H<sub>2</sub>O at 100°,  
 and solution has sp gr = 1.0660 (Murr, C  
 N 33 15)

1 l H<sub>2</sub>O dissolves 78.07 millimols KClO<sub>4</sub>  
 at 10°, 120.4 millimols at 20°, 179.9 milli-  
 mols at 30° (Noyes and Sammet, Z phys  
 Ch 1903, 43 538)

1 l H<sub>2</sub>O dissolves 0.1475 mol KClO<sub>4</sub> at  
 25° (Rothmund, Z phys Ch 1909, 69 539)

Solubility in H<sub>2</sub>O at t°

t°	C KClO <sub>4</sub> in 100 g H <sub>2</sub> O	t°	G KClO <sub>4</sub> in 100 g H <sub>2</sub> O
0	0.70	50	6.45
10	1.14	70	12.3
15	1.54	90	22.2
20.5	1.90		

(Calzolari, Acc Sci Med Ferrara, 1911, 85  
 150)

t	C per 100 g H <sub>2</sub> O	sp gr
0	0.79	1.007
20	1.80	1.011
40	4.81	1.022
60	8.71	1.033
80	14.78	1.053
100	20.98	1.067

(Carlson, Festsch Stockholm, 1911 262)

1 l H<sub>2</sub>O dissolves 0.1481 equivalents  
 KClO<sub>4</sub> at 25° (Noyes and Boggs, J Am  
 Chem Soc 1911, 33 1652)

100 cc of sat solution of KClO<sub>4</sub> in H<sub>2</sub>O con-

tains 2.085 g KClO<sub>4</sub> at 25.2° (Thim and Cum-  
 mings, Chem Soc 1915, 107 361)

KClO<sub>4</sub> is sol in 22 C pts H<sub>2</sub>O at ord temp,  
 and 4.00 pts at 100°, in 29.6 pts NH<sub>4</sub>OH +  
 Aq (conc) at ord temp, in 30.4 pts NH<sub>4</sub>OH  
 + Aq (1 vol conc + 3 vols H<sub>2</sub>O) at ord  
 temp, in 22.4 pts HNO<sub>3</sub> + Aq (1 vol conc +  
 5 vols H<sub>2</sub>O) at ord temp, and 5.00 pts at  
 100°, in 30.4 pts HCl + Aq (1 vol conc +  
 4 vols H<sub>2</sub>O) at ord temp, 45.2 pts HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>  
 + Aq (1 vol commercial acid + 1 vol H<sub>2</sub>O)  
 at ord temp, in 24.4 pts NH<sub>4</sub>C<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq  
 (dil HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + dil NH<sub>4</sub>OH + Aq) at ord  
 temp, and 6.00 pts at 100°, in 25.6 pts  
 NH<sub>4</sub>Cl + Aq (1 pt NH<sub>4</sub>Cl + 10 pts H<sub>2</sub>O) at  
 ord temp, and 6.00 pts at 100°, in 16.0 pts  
 NH<sub>4</sub>NO<sub>3</sub> + Aq (1 pt NH<sub>4</sub>NO<sub>3</sub> + 10 pts H<sub>2</sub>O)  
 at ord temp, and 4.00 pts at 100°, in 25.6  
 pts NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq (conc HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> +  
 Na<sub>2</sub>CO<sub>3</sub> + 4 vols H<sub>2</sub>O) at ord temp, and  
 7.00 pts at 100°, in 29.2 pts Cu(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub> +  
 Aq (Stolba, Z anal 2 390) at ord temp,  
 and 7.00 pts at 100°, in 27.2 pts cane sugar  
 (1 pt + 10 pts H<sub>2</sub>O) at ord temp, in 36.8  
 pts grape sugar (1 pt + 10 pts H<sub>2</sub>O) at ord  
 temp (Approximate) (Pearson, Zeit Chem  
 1869 662)

Solubility of KClO<sub>4</sub> in HClO<sub>4</sub> at 25.2°

Normality of HClO <sub>4</sub>	% KClO <sub>4</sub>
0.01	1.999
0.10	1.485
1.00	0.527

(Thim and Cumming, Chem Soc 1915, 107  
 361)

Solubility in KCl + Aq at 25°

Concentration of KCl Equivalents per litre	Solubility of KClO <sub>4</sub> Equivalents per litre
0.04973	0.1282
0.09933	0.1123

(Noyes and Boggs, J Am Chem Soc 1911,  
 33 1652)

Solubility in K<sub>2</sub>SO<sub>4</sub> + Aq at 25°

Concentration of K <sub>2</sub> SO <sub>4</sub> Equivalents per litre	Solubility of KClO <sub>4</sub> Equivalents per litre
0.04976	0.1315
0.09922	0.1181

(Noyes and Boggs)

Very sl sol in abs alcohol, and insol if  
 alcohol contains trace of an acetate (Ros-  
 coe) Insol in alcohol of 0.835 sp gr (Schlos-  
 sing, C R 73 1269)

Sol in 6400 pts 97.2% alcohol, in 5000  
 pts 95.8% alcohol, in 2500-3000 pts 90%  
 alcohol, in 25,000 pts alcohol-ether (2 pts  
 97% alcohol 1 pt ether) Practically insol

in an alcoholic solution of  $\text{HClO}_4$  (Wenze' Z angew Ch 1891 691)

Solubility of  $\text{KClO}_4$  in ethyl alcohol + Aq at 25°

Vol % alcohol	G $\text{KClO}_4$ sol in 100 g alcohol
51 2	0 754
93 5	0 051
98 8	0 019

(Thun and Cumming, Chem Soc 1915, 107 361)

Solubility in organic compds + Aq at 25°

Solvent	Mol $\text{KClO}_4$ sol in 1 litre
0 5-N methyl alcohol	0 1402
" ethyl alcohol	0 1356
" propyl alcohol	0 1343
" tert amyl alcohol	0 1279
" acetone	0 1451
" ether	0 1336
" glycol	0 1416
" glycerine	0 1404
" urea	0 1510
" ammonia	0 1474
" diethylamine	0 1342
" pyridine	0 1410
" urethane	0 1400
" formamide	0 1539
" acetamide	0 1447
" acetic acid	0 1462
" phenol	0 1362
" methylal	0 1400
" methyl acetate	0 1429

(Rothmund, Z phys Ch 1909, 69 539)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Potassium rubidium perchlorate,  
 $\text{KRb}_2(\text{ClO}_4)_3$

15.5 g are contained in 1 l solution sat at 20°, sp gr = 1.013 (Carlson)

Rubidium perchlorate,  $\text{RbClO}_4$

Sol in 92 l pts  $\text{H}_2\text{O}$  at 21.3° (Longuigne, A 121 123)

1 pt sol in 92 l pts  $\text{H}_2\text{O}$  at 21° as compared with 1 pt  $\text{KClO}_4$  sol in 57.9 pts  $\text{H}_2\text{O}$  at 21° (Erdmann, Arch Pharm 1894, 232 23)

Solubility in  $\text{H}_2\text{O}$  at t°

t°	G $\text{RbClO}_4$ in 100 g $\text{H}_2\text{O}$	t	G $\text{RbClO}_4$ in 100 g $\text{H}_2\text{O}$
0	2 46	42 2	14 94
8	3 50	50	19 40
19 8	6 28	77	41 65
30	9 53	99	76 5

(Calzolari, Acc Sci Med Ferrara, 1911, 85 150)

Solubility in  $\text{H}_2\text{O}$  at t°

t°	G in 100 g $\text{H}_2\text{O}$	Sp gr
0	1 10	1 007
20	1 56	1 010
40	3 26	1 017
60	6 27	1 028
80	11 04	1 050
100	15 75	1 070

(Carlson, Festsck Stockholm, 1911 262)

Scandium perchlorate

(Crookes, Roy Soc Proc 1908, 80 A, 518)

Silver perchlorate,  $\text{AgClO}_4$

Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol (Serullas, A ch 46 307)

Sodium perchlorate,  $\text{NaClO}_4$

Deliquescent, and very sol in  $\text{H}_2\text{O}$  and alcohol (Serullas)

Not deliquescent (Potilitzin, J russ Soc 1889, 1 258)

Solubility in  $\text{H}_2\text{O}$  at t°

t°	G in 1 l of solution	Sp gr
15	1076	1 666
50	1234	1 731
143	1414	1 789

(Carlson, Festsck Stockholm, 1911 262)

+  $\text{H}_2\text{O}$  Not deliquescent (Potilitzin)

Strontium perchlorate,  $\text{Sr}(\text{ClO}_4)_2$

Very deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol (Serullas, A ch 46 304)

Terbium perchlorate

Very sol in  $\text{H}_2\text{O}$  and in alcohol (Potratz, C N 1905, 92 3)

Thallous perchlorate,  $\text{TlClO}_4$

1 pt salt dissolves in 10 pts  $\text{H}_2\text{O}$  at 15°, and 0.6 pt at 100° (Roscoe, Chem Soc (2) 4 504)

Solubility in  $\text{H}_2\text{O}$  at t°

t°	G per 100 g $\text{H}_2\text{O}$	Sp gr
0	6 00	1 060
10	8 04	1 075
30	19 72	1 146
50	39 62	1 251
70	65 32	1 430
80	81 49	1 520

(Carlson, Festsck Stockholm 1911 262)

Sl sol in alcohol (Roscoe)

**Thalic perchlorate,  $Tl(ClO_4)_3 + 6H_2O$** 

Very hygroscopic, sol in  $H_2O$  Decomp in moist air (Gewecke, Z anorg 1912, 75 274)

**Uranyl perchlorate,  $(UO_2)(ClO_4)_2 + 4H_2O$** 

(Salvadori, Ch Z 1912, 36 513)  
+  $6H_2O$  (Salvadori)

**Yttrium perchlorate,  $Y(ClO_4)_3 + 8H_2O$** 

Very deliquescent Sol in  $H_2O$  and alcohol (Cleve)

**Zinc perchlorate,  $Zn(ClO_4)_2$** 

Deliquescent Sol in  $H_2O$  and alcohol (Serullas, A ch 46 302)  
+  $4H_2O$ , and  $6H_2O$  (Salvadori, C C 1912, II 414)

**Zinc perchlorate, ammonia,  $Zn(ClO_4)_2, 4NH_3$** 

Ppt (Salvadori, C C 1912, II 414)  
 $Zn(ClO_4)_2, 6NH_3$  (Ephraim, B 1915, 48 643)

**Perchromic acid**

Sol in ethyl acetate and valerate, in amyl chloride, formate, acetate, butyrate, and valerate (All give blue solutions)

Insol in  $CS_2$ ,  $C_6H_6$ ,  $CHCl_3$ ,  $CCl_4$ ,  $C_6H_5NH_2$ ,  $C_6H_5NO_2$  and toluene (Grosvenor, J Am Chem Soc 1895, 17 41-43)

$H_2CrO_8 + 2H_2O$  Decomp above  $-30^\circ$  (Riesenfeld, B 1914, 47 552)

**Ammonium perchromate,  $(NH_4)_2CrO_8$** 

Very unstable Sl sol in cold  $H_2O$  Decomp by conc  $H_2SO_4$  Insol in pure alcohol and pure ether Decomp by boiling alcohol containing more than 50%  $H_2O$  (Wohlers, B 1905, 38 1888)

$CrO_4, 3NH_3$  Sol in 10%  $NH_4OH + Aq$ , sol in  $H_2O$  with decomp, insol in other solvents (Wiede B 1897, 30 2181)

$NH_4CrO_5, H_2O_2$  Decomp in the air Sol in ice cold  $H_2O$ , decomp when warmed Insol in alcohol, ether, ligroin and  $CHCl_3$  (Wiede, B 1898, 31 518)

**Ammonium hydrogen perchromate,**

$CrO_2(O)(OH)(NH_4)(OH)$

Sol in  $H_2O$  with decomp Difficultly sol in cold abs alcohol (Hofmann, B 1904, 37 3406)

**Barium perchromate,  $BaCrO_8$** 

(Byers and Reid, Am Ch J 1904, 32 513)

**Calcium perchromate,  $CaCr_2O_8$** 

Very sol in  $H_2O$  (Mylus B 1900, 33 3689, Byers and Reid, Am Ch J 1904, 32 513)

**Lithium perchromate,  $Li_2Cr_2O_8$** 

(Byers and Reid, Am Ch J 1904, 32 511)

**Magnesium perchromate,  $MgCr_2O_8$** 

(Byers and Reid)

**Potassium perchromate,  $K_2CrO_8$** 

Sl sol in cold  $H_2O$  Decomp by conc  $H_2SO_4$  Insol in pure alcohol and pure ether Decomp by boiling alcohol containing more than 50%  $H_2O$  (Wohlers, B 1905, 38 1888)

+  $xH_2O$  Sol in  $H_2O$  at  $0^\circ$  without decomp (Riesenfeld and Kutsch, B 1908, 41 3948)

$K_2Cr_2O_8$  Sol in  $H_2O$  Decomp in the air (Byers and Reid, Am Ch J 1904, 32 505)

$KCrO_5, H_2O_2$  or  $KH_2CrO_7$  Sol in cold  $H_2O$ , decomp when warmed explosively (Wiede, B 1898, 31 520)

**Sodium perchromate,  $Na_2CrO_8$** 

Sl sol in cold  $H_2O$  Decomp by conc  $H_2SO_4$  Insol in pure alcohol and pure ether Decomp by boiling with alc containing more than 50%  $H_2O$  (Wohlers, B 1905, 38 1885)

$Na_2Cr_2O_8 + 28H_2O$  Efflorescent Sl sol in cold, easily in hot  $H_2O$ , with decomp Not decomp by  $NaOH + Aq$  (Haussmann J pr (2) 48 70)

$Na_2Cr_2O_8$  (Byers and Reid, Am Ch J 1904, 32 511)

**Perchloroplatinocyanhydric acid,**

$H_2Pt(CN)_4Cl_2 + 4H_2O$

Verv sol in  $H_2O$  and alcohol

**Ammonium perchloroplatinocyanide,**

$(NH_4)_2Pt(CN)_4Cl + 2H_2O$

Sol in  $H_2O$

**Barium —,  $BaPt(CN)_4Cl + 5H_2O$** 

Very sol in  $H_2O$

**Calcium —,  $CaPt(CN)_4Cl$** 

Sol in  $H_2O$

**Magnesium —,  $MgPt(CN)_4Cl + 4H_2O$** 

Sol in  $H_2O$

**Manganous —,  $MnPt(CN)_4Cl + 5H_2O$** 

Sol in  $H_2O$  and alcohol

**Potassium —,  $KPt(CN)_4Cl + 2H_2O$** 

Very efflorescent, and sol in  $H_2O$  and alcohol

**Percolumbic acid,  $HCoO_4 + nH_2O$** 

Insol in  $H_2O$  Sol with decomp in conc  $H_2SO_4$  (Melikoff, Z anorg 1899 20 11)

**Cæsium percholumbate,  $Cs_3CoO_4$** 

Ppt (E F Smith, J Am Chem Soc 1908, 30 1658)

**Cæsium magnesium percolumbate,**  
 $\text{MgCsCbO}_8 + 8\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  without decomp (E F Smith)

**Calcium potassium percolumbate,**  
 $\text{CaKCbO}_8 + 4\text{H}_2\text{O}$   
 Difficultly sol in  $\text{H}_2\text{O}$  (E F Smith)

**Calcium sodium percolumbate,**  $\text{CaNaCbO}_8 + 4\text{H}_2\text{O}$   
 Difficultly sol in  $\text{H}_2\text{O}$  (E F Smith)

**Magnesium potassium percolumbate,**  
 $\text{MgKCbO}_8 + 7\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  without decomp (E F Smith)

**Magnesium rubidium percolumbate,**  
 $\text{MgRbCbO}_8 + 7\frac{1}{2}\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  without decomp (E F Smith)

**Magnesium sodium percolumbate,**  
 $\text{MgNaCbO}_8 + 8\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  without decomp (E F Smith)

**Potassium percolumbate,**  $\text{K}_3\text{CbO}_8$   
 Sol in  $\text{H}_2\text{O}$  Ppt from aq solution by alcohol (E F Smith)  
 Sol with decomp in  
 ol Sol in  $\text{KOH} + \text{H}_2\text{O}_2$   
 anorg 1899, 20 342)

**Rubidium percolumbate,**  $\text{Rb}_3\text{CbO}_8$   
 Sol in  $\text{H}_2\text{O}$  Insol in alcohol (E F Smith)

**Sodium percolumbate,**  $\text{Na}_3\text{CbO}_8$   
 Sol in  $\text{H}_2\text{O}$  Insol in alcohol (E F Smith)

### Perferricyanhydric acid

**Potassium perferricyanide,**  $\text{K}_2\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$  (?)

Very hygroscopic, and sol in  $\text{H}_2\text{O}$  Nearly insol in absolute alcohol Decomp by hot  $\text{H}_2\text{O}$  (Skraup, A 189 368)

### Periodic acid, $\text{H}_5\text{IO}_6$

Deliquescent in moist air, very sol in  $\text{H}_2\text{O}$  (Bengieser, A 17 254)

Rather easily sol in alcohol and ether (Bengieser)

Rather easily sol in alcohol, less in ether (Langtoch)

Sl sol in alcohol, still less in ether (Langlois, J pr 56 36)

Sp gr of  $\text{H}_5\text{IO}_6 + \text{Aq}$   
 $\text{H}_5\text{IO}_6 + 20\text{H}_2\text{O} = 1.4008$   
 $\text{H}_5\text{IO}_6 + 40\text{H}_2\text{O} = 1.2165$   
 $\text{H}_5\text{IO}_6 + 80\text{H}_2\text{O} = 1.1121$   
 $\text{H}_5\text{IO}_6 + 160\text{H}_2\text{O} = 1.0570$   
 $\text{H}_5\text{IO}_6 + 320\text{H}_2\text{O} = 1.0288$   
 (Thomsen, B 7 71)

### Periodates

Most periodates are insol or sl sol in  $\text{H}_2\text{O}$ , all are insol or very sl sol in alcohol, but they all dissolve in dil  $\text{HNO}_3 + \text{Aq}$  (Bengieser)

**Aluminum metaperiodate,**  $\text{Al}(\text{IO}_4)_3 + 3\text{H}_2\text{O}$   
 Stable in solution containing  $\text{HNO}_3$  (Eakle, C C 1896 II, 649)

**Ammonium metaperiodate,**  $\text{NH}_4\text{IO}_4$   
 Sl sol in  $\text{H}_2\text{O}$  Cryst with  $3\text{H}_2\text{O}$  (Ihre, B 3 316),  $2\text{H}_2\text{O}$  (Langlois, A ch (3) 34 257)  
 Stable in solution containing free ammonia (Eakle, Zeit Kryst 1896, 26 258-88)  
 100 pts  $\text{H}_2\text{O}$  dissolve 27 pts  $\text{NH}_4\text{IO}_4$  at  $16^\circ$ , sp gr of sat solution at  $16^\circ/4^\circ = 1.0178$  (Barker, Chem Soc 1908, 93 17)

**Ammonium dimesoperiodate,**  $(\text{NH}_4)_4\text{I}_2\text{O}_9 + 3\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 134 379)

Stable in solution containing free ammonia  
 Two modifications (Eakle, Zeit Kryst 1896, 26 558-88, C C 1896 II, 649)

**Ammonium lithium dimesoperiodate,**  
 $(\text{NH}_4)_2\text{Li}_2\text{I}_2\text{O}_9 + 7\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Ihre)

**Ammonium magnesium mesoperiodate,**  
 $\text{NH}_4\text{MgIO}_5 + 3\text{H}_2\text{O}$   
 Precipitate (Rammelsberg, Pogg 134 510)

**Barium metaperiodate,**  $\text{Ba}(\text{IO}_4)_2$   
 Known only in solution

**Barium dimesoperiodate,**  $\text{Ba}_2\text{I}_2\text{O}_9$   
 Sl sol in  $\text{H}_2\text{O}$ , easily sol in dil  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg, Pogg 134 391)  
 Cryst also with  $3\text{H}_2\text{O}$ ,  $5\text{H}_2\text{O}$ , and  $7\text{H}_2\text{O}$

**Barium mesoperiodate,**  $\text{Ba}_2(\text{IO}_5)_2 + 6\text{H}_2\text{O}$  (Ihre)

**Barium orthoperiodate,**  $\text{Ba}_2(\text{IO}_6)_2$   
 Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg)

**Barium dimesodiperiodate,**  $\text{Ba}_3\text{I}_4\text{O}_{11} + 5\text{H}_2\text{O}$   
 Precipitate Sol in dil  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg, Pogg 134 395)

**Barium periodate tungstate**  
 See Tungstoperiodate, barium

**Cæsium metaperiodate,**  $\text{CsIO}_4$   
 Sl sol in cold  $\text{H}_2\text{O}$ , readily sol in hot  $\text{H}_2\text{O}$  (Wells, Am Ch J 1901, 26 279)  
 215 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $15^\circ$   
 Sp gr of the sat aq solution at  $15^\circ/4^\circ = 1.0166$  (Barker, Chem Soc 1908, 93 17)

**Cæsium periodate hydrogen fluoride,  $2\text{CsIO}_4 \cdot 3\text{HF} + \text{H}_2\text{O}$** 

Sol in 40-60%  $\text{HF} + \text{Aq}$  Decomp by  $\text{H}_2\text{O}$  Efflorescent (Weinland, Z anorg 1899, 22 263)

**Cadmium metaperiodate,  $\text{Cd}(\text{IO}_4)_2$** 

Ppt (Rammelsberg, Pogg 134 516)

**Cadmium dimesoperiodate,  $\text{Cd}_2\text{I}_2\text{O}_9 + 9\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Cadmium mesoperiodate,  $\text{Cd}_3(\text{IO}_5)_2 + 5\text{H}_2\text{O}$** 

Ppt  
 $\text{CdHIO}_5$  (Kimmings, Chem Soc 55 151)

**Cadmium diperiodate,  $\text{Cd}_4\text{I}_2\text{O}_{11} + 3\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Cadmium periodate,  $\text{Cd}_{10}\text{I}_6\text{O}_{31} + 15\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Calcium metaperiodate,  $\text{Ca}(\text{IO}_4)_2$** 

Sol in  $\text{H}_5\text{IO}_6 + \text{Aq}$  and acids (Rammelsberg, Pogg 134 405)

**Calcium dimesoperiodate,  $\text{Ca}_2\text{I}_2\text{O}_9 + 7\text{H}_2\text{O}$ , and  $9\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  (Rammelsberg)  
 $+ 3\text{H}_2\text{O}$  (Langlois)

**Calcium orthoperiodate,  $\text{Ca}_5(\text{IO}_6)_2$** 

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg, Pogg 44 577)

**Cobaltous periodate,  $7\text{CoO} \cdot 2\text{I}_2\text{O}_7 + 18\text{H}_2\text{O}$** 

Attacked by  $\text{HCl}$ , and sol on warming Slowly but completely sol in  $\text{NHO}_3$  (Lautsch, J pr 100 89)

Could not be obtained by Rammelsberg

**Cupric dimesoperiodate,  $\text{Cu}_2\text{I}_2\text{O}_9 + 6\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  without dissolving (Rammelsberg)

**Cupric orthoperiodate,  $\text{CuHIO}_6$** 

Very sol in  $\text{HNO}_3 + \text{Aq}$  (Kimmings, Chem Soc 55 150)

**Cupric diperiodate,  $\text{Cu}_4\text{I}_2\text{O}_{11} + \text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , sol in dil  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg)  
 $+ 7\text{H}_2\text{O}$  (R)

**Cupric periodate,  $5\text{CuO} \cdot \text{I}_2\text{O}_5 + 5\text{H}_2\text{O}$** 

Wholly insol in  $\text{H}_2\text{O}$  (Rammelsberg, B 1 73)

**Didymium peroxide,  $\text{Dy}_2\text{O}_3(\text{IO}_4)_2$** 

Precipitate  
 $\text{DyIO}_5 + 4\text{H}_2\text{O}$  Ppt (Cleve, Bull Soc (2) 43 362)

**Erbium periodate**

Sol in  $\text{H}_2\text{O}$  (Hoglund)

**Glucinum periodate,  $\text{Gl}_3(\text{IO}_5)_2 + 11\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  without dissolving Easily sol in  $\text{HNO}_3 + \text{Aq}$   
 $+ 13\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$  (Atterberg, B 7 474)

**Iron (ferrous) orthoperiodate,  $\text{Fe}_5(\text{IO}_6)_2$** 

(Kimmings, Chem Soc 55 150)

$\text{FeH}_3\text{IO}_5$  (Kimmings)

**Iron (ferric) periodate,  $2\text{Fe}_2\text{O}_3 \cdot \text{I}_2\text{O}_7 + 21\text{H}_2\text{O}$** 

Ppt (Rammelsberg)

**Iron (ferric) dimesoperiodate,  $\text{FeHI}_2\text{O}_9$** 

Insol in dil  $\text{HNO}_3 + \text{Aq}$  (Kimmings, Chem Soc 55 149)

**Iron (ferric) metaperiodate,  $\text{Fe}(\text{IO}_4)_3$** 

(Kimmings)

**Lanthanum periodate,  $\text{La}(\text{IO}_4)_3 + 2\text{H}_2\text{O}$** 

Precipitate (Cleve)

**Lead metaperiodate,  $\text{Pb}(\text{IO}_4)_2$** 

Sol in  $\text{HNO}_3 + \text{Aq}$  (Kimmings)

**Lead orthoperiodate,  $\text{Pb}_3\text{H}_4(\text{IO}_6)_2$** 

Sol in  $\text{HNO}_3 + \text{Aq}$  (Kimmings, Chem Soc 55 149)

**Lead mesoperiodate,  $\text{Pb}_3(\text{IO}_5)_2 + 2\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  or excess of periodic acid +  $\text{Aq}$  Decomp by dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Bengieser, A 17 254)

**Lithium metaperiodate,  $\text{LiHIO}_4$** 

Difficultly sol in  $\text{H}_2\text{O}$  (Rammelsberg, B 1 132)

Somewhat deliquescent

$+ \text{H}_2\text{O}$ , sol in  $\text{H}_2\text{O}$  (Buker, Chem Soc 1911, 99 1326)

**Lithium dimesoperiodate,  $\text{Li}_4\text{I}_2\text{O}_9 + 3\text{H}_2\text{O}$** 

Very sl sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 134 387)

**Lithium orthoperiodate,  $\text{Li}_5\text{IO}_6$** 

$\text{H}_2\text{O}$  dissolves out a slight amount of  $\text{LiI}$  Easily sol in  $\text{HNO}_3 + \text{Aq}$  (Rammelsberg, Pogg 137 313)

**Magnesium metaperiodate,  $\text{Mg}(\text{IO}_4)_2 + 10\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Magnesium diperiodate,  $\text{Mg}_4\text{I}_2\text{O}_{11} + 6\text{H}_2\text{O}$ , or  $9\text{H}_2\text{O}$** 

Sl efflorescent Insol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Magnesium dimesoperiodate**,  $\text{Mg}_2\text{I}_2\text{O}_9 + 3\text{H}_2\text{O}$ 

(Rammelsberg, Pogg **134** 499)  
 $+15\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in periodic acid + Aq (Langlois)

**Manganic periodate**

See Manganoperiodic acid

**Mercurous diperiodate**,  $5\text{Hg}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ , or  $4\text{Hg}_2\text{O}$ ,  $\text{I}_2\text{O}_7 = \text{Hg}_8\text{I}_2\text{O}_{11}$ 

Insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HNO}_3$  + Aq and in  $\text{HCl}$  + Aq (Lautsch, J pr **100** 86)

**Mercuric orthoperiodate**,  $\text{Hg}_6(\text{IO}_6)_2$ 

Insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HCl}$  Sl sol in  $\text{HNO}_3$  (Lautsch)

**Mercuric potassium periodate**,  $10\text{HgO}$ ,  $5\text{K}_2\text{O}$ ,  $6\text{I}_2\text{O}_7$ 

Insol in  $\text{H}_2\text{O}$  Difficultly sol in warm  $\text{HNO}_3$  without decomp (Rammelsberg, Pogg **134** 526)

**Nickel dimesoperiodate**,  $\text{Ni}_2\text{I}_2\text{O}_9$ 

(Kimmins, Chem Soc **55** 151)

**Nickel mesoperiodate**,  $\text{NiI}_3(\text{IO}_6)_2$ 

(Kimmins)

**Nickel periodate**,  $7\text{NiO}$ ,  $4\text{I}_2\text{O}_7 + 63\text{H}_2\text{O}$ 

Sl Easily sol in  $\text{H}_2\text{IO}_6$  + Aq  
 5, Pogg **134** 514)

**Potassium metaperiodate**,  $\text{KIO}_4$ 

Sl sol in  $\text{H}_2\text{O}$  Sol in 290 pts cold  $\text{H}_2\text{O}$  (Rammelsberg, Pogg **134** 320)

Almost insol in  $\text{KOH}$  + Aq  
 0.66 pt is sol in 100 pts  $\text{H}_2\text{O}$  at  $13^\circ$  Sp gr of the sat sol at  $13^\circ/4^\circ = 1.0051$  (Barker, Chem Soc 1908, **93** 16)

Insol in methyl acetate (Naumann, B 1909, **42** 3790)

**Potassium mesoperiodate**,  $\text{K}_3\text{IO}_6 + 4\text{H}_2\text{O}$ 

Deliquescent Easily sol in  $\text{H}_2\text{O}$  (Ihre)

**Potassium dimesoperiodate**,  $\text{K}_4\text{I}_2\text{O}_9 + 9\text{H}_2\text{O}$ 

Sol in 9.7 pts cold  $\text{H}_2\text{O}$  (Rammelsberg, Pogg **134** 320)

Sol in  $\text{KOH}$  + Aq  
 $+3\text{H}_2\text{O}$

**Potassium hydrogen dimesoperiodate**,  $\text{K}_3\text{HI}_2\text{O}_9$ 

Less sol in  $\text{H}_2\text{O}$  than  $\text{KIO}_4$  (Kimmins, Chem Soc **51** 356)

**Potassium manganic periodate**

See Manganoperiodate, potassium

**Potassium zinc periodate**,  $\text{K}_2\text{O}$ ,  $4\text{ZnO}$ ,  $2\text{I}_2\text{O}_7 + 4\text{H}_2\text{O}$ 

Ppt (Rammelsberg, Pogg **134** 368)

**Potassium periodate tungstate**

See Tungstoperiodate, potassium

**Rubidium periodate**,  $\text{RbIO}_4$ 

0.65 pt is sol in 100 pts  $\text{H}_2\text{O}$  at  $13^\circ$  Sp gr of the sat aq solution at  $13^\circ/4^\circ = 1.0052$  (Barker, Chem Soc 1908, **93** 16)

**Samarium periodate**,  $\text{Sm}(\text{IO}_6)_3 + 4\text{H}_2\text{O}$ 

Precipitate (Cleve)

**Silver metaperiodate**,  $\text{AgIO}_4$ 

Decomp by cold  $\text{H}_2\text{O}$  into  $\text{Ag}_4\text{I}_2\text{O}_9 + 3\text{H}_2\text{O}$ , and by warm  $\text{H}_2\text{O}$  into  $\text{Ag}_4\text{I}_2\text{O}_9 + \text{H}_2\text{O}$  (Ammermuller and Magnus, Pogg **28** 516)  
 $+ \text{H}_2\text{O}$  Insol ppt (Kimmins)

**Silver mesoperiodate**,  $\text{Ag}_3\text{IO}_6$ 

(Fernlund, J pr **100** 99)  
 $\text{Ag}_2\text{HIO}_6$  Insol ppt (Kimmins, Chem Soc **51** 358)  
 Ppt by dil  $\text{HNO}_3$ , sol in  $\text{HNO}_3$  (Rosenheim, A 1899, **308** 57)

**Silver dimesoperiodate**,  $\text{Ag}_4\text{I}_2\text{O}_9 + \text{H}_2\text{O}$ , or  $3\text{H}_2\text{O}$ 

Insol ppt (Kimmins)  
 Decomp by boiling  $\text{H}_2\text{O}$  into  $\text{Ag}_3\text{IO}_6$  (Rammelsberg)

**Silver orthoperiodate**,  $\text{Ag}_5\text{IO}_8$ 

Sol in  $\text{HNO}_3$  or  $\text{NH}_4\text{OH}$  + Aq (Rammelsberg, Pogg **134** 386)

Sol in excess  $\text{NH}_4\text{OH}$  + Aq, pptd by  $\text{HNO}_3$  (Rosenheim, A 1899 **308** 56)  
 $\text{Ag}_2\text{H}_2\text{IO}_8$  Insol ppt (Kimmins, Chem Soc **51** 358)

$\text{Ag}_2\text{H}_3\text{IO}_8$  As above (Kimmins)  
 Sol in dil  $\text{HNO}_3$  (Rosenheim, A 1899, **308** 53)

**Silver diperiodate**,  $\text{Ag}_8\text{I}_2\text{O}_{11}$ 

Sl sol in  $\text{HNO}_3$  + Aq, insol in  $\text{NH}_4\text{OH}$  + Aq (Lautsch, J pr **100** 75)

**Silver dimesodiperiodate**,  $\text{Ag}_{10}\text{I}_4\text{O}_{11}$ 

$\text{HNO}_3$  + Aq dissolves out  $\text{Ag}_2\text{O}$  Insol in  $\text{NH}_4\text{OH}$  + Aq (Lautsch)

**Sodium metaperiodate**,  $\text{NaIO}_4$ 

Easily sol in  $\text{H}_2\text{O}$   
 $+2\text{H}_2\text{O}$  (Langlois)  
 $+3\text{H}_2\text{O}$  Efflorescent, sol in 12 pts  $\text{H}_2\text{O}$  at ord temp (Rammelsberg, J pr **103** 278)

**Sodium dimesoperiodate**,  $\text{Na}_4\text{I}_2\text{O}_9 + 3\text{H}_2\text{O}$ 

Scarcely sol in cold, sl sol in hot  $\text{H}_2\text{O}$  (Magnus and Ammermuller, Pogg **28** 514)  
 Very sol in dil  $\text{HNO}_3$  + Aq (Langlois)  
 Sol in  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq with decomp (Bengieser, A **17** 254)

Insol in methyl acetate (Naumann, B 1909, **42** 3790)  
 $+4\text{H}_2\text{O}$

**Sodium mesoperiodate**,  $\text{Na}_3\text{IO}_6 + 5/4\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Ihre)  
 $+\text{H}_2\text{O} = \text{Na}_3\text{H}_3\text{IO}_6$  Less sol in  $\text{H}_2\text{O}$  than  
 $\text{Na}_4\text{I}_2\text{O}_9 + 3\text{H}_2\text{O} (= \text{Na}_2\text{H}_3\text{IO}_6)$  (Kimmings,  
 Chem Soc 51 357)

**Sodium orthoperiodate**,  $\text{Na}_5\text{IO}_6$

$\text{Na}_2\text{H}_3\text{IO}_6$  Correct composition for  
 $\text{Na}_4\text{I}_2\text{O}_9 + 3\text{H}_2\text{O}$  (Kimmings)  
 $\text{Na}_3\text{H}_2\text{IO}_6$  Correct composition for  $\text{Na}_3\text{IO}_6$   
 $+\text{H}_2\text{O}$  (Kimmings)

**Strontium metaperiodate**,  $\text{Sr}(\text{IO}_4)_2 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$

**Strontium dimesoperiodate**,  $\text{Sr}_2\text{I}_2\text{O}_9$

Decomp by  $\text{H}_2\text{O}$   
 $+3\text{H}_2\text{O}$

**Strontium mesoperiodate**,  $\text{Sr}_3(\text{IO}_6)_2$

Precipitate

**Strontium orthoperiodate**,  $\text{Sr}_5(\text{IO}_6)_3$

(Rammelsberg, Pogg 44 577)

**Thallic periodate**,  $3\text{Tl}_2\text{O}_3, \text{I}_2\text{O}_7 + 30\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Decomp by alkalis  
 (Rammelsberg, B 3 361)

**Thorium periodate**

Precipitate Sol in  $\text{HNO}_3 + \text{Aq}$

**Uranous periodate**

Precipitate, which quickly decomposes

**Ytterbium periodate**,  $\text{YbIO}_6 + 2\text{H}_2\text{O}$

Hygroscopic (Clve, Z anorg 1902, 32  
 136)

**Yttrium periodate**,  $\text{Y}_2(\text{IO}) + 9\text{H}_2\text{O}$

Verv slightly sol (Clve)  
 $3\text{Y}_2\text{O}_3, 2\text{I}_2\text{O}_7 + 6\text{H}_2\text{O}$  Precipitate (Clve)

**Zinc dimesoperiodate**,  $\text{Zn}_2\text{I}_2\text{O}_9 + 6\text{H}_2\text{O}$

(Rammelsberg, Pogg 134 513)

**Zinc periodate**,  $3\text{ZnO}, 2\text{I}_2\text{O}_7 + 7\text{H}_2\text{O}$

(Langlois)

**Zinc duperiodate**,  $\text{Zn}_4\text{I}_2\text{O}_{11} + \text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$ , sl acid with  $\text{HNO}_3$   
 (Langlois, A ch (3) 34 257)

**Zinc dimesoduperiodate**,  $\text{Zn}_5\text{I}_4\text{O}_{19} + 14\text{H}_2\text{O}$  (?)

(Rammelsberg)

**Zinc periodate**,  $9\text{ZnO}, 2\text{I}_2\text{O}_7 + 12\text{H}_2\text{O}$

(Rammelsberg)

**Periodoplatinocyanhydric acid**

**Barium periodoplatinocyanide**,  $\text{BaPt}(\text{CN})_4\text{I}_2$   
 $+x\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  or alcohol (Holst, Bull  
 Soc (2) 22 347)

**Potassium periodoplatinocyanide**,  
 $\text{K}_2\text{Pt}(\text{CN})_4\text{I}_2$

Permanent Easily sol in  $\text{H}_2\text{O}$  or alcohol

**Permanganic acid**,  $\text{HMnO}_4$

Known only in solution, which decomposes  
 by evaporation or warming

**Permanganates**

All permanganates are sol in  $\text{H}_2\text{O}$ , except-  
 ing  $\text{AgMnO}_4$ , which is sl sol

**Ammonium permanganate**,  $\text{NH}_4\text{MnO}_4$

Sol in 12.6 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Aschoff)  
 Sol in  $\text{H}_2\text{O}$  with decomp (Christensen,  
 Z anorg 1900, 24 206)

**Barium permanganate**,  $\text{Ba}(\text{MnO}_4)_2$

Sol in  $\text{H}_2\text{O}$

**Cadmium permanganate**,  $\text{Cd}(\text{MnO}_4)_2 + 8\text{H}_2\text{O}$

Stable (Klobb, Bull Soc 1894, (3) 11  
 607)

**Cadmium permanganate ammonia**,

$\text{Cd}(\text{MnO}_4)_2, 4\text{NH}_3$

Sol in  $\text{H}_2\text{O}$  with decomp (Klobb, Bull  
 Soc (3) 3 510)

**Cæsium permanganate**,  $\text{CsMnO}_4$

Sl sol in cold, somewhat more easily sol  
 in hot  $\text{H}_2\text{O}$  (Muthmann, B 1893, 26 1018)  
 Solubility in  $\text{H}_2\text{O}$

100 cm of the sat solution contain at

$1^\circ$	$19^\circ$	$59^\circ$
0.097	0.23	1.25 g $\text{CsMnO}_4$

(Patterson, J Am Chem Soc 1906, 28  
 1735)

**Calcium permanganate**,  $\text{Ca}(\text{MnO}_4)_2 + 5\text{H}_2\text{O}$

Deliquescent

**Cupric permanganate**

Deliquescent



**Cupric permanganate ammonia**,  $\text{Cu}(\text{MnO}_4)_2 \cdot 4\text{NH}_3$ Sol in  $\text{H}_2\text{O}$  with slow decomp (Klobb, Bull Soc (3) 3 509)**Didymium permanganate**,  $\text{D}_1(\text{MnO}_4)_3 + 21\text{H}_2\text{O}$ Sl sol in  $\text{H}_2\text{O}$  (Frerichs and Smith, A 191 331)

Has not been prepared (Cleve, B 11 912)

**Lanthanum permanganate**,  $\text{La}(\text{MnO}_4)_3 + 21\text{H}_2\text{O}$ 

Ppt (Frerichs and Smith, A 191 331)

Has not been prepared (Cleve, B 11 910)

**Lead permanganate**Sol in  $\text{HNO}_3 + \text{Aq}$  (Forchhammer)**Lithium permanganate**,  $\text{LiMnO}_4 + 3\text{H}_2\text{O}$ Sol in 14 pts  $\text{H}_2\text{O}$  at  $16^\circ$  (Aschoff)**Magnesium permanganate**,  $\text{Mg}(\text{MnO}_4)_2$ 

$\text{CHCl}_3$ ,  $\text{CCl}_4$ ,  $\text{C}_6\text{H}_6$ , toluene, nitro-  
n, ether and  $\text{CS}_2$  Sol in  
acetone, pyridine, and readily  
cetic acid Only pyridine and  
acid are sufficiently stable to  
the salt to be of any practical use for  
oxidation purposes (Michael and Garner,  
Am Ch J 1906, 35 268)

+  $6\text{H}_2\text{O}$  Easily deliquescent**Nickel permanganate ammonia**,  $\text{Ni}(\text{MnO}_4)_2 \cdot 4\text{NH}_3$ Sol in  $\text{H}_2\text{O}$  with decomp (Klobb, Bull Soc (3) 3 509)**Potassium permanganate**,  $\text{KMnO}_4$ Sol in 16 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Mitscherlich)Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t$	Pts $\text{KMnO}_4$
0	2 83
9 8	4 31
19 8	6 34
24 8	7 59
29 8	9 03
34 8	10 67
40 0	12 56
45 0	14 58
50 0	16 89
55 0	19 33
65 0	25 03

(Baxter, J Am Chem Soc 1906, 28 1343)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ p = pts  $\text{KMnO}_4$  sol in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	p	$t^\circ$	p	$t^\circ$	p	$t^\circ$	p
0	2 76	19	6 26	38	11 74	57	20 29
1	2 90	20	6 48	39	12 12	58	20 83
2	3 06	21	6 70	40	12 51	59	21 39
3	3 22	22	6 94	41	12 91	60	21 96
4	3 38	23	7 18	42	13 31	61	22 55
5	3 54	24	7 42	43	13 72	62	23 15
6	3 70	25	7 68	44	14 14	63	23 76
7	3 86	26	7 94	45	14 56	64	24 38
8	4 04	27	8 20	46	15 00	65	25 01
9	4 22	28	8 48	47	15 44	66	25 67
10	4 40	29	8 77	48	15 88	67	26 34
11	4 58	30	9 07	49	16 32	68	27 03
12	4 78	31	9 37	50	16 77	69	27 84
13	4 98	32	9 69	51	17 23	70	28 56
14	5 18	33	10 01	52	17 71	71	29 30
15	5 38	34	10 34	53	18 21	72	30 05
16	5 60	35	10 68	54	18 71	73	30 81
17	5 82	36	11 02	55	19 23	74	31 57
18	6 04	37	11 38	56	19 75	74 5	31 95

(Worden, J Soc Chem Ind 1907, 26 453)

Solubility in  $\text{H}_2\text{O}$ 

100 ccm of the sat solution contain at

 $0^\circ$   $15^\circ$   $30^\circ$ 2 84 5 22 5 30 8 69 g  $\text{KMnO}_4$ Sp gr of sat solution at  $15^\circ = 1.035$ 

(Patterson, J Am Chem Soc 1906, 28 1735)

1 l sat  $\text{KMnO}_4 + \text{Aq}$  contains at $0^\circ$   $10^\circ$   $20^\circ$   $30^\circ$   $40^\circ$ 0 176 0 278 0 411 0 573 0 792 mol  $\text{KMnO}_4$  $53^\circ$   $63^\circ$   $70^\circ$   $75^\circ$ 1 154 1 429 1 812 2 047 mol  $\text{KMnO}_4$ 

(Sackur, Z Elektrochem 1912, 18 723)

Solubility of  $\text{KMnO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ 

Grams $\text{KMnO}_4$ sol in 100 grams $\text{H}_2\text{O}$	$t$
0 58	0 18
1 01	0 27
2 02	- 0 48
2 91	- 0 58
4 22	+10
5 20	+15
7 53	+25
11 61	+40
16 75	+50

(Voerman, C C 1906, I 125)

Sol in conc  $\text{H}_2\text{SO}_4$  Deliquesces in liquid  $\text{HCl}$ , but does not dissolve (Gore)Slowly sol in  $\text{H}_3\text{PO}_4 + \text{Aq}$  (Chevillat and Edwards)

Solubility in KOH+Ac at t° expressed in mol per l of the sat solution

t°	H <sub>2</sub> O	1 n KOH	2 n KOH	4 n KOH	6 n KOH	8 n KOH	10 n KOH
0	0 176	0 050	0 031	0 027	0 023	0 017	0 012
10	0 278	0 112	0 068	0 048	0 042	0 028	0 016
20	0 411	0 179	0 119	0 079	19° 0 074	0 032	0 029
30	0 573	32° 0 316	32° 0 213	32° 0 148	0 114	32° 0 062	0 040
40	0 792	0 439	0 306	0 211	0 161	0 084	0 052
50	53° 1 154	50° 0 638	0 462	0 304	0 219	0 111	
63	1 429	61° 0 904	60° 0 639	0 427	0 291	61° 0 143	0 071
70	1 812	1 172	0 869	0 572	0 390	0 188	0 082
75	2 047			0 651			0 089
80		1 513	1 190		0 500	0 231	
84		1 655	1 352	83° 0 803	85° 0 572		
90					0 649	0 297	

(Sackur, Z Elektrochem 1912, 18 723)

Solubility in salts+Aq at t°

Solvent	t°	Mol KMnO <sub>4</sub> in 1 l of sat solution
0 1-n $\frac{K_2CO_3}{2}$	0 25 40	0 1462 0 4375 0 7380
1-n $\frac{K_2CO_3}{2}$	0 25 40	0 0629 0 2589 0 5007
2-n $\frac{K_2CO_3}{2}$	0 40	0 0446 0 3519
4-n $\frac{K_2CO_3}{2}$	0 25	0 0270 0 0930
6-n $\frac{K_2CO_3}{2}$	0	0 0156
0 1-n KCl	0 25 40	0 1395 0 4315 0 7380
0 5-n KCl	0 25 40	0 0760 0 3060 0 5840
1-n KCl	0 25 40	0 0532 0 220 0 444
2-n KCl	0 25 40	0 0379 0 1432 0 288

(Sackur, Z Elektrochem 1912, 18 723)

Very sol in liquid NH<sub>3</sub> (Moissan, A Ch 1895 (7) 6 428, Franklin, Am Ch J 1898, 20 829)

Decomp immediately by alcohol Sol in acetone (Eidmann, C C 1899 II, 1014, Naumann, B 1904, 37 4328)

Solubility in acetone+Aq at 13°

A = ccm acetone in 100 ccm acetone+Aq  
 $\frac{1}{5}$  KMnO<sub>4</sub> = millimols KMnO<sub>4</sub> in 100 ccm of the solution

A	$\frac{1}{5}$ KMnO <sub>4</sub>
0	148 5
10	162 2
20	177 3
30	208 2
40	257 4
50	289 7
60	316 8
70	328 0
80	312 5
90	227 0
100	67 6

(Herz and Knoch, Z anorg 1904, 41 317)

Sol in benzonitrile (Naumann B 1914, 47 1369)

Difficultly sol in methyl acetate (Naumann, B 1909, 42 3795)

Sol in ethyl acetate (Naumann, B 1904, 37 3601)

Rubidium permanganate, RbMnO<sub>4</sub>

Solubility in H<sub>2</sub>O lies between K and Cs salts (Muthmann, B 1893 26 1018)

Solubility in H<sub>2</sub>O  
 100 ccm of the sat solution contain at

2 19° 60°  
 0 46 1 06 4 68 g RbMnO<sub>4</sub>

(Patterson, J Am Chem Soc 1906, 28 1735)

Silver permanganate, Ag<sub>2</sub>MnO<sub>4</sub>

Sol in 109 pts cold H<sub>2</sub>O and much less hot H<sub>2</sub>O Decomp by boiling (Mitscherlich, Pogg 25 301)

Silver permanganate ammonia

Sl sol in cold, more easily in hot H<sub>2</sub>O (Klobb, C R 103 384)

**Sodium permanganate,  $\text{NaMnO}_4 + 3\text{H}_2\text{O}$** 

Deliquescent Extremely sol in  $\text{H}_2\text{O}$   
Moderately sol in liquid  $\text{NH}_3$  (Franklin,  
Am Ch J 1898, 20 829)

**Strontium permanganate,  $\text{Sr}(\text{MnO}_4)_2 + 4\text{H}_2\text{O}$** 

Deliquescent Sol in  $\text{H}_2\text{O}$  (Fromherz)

**Thalious permanganate,  $\text{TlMnO}_4$** 

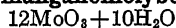
Sol in  $\text{H}_2\text{O}$  with decomp (R. Meyer, Z  
anorg 1899, 22 188)

**Zinc permanganate,  $\text{Zn}(\text{MnO}_4)_2 + 6\text{H}_2\text{O}$** 

Deliquescent Verv sol in  $\text{H}_2\text{O}$  (Marten-  
son, J B 1873 274)

**Zinc permanganate ammonia,**

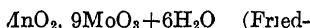
Sol in  $\text{H}_2\text{O}$  with decomp (Klobb, Bull  
Soc (3) 3 509)

**Permanganomolybdic acid,  $\text{MnO}_2$ ,**

Sol in  $\text{H}_2\text{O}$  Decomp by alkalis Sol in  
alcohol (Péchar, C R 1897, 125 31)

**manganomolybdate,**

and Samelson, Z anorg 1900,



(Fried-  
heilmann, Mitt d Nat Ges Bern

1904 23)

+  $7\text{H}_2\text{O}$  (Friedheim and Samelson, Z  
anorg 1900, 24 70)

$4(\text{NH}_4)_2\text{O}, \text{MnO}_2, 11\text{MoO}_3 + 7\text{H}_2\text{O}$  (Fried-  
heim and Samelson)

$3(\text{NH}_4)_2\text{O}, \text{MnO}_2, 12\text{MoO}_3 + 5\text{H}_2\text{O}$  Sl  
sol in cold  $\text{H}_2\text{O}$  Decomp by alkalis Insol  
in alcohol (Péchar, C R 1897, 125 30)

**Ammonium manganous permanganomolyb-  
date,  $3[(\text{NH}_4)_2, \text{Mn}]\text{O}, \text{MnO}_2, 9\text{MoO}_3 +$   
 $6\text{H}_2\text{O}$  and  $+7\text{H}_2\text{O}$** 

(Friedheim and Allemann, Mitt d Nat  
Ges Bern 1904 23)

$3[(\text{NH}_4)_2, \text{Mn}]\text{O}, \text{MnO}_2, 10\text{MoO}_3 + 10\text{H}_2\text{O}$   
(Friedheim and Samelson, Z anorg 1900, 24  
94)

$4[(\text{NH}_4)_2, \text{Mn}]\text{O}, \text{MnO}_2, 10\text{MoO}_3 + 6\text{H}_2\text{O}$   
(Friedheim and Samelson, Z anorg 1900, 24  
75)

$4[(\text{NH}_4)_2, \text{Mn}]\text{O}, \text{MnO}_2, 11\text{MoO}_3 + 8\text{H}_2\text{O}$   
(Friedheim and Samelson, Z anorg 1900, 24  
72)

**Ammonium manganous potassium perman-  
ganomolybdate,  $2(\text{NH}_4)_2\text{O}, \text{MnO}, \text{K}_2\text{O},$   
 $\text{MnO}_2, 10\text{MoO}_3 + 5\text{H}_2\text{O}$** 

Very sl sol in cold, easily sol in  $\text{H}_2\text{O}$  at  
70–80° (Rosenheim, Z anorg 1898, 16 79)

$3[(\text{NH}_4)_2, \text{K}_2, \text{Mn}]\text{O}, \text{MnO}_2, 9\text{MoO}_3 +$   
 $7\text{H}_2\text{O}$  (Friedheim and Allemann, Mitt d  
Nat Ges Bern 1904 23)

$4[(\text{NH}_4)_2, \text{K}_2, \text{Mn}]\text{O}, \text{MnO}_2, 10\text{MoO}_3 +$   
 $5\text{H}_2\text{O}$  (Friedheim and Samelson, Z anorg  
1900, 24 97)

$3[(\text{NH}_4)_2, \text{K}_2, \text{Mn}]\text{O}, \text{MnO}_2, 10\text{MoO}_3 +$   
 $6\text{H}_2\text{O}$ , and  $+10\text{H}_2\text{O}$  (Friedheim and Samel-  
son, Z anorg 1900, 24 92)

**Ammonium potassium permanganomolyb-  
date,  $3[(\text{NH}_4)_2, \text{K}_2]\text{O}, \text{MnO}_2, 8\text{MoO}_3 +$   
 $4\text{H}_2\text{O}$** 

(Friedheim and Samelson)

**Barium permanganomolybdate,  $3\text{BaO}, \text{MnO}_2,$   
 $9\text{MoO}_3 + 12\text{H}_2\text{O}$** 

Ppt (Hall, J Am Chem Soc 1907, 29  
700)

**Manganous potassium permanganomolyb-  
date,  $2\text{K}_2\text{O}, \text{MnO}, \text{MnO}_2, 9\text{MoO}_3 +$   
 $8\text{H}_2\text{O}$** 

True formula for  $5\text{K}_2\text{O}, \text{Mn}_2\text{O}_3, 16\text{MoO}_3 +$   
 $12\text{H}_2\text{O}$  of Struve (Friedheim and Samelson,  
Z anorg 1900, 24 86)

$3[\text{K}_2, \text{Mn}]\text{O}, \text{MnO}_2, 9\text{MoO}_3 + 6\text{H}_2\text{O}$  (Fried-  
heim and Allemann, Mitt d Nat Ges Bern  
1904 23)

$2\text{K}_2\text{O}, 0\text{K}_2\text{O}, 0\text{K}_2\text{O}, \text{MnO}, \text{MnO}_2, 9\text{MoO}_3 + 7\text{H}_2\text{O}$   
Ppt (Hall, J Am Chem Soc 1907, 29  
700)

$4[\text{K}_2, \text{Mn}]\text{O}, \text{MnO}_2, 11\text{MoO}_3 + 7\text{H}_2\text{O}$   
(Friedheim and Samelson, Z anorg 1900, 24  
80)

**Manganous potassium sodium permanganomolyb-  
date,  $3[\text{K}, \text{Na}, \text{Mn}]\text{O}, \text{MnO}_2,$   
 $8\text{MoO}_3 + 4\text{H}_2\text{O}$** 

(Friedheim and Allemann, Mitt d Nat  
Ges Bern 1904 48)

**Manganous sodium permanganomolybdate,  $3[\text{Na}, \text{Mn}]\text{O}, \text{MnO}_2,$   
 $9\text{MoO}_3 + 15\text{H}_2\text{O}$** 

(Friedheim and Allemann)

**Potassium permanganomolybdate,  $3\text{K}_2\text{O},$   
 $\text{MnO}_2, 8\text{MoO}_3 + 3\text{H}_2\text{O}$** 

Much less sol in  $\text{H}_2\text{O}$  than  $\text{NH}_4$  comp  
(Friedheim and Samelson, Z anorg 1900, 24  
78)

+  $5\text{H}_2\text{O}$  Nearly insol in cold or hot  $\text{H}_2\text{O}$   
(Rosenheim and Itz, Z anorg 1898, 16 81)

$3\text{K}_2\text{O}, \text{MnO}_2, 9\text{MoO}_3 + 5\text{H}_2\text{O}$  (Friedheim  
and Samelson, Z anorg 1900, 24 81)

+  $6\text{H}_2\text{O}$  (Hall, J Am Chem Soc 1907,  
29 700)

$3\text{K}_2\text{O}, \text{MnO}_2, 12\text{MoO}_3 + 4\text{H}_2\text{O}$  Nearly  
insol in cold  $\text{H}_2\text{O}$  Decomp by alkalis

Insol in alcohol (Péchar, C R 1897, 125  
31)

**Silver permanganomolybdate,  $3\text{Ag}_2\text{O}, \text{MnO}_2,$   
 $9\text{MoO}_3 + 6\text{H}_2\text{O}$** 

Ppt (Hall, J Am Chem Soc 1907, 29  
700)

**Sodium permanganomolybdate**,  $3\text{Na}_2\text{O}$ ,  $\text{MnO}_2$ ,  $12\text{MoO}_3 + 13\text{H}_2\text{O}$

Efflorescent Verv sol in  $\text{H}_2\text{O}$  Decomp by alkalis Insol in alcohol (Péchar d, C R 125 31)

### Permanganotungstic acid

**Ammonium manganous permanganotungstate**,  $4(\text{NH}_4)_2\text{O}$ ,  $\text{MnO}$ ,  $\text{MnO}_2$ ,  $12\text{WO}_3 + 23\text{H}_2\text{O}$

Readily sol in  $\text{H}_2\text{O}$  Can be cryst therefrom (Rogers and Smith, J Am Chem Soc 1904, 26 1475)

**Sodium permanganotungstate**,  $3\text{Na}_2\text{O}$ ,  $\text{MnO}_2$ ,  $5\text{WO}_3 + 18\text{H}_2\text{O}$

Rather easily sol in hot  $\text{H}_2\text{O}$  Solution decomp on long boiling with separation of manganese peroxide (Just, B 1903, 36 3621)

**Permolybdic acid**,  $\text{Mo}_2\text{O}_7$ ,  $5\text{H}_2\text{O} = \text{HMoO}_4 + 2\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , and not decomp by boiling (Péchar d, A ch (6) 28 550)

$\text{H}_2\text{MoO}_6 + 1\frac{1}{2}\text{H}_2\text{O}$  "Ozo-molybdic acid" Only very sl sol in  $\text{H}_2\text{O}$  after being dried in the air Sol in fairly conc  $\text{H}_2\text{SO}_4$  (Muthmann, B 1898, 31 1838)

$\text{H}_2\text{Mo}_2\text{O}_7$ ,  $\text{H}_2\text{O}_2$  Sl sol in cold, more easily sol in hot  $\text{H}_2\text{O}$ , but does not separate on cooling Sol in dil acids, also in  $\text{H}_3\text{PO}_4$  (Cammereis, Ch Z 1891, 15 957)

**Ammonium permolybdate**,  $\text{NH}_4\text{MoO}_4 + 2\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , sl sol in alcohol, but alcohol extracts it from  $\text{H}_2\text{O}$ , forming a very conc supersat solution, which is pptd by a crystal of  $\text{NH}_4\text{MoO}_4$ , and only a sl amount remains in solution (Péchar d)

$3(\text{NH}_4)_2\text{O}$ ,  $5\text{MoO}_3$ ,  $2\text{MoO}_4 + 6\text{H}_2\text{O}$  (Muthmann, B 1898, 31 1837)

$3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_4 + 12\text{H}_2\text{O}$  Ppt (Muthmann, Z anorg 1898, 17 76)

$3(\text{NH}_4)_2\text{O}$ ,  $5\text{MoO}_4 + 6\text{H}_2\text{O}$  Ppt (Muthmann)

**Ammonium nickel permolybdate ammonia**,  $(\text{NH}_4)_2\text{Ni}(\text{MoO}_4)_2$ ,  $2\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  Sol in dil  $\text{NH}_4\text{OH}$  (Briggs, Chem Soc 1904, 85 674)

**Barium permolybdate**,  $\text{Ba}(\text{MoO}_4) + 2\text{H}_2\text{O}$

(Péchar d, A ch 1893, (6) 28 537)  
 $8\text{BaO}$ ,  $19\text{MoO}_3$ ,  $2\text{H}_2\text{O}_2 + 13\text{H}_2\text{O}$  (Baerwald, Dissert 1885)

**Cesium permolybdate**,  $\text{Cs}_2\text{O}$ ,  $4\text{MoO}_4 + 6\text{H}_2\text{O}$   
Sol hot  $\text{H}_2\text{O}$  (Muthmann, B 1898, 31 1841)

$3\text{Cs}_2\text{O}$ ,  $7\text{MoO}_3$ ,  $3\text{MoO}_4 + 4\text{H}_2\text{O}$  Ppt (Muthmann)

**Copper permolybdate**,  $\text{Cu}(\text{MoO}_4)_2 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , easily sol in acids Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp (Péchar d)

**Magnesium permolybdate**,  $\text{Mg}(\text{MoO}_4)_2 + 10\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , sl sol in alcohol (Péchar d)

### Mercurous permolybdate

Insol in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Péchar d)

**Potassium permolybdate**,  $\text{KMoO}_4 + 2\text{H}_2\text{O}$

Sl sol in cold, more in hot  $\text{H}_2\text{O}$  Sl sol in alcohol (Péchar d)

$\text{K}_2\text{O}$ ,  $2\text{MoO}_3$ ,  $\text{MoO}_4 + 3\text{H}_2\text{O}$  Ppt (Muthmann, Z anorg 1898, 17 77)

$\text{K}_2\text{O}$ ,  $\text{MoO}_4$ ,  $\text{H}_2\text{O}_2$  Decomp by  $\text{H}_2\text{O}$  (Melikoff and Pissarjewsky, B 1898, 31 2449)

$\text{K}_2\text{MoO}_6 + 3\text{H}_2\text{O}$  Nearly insol in cold, easily sol in hot  $\text{H}_2\text{O}$  (Mazzuchelli and Zangrilli, Gazz ch it 1910, 40 (2) 56)

### Rubidium permolybdates

"Rubidium ozo-molybdate"

$3\text{Rb}_2\text{O}$ ,  $10\text{MoO}_4 + 14\text{H}_2\text{O}$  Ppt

$\text{Rb}_2\text{O}$ ,  $2\text{MoO}_3$ ,  $\text{MoO}_4 + 3\text{H}_2\text{O}$  May be recryst from  $\text{H}_2\text{O}_2 + \text{Aq}$

$3\text{Rb}_2\text{O}$ ,  $5\text{MoO}_3$ ,  $2\text{MoO}_4 + 6\text{H}_2\text{O}$  Ppt

$\text{Rb}_2\text{O}$ ,  $3\text{MoO}_3$ ,  $\text{MoO}_4 + 4\text{H}_2\text{O}$  Ppt (Muthmann, B 1898, 31 1839-41)

**Silver permolybdate**,  $\text{AgMoO}_4$

(Péchar d)

**Sodium permolybdate**,  $\text{NaMoO}_4 + 3\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , insol in alcohol, but behaves similarly to K salt (Péchar d)

### Thallous permolybdate

Insol in  $\text{H}_2\text{O}$  (Péchar d, A ch 1893, (6) 28 559)

### Pernitric acid, $\text{NO}_3$

See Nitrogen hexoxide

**Silver pernitrate, basic**,  $3\text{Ag}_2\text{O}_2$ ,  $\text{AgNO}_3$

Decomp  $\text{H}_2\text{O}$  (Mulder, R t c 1898, 17 142)

### Perosmic acid

**Potassium perosmate (?)**

Sol in  $\text{H}_2\text{O}$ , but very easily decomp

### Peroxynitric acid

**Silver peroxynitrate**

Analysis of the black compound formed, under certain circumstances, in a silver voltameter when an aqueous solution of  $\text{AgNO}_3$

is electrolyzed, points to the composition  $3\text{Ag}_2\text{O}$ ,  $5\text{O}$ ,  $\text{AgNO}_3$ , perhaps  $2\text{Ag}_2\text{O}_4$ ,  $\text{AgNO}_3$  or  $3\text{Ag}_2\text{O}_2$ ,  $\text{AgNO}_3$  (Mulder, Chem Soc 1896, 70 (2) 561)

### Peroxyaminesulphonic acid

#### Potassium peroxyaminesulphonate, $\text{N}_2\text{O}_2(\text{SO}_3\text{K})_4$

Very unstable in  $\text{H}_2\text{O}$  Very sl sol in cold  $\text{H}_2\text{O}$  More stable in  $\text{N}/10$   $\text{KOH} + \text{Aq}$   
100 pts  $\text{N}/10$   $\text{KOH} + \text{Aq}$  dissolve 0.62 pt of the salt at  $3^\circ$ , 6.6 pts at  $29^\circ$  (Haga, Chem Soc 1904, 85 86)

#### Perstannic acid, $\text{H}_2\text{Sn}_2\text{O}_7$

Known in colloidal state, sol in  $\text{H}_2\text{O}$  (Spring, Bull Soc (2) 51 180)

#### Potassium perstannate, $\text{KSnO}_4 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Tanatar, B 1905, 38 1185)

#### Sodium perstannate, $\text{NaSnO}_4 + 2\text{H}_2\text{O}$

Difficultly sol in  $\text{H}_2\text{O}$  with decomp (Tanatar)

#### Persulphuric acid, $\text{S}_2\text{O}_7$

See Sulphur heptoxide  
 $\text{H}_2\text{S}_2\text{O}_8$

Sp gr of  $\text{H}_2\text{S}_2\text{O}_8 + \text{Aq}$

Sp gr $14^\circ/14^\circ$	% $\text{H}_2\text{S}_2\text{O}_8$	g $\text{H}_2\text{S}_2\text{O}_8$ per l
1.042	7.2	75
1.096	15.4	169
1.154	23.6	272
1.246	35.2	438

(Elbs and Schonherr, Z Elektrochem 1896, 2 245)

#### Ammonium persulphate, $(\text{NH}_4)_2\text{S}_2\text{O}_8$

Very sol in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 58.2 pts  $(\text{NH}_4)_2\text{S}_2\text{O}_8$  (Marshall, Chem Soc 59 771)

Solubility in  $\text{H}_2\text{O}$  equals 58% at  $8^\circ$  (Moreau, C C 1901, II 56)

100 pts  $\text{H}_2\text{O}$  dissolve 65 pts at ord temp (Elbs, J pr 1893, (2) 48 185)

#### Ammonium lead persulphate,

$(\text{NH}_4)_2\text{Pb}(\text{SO}_4)_3$

Decomp by  $\text{H}_2\text{O}$  Almost insol in cold  $\text{H}_2\text{SO}_4$  of sp gr = 1.7 Sl sol in  $\text{H}_2\text{SO}_4$  (sp gr = 1.7) at  $50^\circ$  Sol in fuming  $\text{H}_2\text{SO}_4$  and in cold conc  $\text{HCl}$  Sol in acetic acid, in  $\text{Na}$  acetate +  $\text{Aq}$  acidified with acetic acid and in excess of cold 20%  $\text{NaOH} + \text{Aq}$  (Elbs, Z Elektrochem 1900, 7 346)

#### Ammonium mercurous persulphate ammonia, $(\text{NH}_4)_2\text{HgS}_2\text{O}_8, 2\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  Insol in dil or conc hot or cold  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$  Sol in  $\text{HC}$  (Tarugi, Gazz ch it 1903, 33 (1) 131)

#### Barium persulphate, $\text{BaS}_2\text{O}_8 + 4\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 39.1 pts  $\text{BaS}_2\text{O}_8$ , or 52.2 pts  $\text{BaS}_2\text{O}_8 \cdot 4\text{H}_2\text{O}$  Sol in absolute alcohol with pptn,  $\text{BaS}_2\text{O}_8 + \text{H}_2\text{O}$  Insol in alcohol (Marshall)

#### Cadmium persulphate ammonia, $\text{CdS}_2\text{O}_8 \cdot 6\text{NH}_3$

Sol in  $\text{H}_2\text{O}$  (Barbieri, Z anorg 1911, 7 350)

#### Cæsium persulphate, $\text{Cs}_2\text{S}_2\text{O}_8$

Sol in  $\text{H}_2\text{O}$  8.71–8.98 pts are sol in 10 pts  $\text{H}_2\text{O}$  at  $23^\circ$  (E F Smith, J Am Chem Soc 1899, 21 935)

#### Calcium persulphate

Very sol in  $\text{H}_2\text{O}$  (Marshall, J Soc Chem Ind 1897, 16 396)

#### Copper persulphate ammonia, $\text{CuS}_2\text{O}_8, 4\text{NH}_3$

Sol in  $\text{H}_2\text{O}$  (Barbieri, Z anorg 1911, 7 351)

#### Lead persulphate, $\text{PbS}_2\text{O}_8$

Decomp by  $\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{SO}_4$ , and  $\text{pyrosulphuric acid}$  Sol in cold conc  $\text{HC}$  Insol or sol with decomp in ill ord solvent (Flbs, Z Elektrochem 1900, 7 345)

Solubility of  $\text{Pb}(\text{SO}_4)_2$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $22^\circ$   
 $v$  = moles of  $\text{H}_2\text{SO}_4$  per mole of  $\text{H}_2\text{O}$   
 $c$  = millimols  $\text{Pb}(\text{SO}_4)_2$  in 1 l

$v$	$c$	$v$	$c$
0.304	0.00	0.555	37.2
0.348	1.8	0.699	40.5
0.387	3.0	0.917	23.3
0.407	3.9	1.11	23.7
0.435	5.3	1.54	49.6
0.477	14.4	2.08	83.5
0.515	23.3	2.13	88.2

(Dolezalek and Finckl, Z anorg 1906, 51 321)

+  $3\text{H}_2\text{O}$  Deliquescent Very sol in  $\text{H}_2\text{O}$  (Marshall)

#### Lead potassium persulphate, $\text{K}_2\text{Pb}(\text{SO}_4)_3$

Decomp by  $\text{H}_2\text{O}$  Almost insol in cold  $\text{H}_2\text{SO}_4$  of sp gr = 1.7 Sl sol in  $\text{H}_2\text{SO}_4$  (sp gr = 1.7) at  $50^\circ$  Sol in fuming  $\text{H}_2\text{SO}_4$ , cold conc  $\text{HCl}$ , excess of cold 20%  $\text{NaOH} + \text{Aq}$  acetic acid and in  $\text{Na}$  acetate +  $\text{Aq}$  acidified with acetic acid (Elbs, Z Elektrochem 1900, 7 346)

**Nickel persulphate ammonia**,  $\text{NiS}_2\text{O}_8 \cdot 6\text{NH}_3$   
Unstable in the air Sol in  $\text{H}_2\text{O}$  with decomp (Barbieri, Z anorg 1911, **71** 351)

**Potassium persulphate**,  $\text{K}_2\text{S}_2\text{O}_8$

100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 1.77 pts  $\text{K}_2\text{S}_2\text{O}_8$ , more sol in hot  $\text{H}_2\text{O}$  with very sl decomp Less sol in  $\text{H}_2\text{O}$  than any other persulphate (Marshall)

**Rubidium persulphate**,  $\text{Rb}_2\text{S}_2\text{O}_8$

Sol in  $\text{H}_2\text{O}$  3.32–3.49 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $22.5^\circ$  (E F Smith, J Am Chem Soc 1899, **21** 934)

**Silver persulphate, basic**,  $5\text{Ag}_2\text{O}_3 \cdot 2\text{Ag}_2\text{SO}_7$

Decomp by  $\text{H}_2\text{O}$  and acids (Mulder, C C 1899 I, 16)

**Sodium persulphate**,  $\text{Na}_2\text{S}_2\text{O}_8$

Very sol in  $\text{H}_2\text{O}$  (Lowenherz)

**Strontium persulphate**

Verv sol in  $\text{H}_2\text{O}$  (Marshall, J Soc Chem Ind 1897, **16** 396)

**Thallium persulphate**,  $\text{Tl}_2\text{S}_2\text{O}_8$

Very sol in  $\text{H}_2\text{O}$  (Smith, J Am Chem Soc 1898, **21** 936)

**Zinc persulphate ammonia**,  $\text{ZnS}_2\text{O}_8 \cdot 4\text{NH}_3$

Sol in  $\text{H}_2\text{O}$  (Barbieri, Z anorg 1911, **71** 350)

**Persulphomolybdic acid**

See Persulphomolybdic acid

**Pertantallic acid**,  $\text{HTaO}_4 + n\text{H}_2\text{O}$

Ppt (Melikoff, Z anorg 1899, **20** 345)

**Cæsium pertantalate**,  $\text{Cs}_3\text{TaO}_8$

Ppt (E F Smith, J Am Chem Soc 1908, **30** 1667)

**Calcium potassium pertantalate**,  $\text{CaK}_2\text{TaO}_8 + 4\frac{1}{2}\text{H}_2\text{O}$

Insol in cold  $\text{H}_2\text{O}$ , decomp by hot  $\text{H}_2\text{O}$  (Melikoff, Z anorg 1899, **20** 347)

**Calcium sodium pertantalate**,  $\text{CaNaTaO}_8 + 4\frac{1}{2}\text{H}_2\text{O}$

Difficultly sol in  $\text{H}_2\text{O}$  (E F Smith, J Am Chem Soc 1908, **30** 1668)

**Magnesium potassium pertantalate**,

$\text{MgK}_2\text{TaO}_8 + 7\text{H}_2\text{O}$

Somewhat sol in  $\text{H}_2\text{O}$  (F F Smith)

**Magnesium rubidium pertantalate**,

$\text{MgRbTaO}_8 + 9\text{H}_2\text{O}$

Somewhat sol in  $\text{H}_2\text{O}$  (E F Smith)

**Magnesium sodium pertantalate**,  $\text{MgNaTaO}_8 + 8\text{H}_2\text{O}$

Somewhat sol in  $\text{H}_2\text{O}$  (E F Smith)

**Potassium pertantalate**,  $\text{K}_3\text{TaO}_8 + \frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with decomp, sol in  $\text{KOH} + \text{H}_2\text{O}_2 + \text{Aq}$ , pptd by alcohol (Melikoff, Z anorg 1899, **20** 346)

**Rubidium pertantalate**,  $\text{Rb}_3\text{TaO}_8$

Somewhat sol in  $\text{H}_2\text{O}$  (E F Smith)

**Sodium pertantalate**,  $\text{Na}_3\text{TaO}_8 + \text{H}_2\text{O}$

Pptd by alcohol Sl sol in  $\text{H}_2\text{O}$ , decomp on heating with  $\text{H}_2\text{O}$  (Melikoff, Z anorg 1899, **20** 348)

$\text{Na}_2\text{TaO}_4 + \text{NaOTaO}_4 + 13\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}_2 + \text{Aq}$ , pptd by alcohol (Melikoff, Z anorg 1899, **20** 349)

**Pertitanic acid**

**Ammonium pertitanate**,  $(\text{NH}_4)_2\text{O}_2$ ,  $\text{TiO}_3 + \text{H}_2\text{O}_2$

Fairly stable, decomp rapidly in aq solution (Melikoff, B 1898, **31** 955)

**Barium pertitanate**,  $\text{BaO}_2$ ,  $\text{TiO}_3 + 5\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Melikoff and Pissarjewsky, Z anorg 1898, **18** 59)

**Potassium pertitanate**,  $\text{K}_2\text{O}$ ,  $\text{TiO}_3$ ,  $\text{K}_2\text{O}_4 + 10\text{H}_2\text{O}$

Stable at zero, deliquesces and decomp at ordinary temp (Melikoff, B 1898, **31** 680)

**Sodium pertitanate**,  $\text{Na}_2\text{O}_2$ ,  $\text{TiO}_3 + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Pptd in alcohol (Melikoff, B 1898, **31** 955)

$4\text{Na}_2\text{O}_2$ ,  $\text{Ti}_2\text{O}_7 + 10\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Melikoff)

**Pertungstic acid**

**Barium pertungstate**,  $\text{BaO}$ ,  $2\text{WO}_3$ ,  $\text{O} + 6\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Decomp by acids (Kellner, Dissert 1909)

**Cæsium pertungstate**,  $3\text{Cs}_2\text{O}$ ,  $12\text{WO}_3$ ,  $2\text{O} + 12\text{H}_2\text{O}$

Sl sol in cold, easily sol in warm  $\text{H}_2\text{O}$  (Kellner)

$5\text{Cs}_2\text{O}$ ,  $12\text{WO}_3$ ,  $24\text{O} + 11\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Kellner)

**Calcium pertungstate**,  $3\text{CaO}$ ,  $6\text{WO}_3$ ,  $8\text{O} + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Kellner)

**Lithium pertungstate**,  $\text{Li}_2\text{O}$ ,  $2\text{WO}_3$ ,  $2\text{O} + 6\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Kellner)

$3\text{Li}_2\text{O}$ ,  $4\text{WO}_3$ ,  $\text{O} + 9\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Kellner)

**Magnesium pertungstate**,  $2\text{MgO}$ ,  $4\text{WO}_3$ ,  $6\text{O} + 9\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Kellner)

**Potassium pertungstate**,  $\text{K}_2\text{O}_4$ ,  $\text{WO}_4 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with decomp, explodes in the air at  $80^\circ$  (Melikoff, B 1898, 31 634)

$\text{K}_2\text{O}$ ,  $2\text{WO}_3$ ,  $4\text{O} + 4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  from which it is ppt by alcohol and ether (Kellner)

$7\text{K}_2\text{O}$ ,  $10\text{WO}_3$ ,  $5\text{O} + 22\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Kellner)

**Rubidium pertungstate**,  $2\text{Rb}_2\text{O}$ ,  $4\text{WO}_3$ ,  $\text{O} + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with slow decomp (Kellner)  
 $5\text{Rb}_2\text{O}$ ,  $12\text{WO}_3$ ,  $3\text{O} + 12\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Kellner)

**Sodium pertungstate**,  $\text{Na}_2\text{WO}_4 + \text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Péchar, C R 112 1060)

$+2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  but easily decomp (Kellner)

$\text{Na}_2\text{W}_2\text{O}_9 + 6\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  and can be cryst therefrom (Pissarjewsky, Z anorg 1900, 24 113)

$\text{Na}_2\text{O}_2$ ,  $\text{WO}_4 + \text{H}_2\text{O}_2$ ,  $(\text{Na}_2\text{O}_2)\text{WO}_4 + 7\text{H}_2\text{O}$  Decomp in the air Sol in  $\text{H}_2\text{O}$  with decomp (Melikoff, B 1898, 31 633)

$\text{Na}_2\text{O}_2$ ,  $\text{WO}_4$ ,  $\text{H}_2\text{O}_2$  Very unstable Decomp in the air and by  $\text{H}_2\text{O}$  (Melikoff)

**Strontium pertungstate**,  $\text{SrO}$ ,  $2\text{WO}_3$ ,  $\text{O} + 6\text{H}_2\text{O}$

(Kellner)

**Peruranic acid**,  $\text{UO}_6$ ,  $x\text{H}_2\text{O}$  (?)

Known only in its salts

**Ammonium peruranate**,  $(\text{NH}_4)_2\text{O}_2$ ,  $(\text{UO}_4)_2 + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , decomp by acids and by  $\text{Al}(\text{OH})_3$  in aq solution (Melikoff, B 1897, 30 2904)

**Ammonium uranyl peruranate**,  $(\text{NH}_4)_2(\text{UO}_2)\text{UO}_6 + 8\text{H}_2\text{O}$  (?)

Easily sol in  $\text{H}_2\text{O}$  (Fairley, Chem Soc (2) 31 134)

**Barium peruranate**,  $\text{BaUO}_6$

As K salt (de Coninck, C C 1909, I 1970)

$(\text{BaO}_2)_2\text{UO}_4 + 8\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{CO}_3$  (Melikoff, B 1897, 30 2905)

$\text{BaO}_2(\text{UO}_4)_2 + 9\text{H}_2\text{O}$  Ppt (Melikoff)

**Calcium peruranate**,  $\text{CaUO}_6$

As K salt (de Coninck)

**Calcium peruranate**,  $(\text{CaO}_2)_2\text{UO}_4 + 10\text{H}_2\text{O}$

Ppt (Melikoff, B 1897, 30 2906)

**Copper peruranate**,  $(\text{CuO}_2)_2\text{UO}_4$

Ppt (Melikoff)

**Lead peruranate**,  $(\text{PbO})_2\text{UO}_4$ ,  $\text{PbO}$ ,  $\text{UO}_3$

Ppt (Melikoff)

**Lithium peruranate**,  $(\text{Li}_2\text{O}_2)(\text{UO}_4)_2 + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , decomp by acids and by  $\text{Al}(\text{OH})_3$  in aq solution, very unstable (Melikoff)

**Nickel peruranate**,  $(\text{NiO})_2\text{UO}_4$

Ppt (Melikoff)

**Potassium peruranate**,  $\text{K}_4\text{UO}_6 + 10\text{H}_2\text{O}$  (?)

Unstable (Fairley)

$\text{K}_2\text{UO}_6$  (de Coninck, C R 1909, 148 1769)

$+3\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$ ,  $\text{HCl}$  and dil  $\text{HNO}_3$  (Aloy, Bull Soc 1903, (3) 29 293)

**Silver peruranate**,  $\text{Ag}_2\text{U}_2\text{O}_{11}$  (?)

(Guyard, Bull Soc (2) 1 95)

Does not exist (Albigoff, A 233 117)

**Sodium peruranate**,  $\text{Na}_4\text{UO}_6 + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Sl sol in alcohol (Fairley)

$\text{Na}_2\text{UO}_6$  As K salt (de Coninck, C C 1909, I 1970)

$+5\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  and  $\text{HCl}$  (Aloy, Bull Soc 1903, (3) 29 293)

$(\text{Na}_2\text{O}_2)_2\text{UO}_4 + 8\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , decomp by dil  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , and by  $\text{Al}(\text{OH})_3$  in aq solution (Melikoff, B 1897, 30 2903)

**Sodium uranyl peruranate**,  $\text{Na}_2(\text{UO}_2)\text{UO}_6 + 6\text{H}_2\text{O}$  (?)

Sol in  $\text{H}_2\text{O}$  (Fairley)

**Pervanadic acid**,  $\text{HVO}_4$  (?)

Sol in  $\text{H}_2\text{O}$  (Pissarjewsky, C C 1902, II 565)

**Ammonium pervanadate**,  $\text{NH}_4\text{VO}_4$

Sol in  $\text{H}_2\text{O} + \text{Aq}$ , insol in alcohol (Scheuer Z anorg 1895, 16 294)

$(\text{NH}_4)_2\text{VO}_6 + 2\frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Melikoff, B 1909, 42 2292)

$(\text{NH}_4)_4\text{V}_2\text{O}_{11}$  Sol in  $\text{H}_2\text{O} + \text{Aq}$ , ppt from aq solution by alcohol (Melikoff, Z anorg 1899, 19 406)

**Barium pervanadate**,  $\text{Ba}(\text{VO}_4)_2$

Sl sol in  $\text{H}_2\text{O}_2 + \text{Aq}$  free from  $\text{H}_2\text{SO}_4$ , insol in alcohol (Scheuer, Z anorg 1895, 16 288)

**Cadmium pervanadate**,  $\text{Cd}(\text{VO}_4)_2$

Sl sol in  $\text{H}_2\text{O}_2 + \text{Aq}$ , insol in alcohol (Scheuer)

**Calcium pervanadate**,  $\text{Ca}(\text{VO}_4)_2$

Sol in  $\text{H}_2\text{O}_2 + \text{Aq}$ , insol in alcohol (Scheuer)

**Lead pervanadate, Pb(VO<sub>4</sub>)<sub>2</sub>**

Sl sol in H<sub>2</sub>O + Aq free from H<sub>2</sub>SO<sub>4</sub>, insol in alcohol (Scheuer)

**Lithium pervanadate, LiVO<sub>4</sub>**

Sol in H<sub>2</sub>O<sub>2</sub> + Aq, insol in alcohol (Scheuer)

**Potassium pervanadate, KVO<sub>4</sub>**

Sol in H<sub>2</sub>O<sub>2</sub> + Aq acidified with H<sub>2</sub>SO<sub>4</sub>, insol in alcohol (Scheuer)

K<sub>2</sub>VO<sub>6</sub> + 2½H<sub>2</sub>O Sol in H<sub>2</sub>O, insol in alcohol (Melikoff, B 1909, 42 2293)

3K<sub>2</sub>O<sub>2</sub>VO<sub>4</sub>, 2KVO<sub>4</sub> + 2H<sub>2</sub>O 0.855 g is sol in 100 g H<sub>2</sub>O at 19°, sl sol in KOH + Aq, very stable in the air (Melikoff and Pissarjewsky, Z anorg 1899, 19 408)

K<sub>4</sub>V<sub>2</sub>O<sub>12</sub> + 2H<sub>2</sub>O (Melikoff and Pissarjewsky, Z anorg 1899, 19 411)

K<sub>4</sub>V<sub>2</sub>O<sub>13</sub> + 3½H<sub>2</sub>O Moderately sol in H<sub>2</sub>O with slow decomp (Melikoff and Pissarjewsky, Z anorg 1899, 19 410)

**Silver pervanadate, AgVO<sub>4</sub>**

Sl sol in H<sub>2</sub>O<sub>2</sub> + Aq free from H<sub>2</sub>SO<sub>4</sub>, sol in alcohol (Scheuer)

**Sodium pervanadate, NaVO<sub>4</sub>**

Sol in H<sub>2</sub>O<sub>2</sub> acidified with H<sub>2</sub>SO<sub>4</sub>, insol in alcohol (Scheuer)

**Strontium pervanadate, Sr(VO<sub>4</sub>)<sub>2</sub>**

Sl sol in H<sub>2</sub>O<sub>2</sub> + Aq free from H<sub>2</sub>SO<sub>4</sub>, insol in alcohol (Scheuer)

**Philippium, Ph (?)**

(Delafontaine, C R 87 559)  
Consists of cerium and yttrium (Roscoe, B 15 1274)

**Phosgene, CoCl<sub>2</sub>**

See Carbonyl chloride

**Phosphame, PN<sub>2</sub>H (?)**

Insol in H<sub>2</sub>O Insol in dil HNO<sub>3</sub> + Aq, gradually decomp by conc HNO<sub>3</sub> (Rose, Pogg 24 308)

Insol in conc HNO<sub>3</sub> (Pauli, A 123 236)  
Sol in H<sub>2</sub>SO<sub>4</sub> with decomp (Rose)

Insol in dil, but decomp by conc KOH or NaOH + Aq

Insol in alcohol or ether  
Formula is perhaps P<sub>3</sub>N<sub>3</sub>H<sub>4</sub> (Sulzmann, B 6 494)

**Phosphamic acid, PO<math>\begin{smallmatrix} \text{NH} \\ \text{OH} \end{smallmatrix}</math>**

(Schiff)

Does not exist, but was impure *pyrophosphodiamic acid* (Gladstone) Also Mente (A 248 245)

**Pyrophosphamic acid, P<sub>2</sub>NH<sub>2</sub>O<sub>6</sub> = P<sub>2</sub>O<sub>5</sub>(OH)<sub>2</sub>NH<sub>2</sub>**

Deliquescent in moist air, easily sol in H<sub>2</sub>O or alcohol, sl sol in ether (Gladstone, Chem Soc 3 152)

Correct composition is imidodiphosphoric acid, P<sub>2</sub>NH<sub>4</sub>O<sub>6</sub> = HO—PO<math>\begin{smallmatrix} \text{O} \\ \text{NH} \end{smallmatrix}>\text{PO—OH}</math> (Mente, A 248 232)

**Barium pyrophosphamate, Ba<sub>3</sub>(P NH<sub>2</sub>O<sub>6</sub>)<sub>2</sub>**

Sol in HCl or HNO<sub>3</sub> + Aq, not in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq (Gladstone and Holmes, Chem Soc (2) 2 233)

**Cupric —, Cu<sub>3</sub>(P<sub>2</sub>NH<sub>2</sub>O<sub>6</sub>)<sub>2</sub> + 2H<sub>2</sub>O**

Ppt Decomp by cold KOH + Aq (Gladstone, Chem Soc 3 135)

**Ferric —, Fe<sub>3</sub>(P<sub>2</sub>NH<sub>2</sub>O<sub>6</sub>)<sub>2</sub> + 2H<sub>2</sub>O**

Insol in dil acids Sol in conc H<sub>2</sub>SO<sub>4</sub>, and decomp by warming Easily sol in NH<sub>4</sub>OH + Aq Decomp by KOH + Aq (Gladstone, Chem Soc 3 142)

**Lead —, Pb<sub>3</sub>(P<sub>2</sub>NH<sub>2</sub>O<sub>6</sub>)<sub>2</sub> + 4H<sub>2</sub>O**

Insol in NH<sub>4</sub>OH + Aq

**Potassium —, K<sub>3</sub>P<sub>2</sub>NH<sub>2</sub>O<sub>6</sub>**

Deliquescent Sol in H<sub>2</sub>O Insol in alcohol (Gladstone A 76 85)

**Silver —, Ag<sub>3</sub>P NH<sub>2</sub>O<sub>6</sub> + 5H<sub>2</sub>O**

Ppt

**Zinc —, Zn<sub>3</sub>(P<sub>2</sub>NH<sub>2</sub>O<sub>6</sub>)<sub>2</sub>**

(Gladstone and Holmes, Chem Soc (2) 2 225)

**Phosphamide, PON**

See Phosphoryl nitride

PN<sub>2</sub>H<sub>3</sub>O

See Phosphoryl imidoamide

**Triphosphamide, PON<sub>3</sub>H<sub>3</sub>**

See Phosphoryl triamide

**Trimetaphosphumic acid, P<sub>3</sub>N<sub>3</sub>H<sub>3</sub>O<sub>6</sub>**

Sol in H<sub>2</sub>O, aq solution does not coagulate albumen (Stokes, Am Ch J 1895, 17 275)

**Ammonium trimetaphosphumate,**

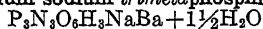
(NH<sub>4</sub>)<sub>3</sub>P<sub>3</sub>N<sub>3</sub>O<sub>6</sub>H<sub>3</sub>

Sol in H<sub>2</sub>O, insol in alcohol, unstable (Stokes, Am Ch J 1896, 18 643)

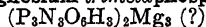
**Barium trimetaphosphumate, Ba<sub>3</sub>(P<sub>3</sub>N<sub>3</sub>O<sub>6</sub>H<sub>3</sub>)<sub>2</sub> + 4H<sub>2</sub>O**

+ 6H<sub>2</sub>O Sl sol in H<sub>2</sub>O Easily sol in NH<sub>4</sub>Cl + Aq and in NaCl + Aq (Stokes)

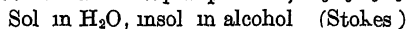


**Barium sodium trimetaphosphumate,**

Almost insol in  $H_2O$ , easily sol in  $NH_4Cl + Aq$  and in  $NaCl + Aq$  (Stokes)

**Magnesium trimetaphosphumate,**

Sol in  $H_2O$ , insol in alcohol, aq solution decomp on boiling (Stokes)

**Potassium trimetaphosphumate,**

Sol in  $H_2O$ , insol in alcohol (Stokes)

**Silver trimetaphosphumate,**

Ppt, sol in  $NH_4OH + Aq$ , insol in  $H_2O$ ,

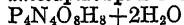
sl sol in  $HNO_3 + Aq$  (Stokes)

 **$\alpha$  Sodium trimetaphosphumate,**

183 pts are sol in 100 pts  $H_2O$  at  $20^\circ$ , very sol in hot  $H_2O$ , decomp by alkali on long boiling (Stokes)

 **$\beta$  Sodium trimetaphosphumate,**

Sol in  $H_2O$ , insol in alcohol (Stokes)

**Tetrametaphosphimic acid,**

Very sl sol in  $H_2O$ , decomposes the sol salts of  $HCl$ ,  $H_2SO_4$  and  $HNO_3$  (Stokes, Am Ch J 1895, 17 290)

100 pts  $H_2O$  at  $20^\circ$  dissolve 0.64 pt crystallized acid. Somewhat more sol in boiling  $H_2O$  (Stokes)

100 pts 10%  $HNO_3 + Aq$  at  $20^\circ$  dissolve 0.26 pt of crystallized acid (Stokes)

Not decomp by boiling alkalies +  $Aq$  (Stokes, Am Ch J 1896, 18 785)

Insol in alcohol (Stokes, Am Ch J 1896, 18 784)

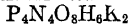
**Ammonium tetrametaphosphumate,**

Only sl sol in boiling  $H_2O$ , sol in excess of hot 5%  $HNO_3$  (Stokes)

$P_4N_4O_8H_8(NH_4)_4 + 4H_2O$  Readily sol in  $H_2O$ , sl sol in  $NH_4OH + Aq$  (Stokes)

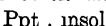
**Barium tetrametaphosphumate,**

Ppt, insol in  $H_2O$  (Stokes)

**Potassium tetrametaphosphumate,**

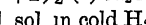
Sl sol in boiling  $H_2O$ , sol in cold dil  $KOH + Aq$  (Stokes)

$P_4N_4O_8H_8K_4 (?)$  Very sol in  $H_2O$  (Stokes)

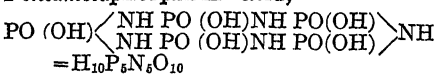
**Silver tetrametaphosphumate,**

Ppt, insol in  $H_2O$ , sl sol in  $HNO_3 + Aq$  (Stokes)

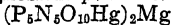
$P_4N_4O_8Ag_8$  Ppt, sol in  $NH_4NO_3 + Aq$  (Stokes)

**Sodium tetrametaphosphumate,**

Sl sol in cold  $H_2O$  Easily sol in hot  $H_2O$  Ppt from aqueous solution by excess of alkali (Stokes)

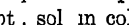
**Pentametaphosphimic acid,**

Sol in  $H_2O$ , pptd by alcohol (Stokes, Am Ch J 1898, 20 748)

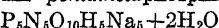
**Magnesium pentametaphosphumate,**

Ppt (Stokes)

$P_5N_5O_{10}H_{10}Mg_2 + 5H_2O$  Ppt, insol in alcohol, almost insol in  $H_2O$ , sl sol in conc acetic acid (Stokes)

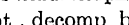
**Silver pentametaphosphumate,**

Ppt, sol in cold  $KOH + Aq$  with decomp (Stokes)

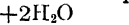
**Sodium pentametaphosphumate,**

Sol in  $H_2O$ , insol in alcohol (Stokes)

$P_5N_5O_{10}H_{10}Na_4 + 2H_2O$  Sol in 80% acetic acid, pptd by alcohol (Stokes)

**Hexametaphosphimic acid****Silver hexametaphosphumate,**

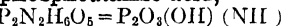
Ppt, decomp by cold  $KOH + Aq$  (Stokes, Am Ch J 1896, 20 757)

**Sodium hexametaphosphumate,**

Sol in  $H_2O$ , pptd by alcohol (Stokes)

**Phosphine**

See Hydrogen phosphide

**Pyrophosphodiamic acid,**

Deliquescent. Easily sol in  $H_2O$ , alcohol, or ether. Sol in cold conc  $H_2SO_4$  without decomp (Gladstone, Chem Soc 3 353)

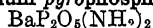
Correct composition is dimethyldiphosphoric acid,  $P_2N_2H_4O_4 + H_2O = H(O - P)(O - P)(NH) = PO - OH$  (Ment)

**Aluminum pyrophosphodiamic acid**

Precipitate. Sol in  $NH_4OH + Aq$  Insol in acids (Gladstone, A 76 82)

**Ammonium —,  $P_2O_5(NH_4)_2$** 

Very deliquescent in moist air. Sol in  $H_2O$  (Schiff, A 103 168)

**Barium pyrophosphodiamate,**


Precipitate SI sol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Gladstone)

**Calcium —,  $\text{CaP}_2\text{O}_5(\text{NH}_2)_2$** 

Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  and acids (Gladstone and Holmes)

**Lead —**

Ppt Decomp by  $\text{H}_2\text{O}$

**Magnesium —**

Ppt (Gladstone and Holmes)

**Silver —,  $\text{Ag}_2\text{P}_2\text{O}_5(\text{NH}_2)_2$** 

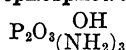
SI sol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3 + \text{Aq}$  (Gladstone and Holmes)

**Strontium —**

Sol in acids and  $\text{NH}_4\text{Cl} + \text{Aq}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Gladstone and Holmes, Chem Soc (2) 4 295)

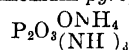
**Zinc —,  $\text{ZnP}_2\text{O}_5(\text{NH}_2)_2$** 

Ppt (Gladstone and Holmes)

**Pyrophosphotriamic acid,  $\text{P}_2\text{N}_3\text{H}_7\text{O}_4 =$** 


Decomp bv boiling  $\text{H}_2\text{O}$  or  $\text{HCl}$  Sol in conc  $\text{H}_2\text{SO}_4$  upon heating (Gladstone and Holmes)

Correct formula is  $\text{HO}-\text{PO}<\frac{\text{NH}}{\text{NH}}>\text{PO}-\text{NH}_2 = \text{dimidodiphosphomonamic acid}$  (Mente, A 248 241)

**Ammonium pyrophosphotriamate,**


Insol in  $\text{H}_2\text{O}$  (Gladstone and Holmes)

**Barium —,  $\text{BaP}_2\text{N}_3\text{H}_6\text{O}_4$** 

$\text{BaH}_2(\text{P}_2\text{N}_3\text{H}_6\text{O}_4)_2$  Decomp by  $\text{HCl} + \text{Aq}$  (Gladstone, Chem Soc 4 6)

**Cobaltous —,  $\text{CoP}_2\text{N}_3\text{H}_6\text{O}_4$** 

Slowly decomp by dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ , not by  $\text{HCl} + \text{Aq}$  (Gladstone and Holmes, Chem Soc (2) 4 1)

**Cupric —,  $\text{CuP}_2\text{N}_3\text{H}_6\text{O}_4$** 

Insol in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  (Gladstone and Holmes, Chem Soc (2) 4 1)

**Ferrous —,  $\text{FeH}_6(\text{P}_2\text{N}_3\text{H}_6\text{O}_4)_2$** 

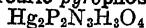
Insol in dil acids (Gladstone, Chem Soc (2) 4 1)

**Lead —,  $\text{H}_2\text{Pb}_3(\text{P}_2\text{N}_3\text{H}_6\text{O}_4)_2$** 

Ppt (Gladstone and Holmes, Chem Soc (2) 4 1)

$\text{H}_2\text{Pb}_2(\text{P}_2\text{N}_3\text{H}_6\text{O}_4)_2$  Ppt (G and H)

$\text{H}_2\text{Pb}(\text{P}_2\text{N}_3\text{H}_6\text{O}_4)_2$  (G and H)

**Mercuric pyrophosphotriamate,**


Insol in  $\text{H}_2\text{O}$  or dil  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  (Gladstone and Holmes, Chem Soc (2) 4 1)

**Platinum —,  $\text{Pt}_2\text{P}_2\text{N}_3\text{H}_6\text{O}_4$** 

Decomp by  $\text{H}_2\text{O}$  when freshly pptd (G and H)

**Potassium —,  $\text{KP}_2\text{N}_3\text{H}_6\text{O}_4$** 

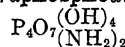
Almost insol in  $\text{H}_2\text{O}$  (Gladstone, Chem Soc 4 10)

**Silver —,  $\text{Ag}_3\text{P}_2\text{N}_3\text{H}_6\text{O}_4$** 

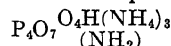
Ppt SI attacked by  $\text{HC}_2\text{H}_3\text{O}_2$ , decomp by  $\text{HNO}_3$  or  $\text{NH}_4\text{OH} + \text{Aq}$  into—  
 $\text{AgH}_2\text{P}_2\text{N}_3\text{H}_6\text{O}_4$  Insol in  $\text{H}_2\text{O}$  Decomp bv  $\text{HCl}$  (Gladstone, Chem Soc (2) 4 1)

**Zinc —**

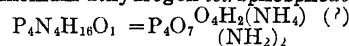
Insol in  $\text{H}_2\text{O}$  (Gladstone and Holmes)

**Tetraphosphodiamic acid,  $\text{P}_4\text{N}_2\text{H}_8\text{O}_{11} =$** 


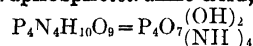
Known only as  $\text{NH}_4$  salt

**Ammonium tetraphosphodiamate,**


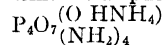
Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Gladstone)

**Ammonium dihydrogen tetraphosphodiamate,**


Insol in cold, easily sol in hot  $\text{H}_2\text{O}$  and dil acids (Gladstone)

**Tetraphosphotetramic acid,**


Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Gladstone)

**Ammonium tetraphosphotetramate,**


Sol in  $\text{H}_2\text{O}$ , and precipitated from solution by alcohol (Gladstone)

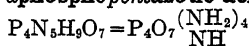
**Silver —,  $\text{Ag}_6\text{P}_4\text{N}_4\text{H}_4\text{O}_9$** 

Ppt

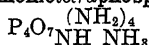
$\text{AgH}_4\text{P}_4\text{N}_4\text{H}_4\text{O}_9$  Ppt

**Ammonium phosphoarsenovanadico-vanadiotungstate**

See Arseniophosphovanadico-vanadiotungstate, ammonium

**Tetraphosphopentazotic acid,**

Insol in  $H_2O$  Decomp gradually by boiling with  $H_2O$  (Gladstone)

**Ammoniotetraphosphopentazotic acid ('),**

Decomp by  $H_2O$  (Gladstone)

**Uptic tetraphosphopentazotate**

(Gladstone, Chem Soc (2) 6 261)

**Lead —**

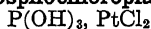
(Gladstone, Chem Soc (2) 6 261)

**Potassium —,  $KOP_4N_5H_9O_6$** 

Insol in  $H_2O$  (Gladstone, Chem Soc (2) 268)

**Phosphoboric acid,  $H_3BO_3$ ,  $H_3PO_4 = BPO_4 + 3H_2O$** 

Not decomp by boiling  $H_2O$  or conc acids  
Sol in boiling solution of caustic alkalis  
Vogel, N Repert Pharm 18 611)

**Phosphochloroplatinous acid,**

See Chloroplatinophosphoric acid

**Phosphochromic acid****Ammonium phosphochromate,  $3(NH_4)_2O$ ,  $P_2O_5$ ,  $8CrO_3 + H_2O$** 

Sol in  $H_2O$  with decomp (Friedheim, Z anorg 1894, 6 284)

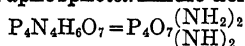
**Potassium phosphochromate,  $2K_2O$ ,  $P_2O_5$ ,  $4CrO_3 + H_2O$** 

Sol in  $H_2O$  but cannot be cryst therefrom without decomp Can be cryst without decomp from  $H_2O$  containing phosphoric acid (Friedheim)

$3K_2O$ ,  $P_2O_5$ ,  $8CrO_3$  Sol in  $H_2O$  but cannot be cryst therefrom without decomp (Blondel, C R 1894, 118 194)

**Phosphohypophosphotungstic acid****Potassium sodium phosphohypophosphotungstate,  $9K_2O$ ,  $Na_2O$ ,  $4P_2O_5$ ,  $2PO_2H_3$ ,  $26WO_3 + 23H_2O$** 

Precipitate Easily sol in hot  $H_2O$  (Gibbs, Am Ch J 7 313)

**Tetraphosphotetrimidic acid,**

Known only in its salts (Gladstone)

**Silver tetraphosphotetrimidate**

Ppt (Gladstone)

**Phosphoiodic acid,  $P_2O_5$ ,  $18I_2O_5 + 4H_2O$** 

Decomp by  $H_2O$  (Chrétien, A ch 1898, (7) 15 389)

**Ammonium phosphiodate,  $4(NH_4)_2O$ ,  $P_2O_5$ ,  $18I_2O_5 + 12H_2O$** 

Sol in  $H_2O$  Sl sol in conc  $H_3PO_4 + Aq$  (Chrétien)

**Lithium phosphiodate,  $3Li_2O$ ,  $P_2O_5$ ,  $18I_2O_5 + 11H_2O$** 

Sol in  $H_2O$  Sl sol in conc  $H_3PO_4 + Aq$  (Chrétien)

**Potassium phosphiodate,  $4K_2O$ ,  $P_2O_5$ ,  $18I_2O_5 + 5H_2O$** 

Decomp by a small amt of  $H_2O$ , sol in a large amt Sl sol in conc  $H_3PO_4 + Aq$  (Chrétien)

**Sodium phosphiodate,  $6Na_2O$ ,  $P_2O_5$ ,  $18I_2O_5 + 5H_2O$** 

Sol in  $H_2O$  Sl sol in conc  $H_3PO_4 + Aq$  (Chrétien)

**Phosphoiridic acid**

See Chlorophosphoiridic acid

**Phospholuteotungstic acid,  $H_6PW_8O_{29}$** 

See under Phosphotungstic acid

**Phosphomolybdic acid,  $P_2O_5$ ,  $18MoO_3 + xH_2O$** 

"Phospholuteomolybdic acid"

Deliquescent Sol in  $H_2O$  in all proportions (Kehrmann, Z anorg 1894, 7 418)

$3H_2O$ ,  $P_2O_5$ ,  $20MoO_3 + 21H_2O$  Very sol in  $H_2O$  Sol in ether By vaporization of  $H_2O$  solution crystals with  $44H_2O$ , or from a strong solution in conc  $HNO_3 + Aq$ , with  $19H_2O$ , are obtained, also crystals with  $38$ , and  $48H_2O$  are known (Doblay, C R 66 704)

According to Rammelsberg (B 10 177b) formula is  $3H_2O$   $P_2O_5$ ,  $22MoO_3$

According to Gibbs (Am Ch J 3 317) formula is  $3H_2O$ ,  $P_2O_5$ ,  $24MoO_3 + 59H_2O$

Finkner (B 11 1638) gives the formula as  $3H_2O$ ,  $P_2O_5$ ,  $24MoO_3 + 58H_2O$ , also with  $29H_2O$

$P_2O_5$ ,  $20MoO_3 + 52H_2O$  Sol in dry ether with evolution of heat, and subsequent separation into two layers, the upper consisting of pure ether, and lower of a solution of acid in ether Sp gr of lower layer, when sat at  $13^\circ$ , is 1.3 On warming lower layer, ether separates out and forms an upper layer This redissolves on cooling and shaking The lower layer is insol in  $H_2O$  and miscible with alcohol

100 pts ether thus dissolve 80.6 pts acid at 0°, 84.7 pts at 81°, 96.7 pts at 19.3°, 103.9 pts at 27.4°, 107.9 pts at 32.9° (Parmentier, C R 104 688)

$P_2O_5$ ,  $22MoO_3 + 57H_2O$ , and  $+58H_2O$  (Pohl, Dissert 1906)

$P_2O_5$ ,  $23MoO_3 + 61H_2O$  (Pohl)

$P_2O_5$ ,  $24MoO_3 + 61H_2O$  (Molati, C C 1903, 11 789)

$+64H_2O$  (Pohl)

### Diphosphopentamolybdic acid,

$H_4P_2Mo_5O_{23} = 3H_2O$ ,  $P_2O_5$ ,  $5MoO_3$

Not known in free state

### Ammonium phosphomolybdate, $(NH_4)_2O$ ,

$P_2O_5$ ,  $2MoO_3 + 2H_2O$

(Meschorier, Dissert 1894)

$2(NH_4)_2O$ ,  $P_2O_5$ ,  $4MoO_3 + 5H_2O$  (Friedheim, Z anorg 1894, 6 33)

$+6H_2O$  (Perlberger, Dissert 1904)

$(NH_4)_3PO_4$ ,  $11MoO_3 + 6H_2O$

Formula is  $(NH_4)_3PO_4$ ,  $10MoO_3 + 1\frac{1}{2}H_2O$ , according to the older authorities

Scarcely sol in  $H_2O$  or aqueous acid solutions. Easily sol in ammonia, and alkalies + Aq (Svanberg and Struve, J pr 44 291)

It is almost completely insol in a mixture of  $(NH_4)_2MoO_4 + Aq$ , and dil  $HNO_3 + Aq$ . Absolutely insol in a dil nitric acid solution of ammonium nitrate (Richters, Z anal 10 471)

Solubility is increased even in presence of ammonium molybdate and free  $HNO_3$  by  $HCl$ , ammonium, and other chlorides, tartaric acid, or large quantities of ammonium oxalate or citrate. Not precipitated in presence of excess of  $H_3PO_4$  (Fresenius, Z anal 3 446)

Sol in 10,000 pts  $H_2O$  at 16°, in 6600 pts  $H_2O$  containing 1 vol %  $HNO_3$ , in 550 pts  $HCl + Aq$  of 1.12 sp gr, in 620 pts alcohol of 0.80 sp gr, in 190 pts  $HNO_3 + Aq$  (sp gr = 1.2) at 50°, in 5 pts conc  $H_2SO_4$  at 100°, in 3 pts  $NH_4OH + Aq$  of 0.95 sp gr (Eggertz, J pr 79 496)

Sol in 21,186 pts  $H_2O$ , 35,117 pts dil alcohol, and 13,513 pts strong alcohol (Hehner, Analyst, 1879 23)

According to Sonnenschein, the solubility is increased by much  $H_2O$  or alcohol, alkaline hydroxides, carbonates, ortho-, pyro-, and metaphosphates, sodium borate, hyposulphate, thiosulphate, acetate, arsenate, and arsenite, potassium sodium tartrate, ammonium oxalate, orthophosphoric acid, and sulphuric acid. It is not increased by ammonium molybdate or sulphate, potassium sulphate, acid tartrate, acid oxalate, nitrate, or chlorate, iodide, chloride, or bromide, sodium bromide or nitrate, nitric, hydrochloric, boric, tartaric, oxalic, and dilute sulphuric acids (Sonnenschein, J pr 53 342)

Sol in hot  $H_2O$ . Sol in cold caustic alkalies, alkali carbonates, and phosphates,

$NH_4Cl$ , and  $(NH_4)_2C_2O_4 + Aq$ , sl sol in  $(NH_4)_2SO_4$ ,  $KNO_3$ , and  $KCl + Aq$ , very sl sol in  $NH_4NO_3 + Aq$ . Sol in  $K_2SO_4$ ,  $Na_2SO_4$ ,  $NaCl$ ,  $MgCl_2$ ,  $H_2SO_4$ ,  $HCl$ , and conc or dil  $HNO_3 + Aq$

Presence of  $(NH_4)_2MoO_4$  totally changes the effect of acid liquids, insol in dil  $HNO_3$  or  $H_2SO_4 + Aq$  containing  $(NH_4)_2MoO_4$ , but somewhat sol in  $HCl + Aq$ , even in presence of that salt. Tartaric acid and similar organic substances totally prevent the precipitation of this salt (Eggertz in Fresenius' Quant anal)

$5(NH_4)_2O$ ,  $48MoO_3$ ,  $2P_2O_5 + 17H_2O = 3(NH_4)_2O$ ,  $24MoO_3$ ,  $P_2O_5 + 2(NH_4)_2O$ ,  $H_2O$ ,  $24MoO_3$ ,  $P_2O_5 + 16H_2O$ . Formula of above salt according to Gibbs

$3(NH_4)_2O$ ,  $22MoO_3$ ,  $P_2O_5 + 9H_2O$ , or  $12H_2O$

$8(NH_4)_2O$ ,  $H_2O$ ,  $60MoO_3$ ,  $3P_2O_5 + 11H_2O$ . Sl sol in  $H_2O$

$3(NH_4)_2O$ ,  $16MoO_3$ ,  $P_2O_5 + 14H_2O$ . Insol in cold, sol with decomp in hot  $H_2O$ . Sol in  $NH_4OH + Aq$  (Gibbs, Am Ch J 3 317)

$5(NH_4)_2O$ ,  $P_2O_5$ ,  $16MoO_3$  (Meschorier, Dissert 1894)

$3(NH_4)_2O$ ,  $P_2O_5$ ,  $18MoO_3 + 14H_2O$ . Sol in  $H_2O$ . The aqueous solution is stable at ordinary temp for several days, but when warmed ordinary ammonium phosphomolybdate separates (Kehrmann, Z anorg 1894, 7 414)

$3(NH_4)_2O$ ,  $P_2O_5$ ,  $28MoO_3 + 8H_2O$ . 100 g  $H_2O$  dissolve 0.0238 g at 15°. 1 pt is sol at 15° in 4206 pts  $H_2O$ , 7300 pts 5%  $NH_4NO_3 + Aq$ , 4930 pts 1%  $HNO_3 + Aq$  (de Lucchi, Rass Min 1910, 32 21)

$9(NH_4)_2O$ ,  $2P_2O_5$ ,  $26MoO_3 + 8H_2O$  (Meschorier, Dissert 1894)

### Ammonium diphosphopentamolybdate,

$2(NH_4)_3PO_4$ ,  $5MoO_3 + 7H_2O = 3(NH_4)_2O$ ,  $5MoO_3$ ,  $P_2O_5 + 7H_2O$

Easily sol in hot, less in cold  $H_2O$  (Zenlner, J pr 58 256)

$5(NH_4)_2O$ ,  $H_2O$ ,  $10MoO_3$ ,  $2P_2O_5 + 6H_2O = 3(NH_4)_2O$ ,  $5MoO_3$ ,  $P_2O_5 + 2(NH_4)_2O$ ,  $H_2O$ ,  $5MoO_3$ ,  $P_2O_5 + 6H_2O$ . Sol in  $H_2O$  (Gibbs, Am Ch J 1895, 17 87)

$+8H_2O$  (Perlberger)

$+18H_2O$  (Mazzuchelli and Zungilli, Gazz ch it 1910 40 (2) 55)

$5(NH_4)_2O$ ,  $P_2O_5$ ,  $10MoO_3 + 13H_2O$ , and  $+14H_2O$  (Perlberger, Dissert 1904)

### Ammonium barium phosphomolybdate,

$3(NH_4)_2O$ ,  $30BaO$ ,  $P_2O_5$ ,  $30MoO_3$

Insol precipitate (Seligsohn, J pr 67 478)

### Ammonium cadmium phosphomolybdate,

$5(NH_4)_2O$ ,  $CdO$ ,  $P_2O_5$ ,  $6MoO_3 + 8H_2O$

(Perlberger, Dissert 1904)

$3(NH_4)_2O$ ,  $2CdO$ ,  $2P_2O_5$ ,  $9MoO_3 + 141H_2O$  (Perlberger)

**Ammonium cobaltous phosphomolybdate**,  
 $(\text{NH}_4)_2\text{O}$ ,  $2\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 10\text{H}_2\text{O}$

Decomp by cold  $\text{H}_2\text{O}$  Sol in acids and hot  $\text{H}_2\text{O}$  (Arnfeld, Dissert 1898)

$4(\text{NH}_4)_2\text{O}$ ,  $\text{CoO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 12\text{H}_2\text{O}$   
 Sl sol in cold, easily sol in hot  $\text{H}_2\text{O}$  (Arnfeld)

**Ammonium manganous phosphomolybdate**,  
 $(\text{NH}_4)_2\text{O}$ ,  $2\text{MnO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 20\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$ , but dissolves clear on heating (Arnfeld)

$4(\text{NH}_4)_2\text{O}$ ,  $\text{MnO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 13\text{H}_2\text{O}$  (Arnfeld)

$5(\text{NH}_4)_2\text{O}$ ,  $10\text{MnO}$ ,  $2\text{P}_2\text{O}_5$ ,  $20\text{MoO}_3 + 10\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 1895, 17 87)

**Ammonium nickel phosphomolybdate**,  
 $(\text{NH}_4)_2\text{O}$ ,  $2\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 10\text{H}_2\text{O}$

Decomp by cold, but sol in hot  $\text{H}_2\text{O}$  (Arnfeld)

$(\text{NH}_4)_2\text{O}$ ,  $\text{NiO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 12\text{H}_2\text{O}$   
 Very sol in  $\text{H}_2\text{O}$  (Arnfeld)

**Ammonium potassium phosphomolybdate**,  
 $6(\text{NH}_4)_2\text{O}$ ,  $15\text{K}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $60\text{MoO}_3 + 12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Seligsohn, J pr 67 477)

**Ammonium sodium phosphomolybdate**,  
 $6(\text{NH}_4)_2\text{O}$ ,  $15\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $60\text{MoO}_3 + 18\text{H}_2\text{O}$

Sol in much boiling  $\text{H}_2\text{O}$  Insol in alcohol (Seligsohn, J pr 67 474)

**Barium phosphomolybdate**,  $3\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  
 $24\text{MoO}_3 + x\text{H}_2\text{O}$

Moderately sol in cold, very easily sol in hot  $\text{H}_2\text{O}$  Decomp in aqueous solution at ordinary temp on standing (Kehrmann, Z anorg 1894, 7 414)

**Cæsium phosphomolybdate**,  $3\text{Cs}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  
 $6\text{MoO}_3 + 8\text{H}_2\text{O}$

Ppt (Ephraim, Z anorg 1910, 65 240)  
 $2\text{Cs}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $14\text{MoO}_3 + 3\text{H}_2\text{O}$  Difficultly sol in  $\text{H}_2\text{O}$  (Ephraim)

$3\text{Cs}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $21\text{MoO}_3 + 4\text{H}_2\text{O}$  (?) (Ephraim)

**Calcium potassium phosphomolybdate**,  $2\text{CaO}$ ,  
 $3\text{K}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 22\text{H}_2\text{O}$

(Friedheim, Z anorg 1893, 4 293)

**Cobaltous phosphomolybdate**,  $2\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  
 $4\text{MoO}_3 + 2\text{H}_2\text{O}$

(Arnfeld, Dissert 1898)

$3\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 16\frac{1}{2}\text{H}_2\text{O}$ , and  $+17\frac{1}{2}\text{H}_2\text{O}$  Extremely sol in  $\text{H}_2\text{O}$  (Arnfeld)

$3\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 38\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Arnfeld)

$3\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + 56\text{H}_2\text{O}$ , and  $+60\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Arnfeld)

**Cobaltous potassium phosphomolybdate**,  
 $\text{K}_2\text{O}$ ,  $2\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 15\text{H}_2\text{O}$

(Arnfeld)

$4\text{K}_2\text{O}$ ,  $\text{CoO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 12\text{H}_2\text{O}$  Sl sol in cold, easily sol in hot  $\text{H}_2\text{O}$  (Arnfeld)

**Croceocobaltic phosphomolybdate**,  $24\text{MoO}_3$ ,  
 $\text{P}_2\text{O}_5$ ,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]\text{H}_2\text{O}$ ,  $2\text{H}_2\text{O} + 21\text{H}_2\text{O}$

Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 3 317)

**Gold phosphomolybdate ammonia**,  $12\text{Au}_2\text{O}_3$ ,  
 $7\text{P}_2\text{O}_5$ ,  $3\text{MoO}_3$ ,  $24\text{NH}_3 + 21\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 1895, 17 172)

**Gold sodium phosphomolybdate ammonia**,  
 $5\text{Au}_2\text{O}_3$ ,  $\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $11\text{MoO}_3$ ,  $15\text{NH}_3 + 10\text{H}_2\text{O}$

Sol in dil  $\text{HCl}$  Almost insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Gibbs)

**Lead phosphomolybdate**,  $23\text{PbMoO}_4$ ,  $\text{P}_2\text{O}_5$ ,  
 $2\text{PbPO}_4 + 7\text{H}_2\text{O}$

Sol in 500,000 pts  $\text{H}_2\text{O}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  Easily sol in  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{HNO}_3 + \text{Aq}$ , somewhat less sol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Beuf, Bull Soc (3) 3 852)

**Lithium phosphomolybdate**,  $12\text{Li}_2\text{O}$ ,  $4\text{P}_2\text{O}_5$ ,  
 $5\text{MoO}_3 + 18\text{H}_2\text{O}$

Partially sol in  $\text{H}_2\text{O}$  (Ephraim, Z anorg 1909, 64 233)

$3\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 16\text{H}_2\text{O}$  Ppt

(Ephraim, Z anorg 1910, 65 233-6)

$3\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 17\text{H}_2\text{O}$  Ppt (F)

$5\text{Li}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $8\text{MoO}_3 + 28\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (E)

$3\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{MoO}_3 + 18\text{H}_2\text{O}$  Ppt (F)

$3\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 27\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (E)

**Manganous phosphomolybdate**,  $3\text{MnO}$ ,  $\text{P}_2\text{O}_5$ ,  
 $5\text{MoO}_3 + 20\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Sl sol in alcohol (Arnfeld)

$3\text{MnO}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 38\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Arnfeld)

$3\text{MnO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + 58\text{H}_2\text{O}$ , and  $+60\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Arnfeld)

**Manganous potassium phosphomolybdate**,  
 $2\text{MnO}$ ,  $3\text{K}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 30\text{H}_2\text{O}$

Sol in hot  $\text{H}_2\text{O}$  (Arnfeld)

**Manganous sodium phosphomolybdate**,  
 $7\text{MnO}$ ,  $9\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 30\text{H}_2\text{O}$

Nearly insol in cold  $\text{H}_2\text{O}$  Sol in boiling  $\text{H}_2\text{O}$  but decomp thereby (Gibbs, Am Ch J 1895, 17 85)

**Nickel phosphomolybdate**,  $2\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  
 $4\text{MoO}_3 + x\text{H}_2\text{O}$

Ppt (Arnfeld)

$3\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 20\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Arnfeld)

$3\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 34\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Arnfeld)  
 $3\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + 58\text{H}_2\text{O}$ , and  $+60\text{H}_2\text{O}$  Efflorescent Sol in  $\text{H}_2\text{O}$  (Arnfeld)

**Nickel potassium phosphomolybdate**,  $\text{K}_2\text{O}$ ,  $2\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 13\text{H}_2\text{O}$

Decomp by cold  $\text{H}_2\text{O}$ , but goes into solution by boiling (Arnfeld)

$4\text{K}_2\text{O}$ ,  $\text{NiO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 12\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Arnfeld)

**Potassium phosphomolybdate**,  $\text{K}_3\text{PO}_4$ ,

$11\text{MoO}_3 + 1\frac{1}{2}\text{H}_2\text{O} = 3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{MoO}_3 + 3\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Easily sol in alkalis (Svanberg and Struve)

100 g  $\text{H}_2\text{O}$  dissolve 0.007 g at  $30^\circ$ , 100 g 10%  $\text{HNO}_3 + \text{Aq}$  dissolve 0.204 g at  $30^\circ$  (Donk, Bull 90, Bur of Chem, U S Dept of Agric 1905)

According to older authorities the formula is  $\text{K}_3\text{PO}_4$ ,  $10\text{MoO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$

$+6\text{H}_2\text{O}$  (Rammelsberg)  
 $2\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $24\text{MoO}_3$ ,  $\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$

$5\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $44\text{MoO}_3$ ,  $2\text{P}_2\text{O}_5 + 21\text{H}_2\text{O}$  (Gibbs Am Ch J 3 317)

$3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 11\text{H}_2\text{O}$ , and  $+15\text{H}_2\text{O}$  (Elias)

$+14\text{H}_2\text{O}$  Sl sol in cold, very easily sol in hot  $\text{H}_2\text{O}$  Can be cryst from hot  $\text{H}_2\text{O}$  (Kehrmann, Z anorg 1894, 7 416)

$3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $17\text{MoO}_3 + 12\text{H}_2\text{O}$  Moderately sol in  $\text{H}_2\text{O}$  (Fluiss, Dissert 1906)

$5\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $17\text{MoO}_3 + x\text{H}_2\text{O}$  Aqueous solution decomp rapidly in the cold (Kehrmann, Z anorg 1894, 7 423)

$4\text{K}_2\text{O}$ ,  $2\text{H}_2\text{O}$ ,  $9\text{MoO}_3$ ,  $\text{P}_2\text{O}_5 + 18\text{H}_2\text{O}$  (Zenkner)

$5\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $10\text{MoO}_3$ ,  $\text{P}_2\text{O}_5 + 19\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Rammelsberg, B 10 1776)

$6\text{K}_2\text{O}$ ,  $15\text{MoO}_3$ ,  $\text{P}_2\text{O}_5$  Insol in  $\text{H}_2\text{O}$  Sol in  $\text{KOH} + \text{Aq}$  (Rammelsberg)

$\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $2\text{MoO}_3 + 13\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Friedheim Z anorg 4 287)

$2\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{MoO}_3 + 8\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Friedheim)

**Potassium diphosphopentamolybdate**,  $3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 7\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , precipitated by  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$  (Zenkner, J pr 58 261)

$2\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 6\text{H}_2\text{O}$  (Friedheim)

**Potassium phosphomolybdate nitrate**,  $2\text{K}_2\text{PO}_4$

(Debray, C R 66 706)

**Rubidium phosphomolybdates**

$7\text{Rb}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{MoO}_3 + 12\text{H}_2\text{O}$ ,  $3\text{Rb}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{MoO}_3 + 12\text{H}_2\text{O}$ ,  $6\text{Rb}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 10\text{H}_2\text{O}$ ,  $5\text{Rb}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $9\text{MoO}_3 + 13\text{H}_2\text{O}$ ,  $7\text{Rb}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 15\text{H}_2\text{O}$  (Ephraim, Z anorg 1910, 65 237 9)

**Silver phosphomolybdate**,  $7\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{MoO}_3 + 24\text{H}_2\text{O}$

Ppt Sol in dil  $\text{HNO}_3 + \text{Aq}$ , forming—  
 $2\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{MoO}_3 + 7\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Rammelsberg)

Formula of first salt is—

$7\text{Ag}_2\text{O}$ ,  $22\text{MoO}_3$ ,  $\text{P}_2\text{O}_5 + 14\text{H}_2\text{O}$  Sol in hot  $\text{H}_2\text{O}$ , but solution is quickly decomp (Gibbs, Am Ch J 3 317)

$7\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3$  Ppt (Miolati, J pr 1908 (2) 77 451)

**Silver diphosphopentamolybdate**,

$\text{Ag}_5\text{Mo}_5\text{P}_2\text{O}_{23} + 7\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Debray, C R 66 706)

**Sodium phosphomolybdate**

Sol in  $\text{H}_2\text{O}$  and  $\text{HNO}_3 + \text{Aq}$  (Sonnen-schein, A 104 45)

$\text{Na}_2\text{O}$ ,  $5\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + x\text{H}_2\text{O}$   
 $2\text{Na}_2\text{O}$ ,  $4\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + x\text{H}_2\text{O}$

$3\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 26\text{H}_2\text{O}$  (Friedheim)

$3\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + 42\text{H}_2\text{O}$  (Rosenheim and Pinsker, Z anorg 1911, 70 79)

**Sodium diphosphopentamolybdate**,  $3\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 14\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Debray)

**Sodium auramine phosphomolybdate**,  $\text{Na}_2\text{O}$ ,  $5\text{Au}_2\text{O}_3$ ,  $2\text{P}_2\text{O}_5$ ,  $11\text{MoO}_3$ ,  $15\text{NH}_3$

Sol in hot  $\text{H}_2\text{O}$  Very sol in hot  $\text{HCl}$  (Gibbs, Am Ch J 1895, 17 171)

**Metaphosphomolybdic acid**

**Ammonium monometaphosphomolybdate**,  $3(\text{NH}_4)_2\text{O}$ ,  $4\text{NH}_4\text{PO}_3$ ,  $10\text{MoO}_3 + 9\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 7 392)

**Barium hexametaphosphomolybdate**,  $\text{BaO}$ ,  $\text{Ba}_3(\text{PO}_3)_6$ ,  $14\text{MoO}_3 + 55\text{H}_2\text{O}$

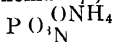
Sol in  $\text{H}_2\text{O}$  (Gibbs)

**Pyrophosphonitrylic acid**,  $\text{P}(\text{HNO})_2 =$



Not known in free state

**Ammonium pyrophosphonitrylate**,



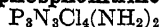
Insol but gradually decomp by  $\text{H}_2\text{O}$  (Gladstone)

**Potassium —**,  $\text{K}_2\text{P}_2\text{NO}_4$

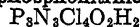
Insol in  $\text{H}_2\text{O}$  (Gladstone)

**Silver —**,  $\text{Ag}_2\text{P}_2\text{NO}_4$

Ppt

**Triphosphonitrilic chloramide,**

Sol in  $H_2O$  without decomp, sol in ether, alcohol, sl sol in benzene (Stokes, Am Ch J 1895, 17 287)

**Triphosphonitrilic tetrachlorhydrin,**

Sol in ether, alcohol, and  $H_2O$  insol in benzene and  $CS_2$  (Stokes, Am Ch J 1895, 17 286)

**Triphosphonitrilic chloride,  $P_3N_3Cl_6$** 

Sol in glacial acetic acid and  $H_2SO_4$  100 pts ether dissolve 46.5 pts at  $20^\circ$  (Liebig)

Insol in light petroleum, sol in benzene (Stokes, Am Ch J 1897, 19 783)

**Tetraphosphonitrilic chloride,  $P_4N_4Cl_8$** 

Sol in alcohol, ether, benzene,  $H_2SO_4$  Sl sol in  $H_2O$  with decomp 100 pts ether dissolve 12.3 pts at  $20^\circ$  (Stokes, Am Ch J 1895, 17 281)

**Pentaphosphonitrilic chloride,  $(PNCl_2)_5 = P_5N_5Cl_{10}$** 

Sol in benzene, light petroleum, acetic acid, ether,  $CS_2$ , insol in  $H_2O$  (Stokes, Am Ch J 1897, 19 790)

**Hexaphosphonitrilic chloride,  $(PNCl_2)_6 = P_6N_6Cl_{12}$** 

Sol in benzene, light petroleum, ether,  $CS_2$ , insol in  $H_2O$  (Stokes)

**Heptaphosphonitrilic chloride,  $(PNCl_2)_7 = P_7N_7Cl_{14}$** 

Sol in benzene, light petroleum, ether,  $CS_2$  insol in  $H_2O$ , sol in alcohol with decomp (Stokes)

**Polyphosphonitrilic chloride,  $(PNCl_2)_x$** 

Depolymerizes on distillation, insol in benzene and light petroleum and all neutral solvents, sol in  $H_2O$  with decomp (Stokes)

**Phosphonitrilochloramide,  $P_2NCl_3(NH_2)$** 

Slowly sol in  $H_2O$  with decomp Insol in ether and  $CS_2$  Sl sol in boiling  $CCl_4$  (Besson and Rosset, C R 1908, 146 1149)

**Phosphonium bromide,  $PH_4Br$** 

Decomp violently by  $H_2O$

**Phosphonium chloride,  $PH_4Cl$** 

(Ogier, Bull Soc (2) 32 483)

**Phosphonium titanium chloride,  $2PH_4Cl, 3TiCl_4$** 

Decomp by  $H_2O$ ,  $HCl$ , or alkalis + Aq (Rose)

**Phosphonium iodide,  $PH_4I$** 

Decomp by  $H_2O$ , alkalis, alcohol, etc (Rose, Pogg 46 636)

Decomp by  $PCl$  (Wilde, B 16 217)

**Phosphonium sulphate (?)**

Deliquescent, very unstable (Besson, C R 109 644)

**Phosphoramidate,  $P(NH_2)_3$** 

Insol in  $NH_4Br$ ,  $3NH_3$ , sol in  $NH_4I$ ,  $3NH_3$  (Hugot, C R 1905, 141 1235)

**Phosphortriamide,  $PON_3H_3$** 

See Phosphoryl triamide

**Phosphoric acid, anhydrous,  $P_2O_5$** 

See Phosphorus pentoxide

**Metaphosphoric acid,  $HPO_3$** 

Sol in  $H_2O$  Not isolated (Fleitmann, Pogg 78 362)

Deliquescent Sol in  $H_2O$ , but aqueous solution decomp into  $H_3PO_4$ , slowly in the cold, but more rapidly on heating Conc solutions decomp more rapidly than when dil (Giran, A ch 1903, (7) 30 203)

Insol in liquid  $CO_2$  (Buchner, Z phys Ch 1906, 54 674)

**Dimetaphosphoric acid,  $H_2P_2O_6$** 

Not isolated (Fleitmann)

**Trimetaphosphoric acid,  $H_3P_3O_9$** 

Sol in  $H_2O$ , the solution is permanent in the cold, but on evaporation it is quickly decomp to  $H_3PO_4$

**Tetrametaphosphoric acid,  $H_4P_4O_{12}$** 

Not isolated

**Hexametaphosphoric acid,  $H_6P_6O_{18}$** 

(Glacial phosphoric acid)

Deliquescent, easily sol in  $H_2O$  with evolution of heat and conversion into  $H_3PO_4$  Not easily sol in presence of slight impurities

Insol in liquid  $NH_3$  (Gore, Am Ch J 1895, 20 824)

**Orthophosphoric acid,  $H_3PO_4$** 

Very sol in  $H_2O$

100 pts of the solution contain at

26  $23^\circ$  27  $02^\circ$  29  $42^\circ$  29  $77^\circ$   
95.9 95.98 96.15 96.11 pts  $H_3PO_4$ ,

37  $65^\circ$  39  $35^\circ$  42  $30^\circ$  (mpt)

97.8 98.48 100 pts  $H_3PO_4$

(Smith and Menzies, J Am Chem Soc 1909, 31 1186)

See also  $10H_3PO_4 + H_2O$ , and  $2H_3PO_4 + H_2O$

Sp gr of  $H_3PO_4 + Aq$  containing

10 20 30 40 50 %  $P_2O_5$

1.1 1.23 1.39 1.6 1.85

(Dalton)

Sp gr of  $\text{H}_3\text{PO}_4 + \text{Aq}$ 

Sp gr	% $\text{P}_2\text{O}_5$	Sp gr	% $\text{P}_2\text{O}_5$	Sp gr	% $\text{P}_2\text{O}_5$
1 508	49 60	1 328	36 15	1 144	17 89
1 492	48 41	1 315	34 82	1 136	16 95
1 476	47 10	1 302	33 49	1 124	15 64
1 464	45 63	1 293	32 71	1 113	14 33
1 453	45 38	1 285	31 94	1 109	13 25
1 442	44 13	1 276	31 03	1 095	12 18
1 434	43 95	1 268	30 13	1 081	10 44
1 426	43 28	1 257	29 16	1 073	9 53
1 418	42 61	1 247	28 24	1 066	8 62
1 401	41 60	1 236	27 30	1 056	7 39
1 392	40 86	1 226	26 36	1 047	6 17
1 384	40 12	1 211	24 79	1 031	4 15
1 376	39 66	1 197	23 23	1 022	3 03
1 369	39 21	1 185	22 07	1 014	1 91
1 356	38 00	1 173	20 91	1 006	0 79
1 347	37 37	1 162	19 73		
1 339	36 74	1 153	18 81		

(Watts, C N 12 160)

Specific gravity of  $\text{H}_3\text{PO}_4 + \text{Aq}$  containing6 12 18 %  $\text{H}_3\text{PO}_4$ ,

1 0333 1 0388 1 1065

24 36 54 %  $\text{H}_3\text{PO}_4$ 

1 1463 1 2338 1 3840

(Schiff, A 113 183)

Sp gr of  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $15^\circ$  a = sp gr if %  
is  $\text{P}_2\text{O}_5$ , b = sp gr if % is  $\text{H}_3\text{PO}_4$ 

%	a	b	%	a	b
1	1 009	1 0054	31	1 288	1 1962
2	1 017	1 0109	32	1 299	1 2036
3	1 025	1 0164	33	1 310	1 2111
4	1 032	1 0220	34	1 321	1 2186
5	1 039	1 0276	35	1 333	1 2262
6	1 047	1 0333	36	1 345	1 2338
7	1 055	1 0390	37	1 357	1 2415
8	1 063	1 0449	38	1 369	1 2493
9	1 071	1 0508	39	1 381	1 2572
10	1 080	1 0567	40	1 393	1 2651
11	1 089	1 0627	41	1 407	1 2731
12	1 098	1 0688	42	1 420	1 2812
13	1 106	1 0749	43	1 432	1 2894
14	1 115	1 0811	44	1 445	1 2976
15	1 124	1 0874	45		1 3059
16	1 133	1 0937	46		1 3143
17	1 142	1 1001	47		1 3227
18	1 151	1 1065	48		1 3313
19	1 161	1 1130	49		1 3399
20	1 171	1 1196	50		1 3486
21	1 182	1 1262	51		1 3573
22	1 192	1 1329	52		1 3661
23	1 202	1 1397	53		1 3750
24	1 212	1 1465	54		1 3840
25	1 223	1 1534	55		1 3931
26	1 233	1 1604	56		1 4022
27	1 244	1 1674	57		1 4114
28	1 254	1 1745	58		1 4207
29	1 265	1 1817	59		1 4301
30	1 277	1 1889	60		1 4395

(Schiff, calculated by Gerlach, Z anal 8 292)

Sp gr of  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $17.5^\circ$ 

% $\text{P}_2\text{O}_5$	Sp gr	% $\text{P}_2\text{O}_5$	Sp gr	% $\text{P}_2\text{O}_5$	Sp gr
1	1 007	24	1 208	47	1 476
2	1 014	25	1 219	48	1 491
3	1 021	26	1 229	49	1 505
4	1 028	27	1 240	50	1 521
5	1 036	28	1 250	51	1 536
6	1 044	29	1 261	52	1 551
7	1 053	30	1 272	53	1 566
8	1 061	31	1 282	54	1 581
9	1 070	32	1 293	55	1 597
10	1 078	33	1 304	56	1 613
11	1 086	34	1 315	57	1 629
12	1 095	35	1 326	58	1 645
13	1 103	36	1 338	59	1 661
14	1 112	37	1 350	60	1 677
15	1 120	38	1 362	61	1 693
16	1 129	39	1 374	62	1 709
17	1 139	40	1 386	63	1 725
18	1 148	41	1 398	64	1 741
19	1 158	42	1 410	65	1 758
20	1 168	43	1 423	66	1 775
21	1 178	44	1 436	67	1 792
22	1 188	45	1 448	68	1 809
23	1 198	46	1 462		

(Hager, Adjumenta varia, Leipzig, 1876)

Table for correction to be added or subtracted  
for  $1^\circ$  change in temperature

% $\text{P}_2\text{O}_5$	Corr	% $\text{P}_2\text{O}_5$	Corr
10-14	0 00035	36-45	0 00068
15-25	0 0004	46-55	0 00082
26-35	0 00052	56-68	0 001

(Hager)

Sp gr of  $\text{H}_3\text{PO}_4 + \text{Aq}$ 

G equivalents $\text{H}_3\text{PO}_4$ per litre	$t^\circ$	Sp gr $t^\circ, t^\circ$
0 002572	17 714	1 001552
0 005142	17 706	1 0003051
0 01025	17 685	1 000595
0 02042	17 683	1 001158
0 03056	17 687	1 001708
0 04065	17 704	1 002252
~ 37	17 663	1 002790
0 10046	17 696	1 005412
0 19951	17 749	1 010560
0 29716	17 701	1 015584
0 49057	17 719	1 025469
0 5070	17 58	1 02627
5 0700	17 84	1 25162

(Kohlrausch, W Ann 1894, 53 29)

Miscible with conc  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  Sol  
in 30 pts warm creosote  
1 cc of a sat solution of ether in  $\text{H}_2\text{O}$  dis-  
solves 0 0886 grams  $\text{H}_3\text{PO}_4$



1 cc of a sat solution of  $H_2O$  in ether dissolves 0.00033 grams  $H_3PO_4$ .

Solutions of  $H_3PO_4$  in  $H_2O$  containing less than 0.434 grams acid per 1 cc lose an insignificant amount of acid to ether when agitated therewith (Berthelot, C R 1896, 123 345).

The composition of the hydrates formed by  $H_3PO_4$  at different dilutions is calculated from determinations of the lowering of the fr-pt produced by  $H_3PO_4$  and of the conductivity and sp gr of  $H_3PO_4 + Aq$  (Jones, Am Ch J 1905, 34 331).

$10H_3PO_4 + H_2O$  Solubility in  $H_2O$

100 pts of the solution contain at

24 11°	24 38°	24 40°
94 78	94 80	94 84 pts $H_3PO_4$ ,

24 81°	25 41°	25 85°
94 95	95 26	95 54 pts $H_3PO_4$

(Smith and Menzies, J Am Chem Soc 1909, 31 1186)

$2H_3PO_4 + H_2O$  Solubility in  $H_2O$

100 pts of the solution contain at

-16 3°	0 5°	14 95°	24 03°	27 0°
76 7	78 7	81 7	85 7	87 7 pts $H_3PO_4$ ,

29 15°	29 35° (mpt)
90 5	91 6 pts $H_3PO_4$ ,

28 5°	27 0°	25 41°
92 5	93 4	94 1 pts $H_3PO_4$

Retroflex part of curve

(Smith and Menzies, J Am Chem Soc 1909, 31 1186)

**Pyrophosphoric acid (Diphosphoric acid),**  
 $H_4P_2O_7$

Very sol in  $H_2O$ . The solution may be kept without change, but on heating it is converted into  $H_3PO_4$ .

The acid in solution gradually changes to  $H_3PO_4$ , the conversion being more rapid with more concentrated solutions (Montemartini and Egidi, Gazz ch it 1902, 32 (1) 381).

**Phosphoric acid,  $H_3P_2O_5$  (?)**

Sol in  $H_2O$  (Joly, C R 100 447)

**Phosphates**

The phosphates of  $NH_4$ , K, Na, Li, Cs, and Rb are sol in  $H_2O$ , with the exception of certain metaphosphates, the other phosphates excepting neutral Ti salts, are nearly insol in  $H_2O$ , excepting when an excess of  $H_3PO_4$  is present. The latter are all sol in  $HNO_3 + Aq$ .

(a) **Metaphosphates**

**Monometaphosphates** Only alkali monometaphosphates are known, and they are all insol in  $H_2O$ .

**Dimetaphosphates** Alkali dimetaphosphates and some double salts containing an alkali as one of the bases are sol in  $H_2O$ , the rest are sl sol or insol in  $H_2O$ .

**Trimetaphosphates** All salts are sol in  $H_2O$ .

**Tetrametaphosphates** The alkali salts are sol in  $H_2O$ , the others are insol.

**Hexametaphosphates** The alkali salts are sol, the others insol, in  $H_2O$ , but are mostly sol in Na hexametaphosphate + Aq.

(b) **Orthophosphates** K, Na, Li, Cs, and Rb orthophosphates are sol in  $H_2O$ . All the others are insol in  $H_2O$ , but sol in excess of  $H_3PO_4$  and  $HNO_3 + Aq$ , less easily sol in  $HC_2H_3O_2 + Aq$ . Pb, Al, and Fe<sub>2</sub> phosphates are insol in  $HC_2H_3O_2 + Aq$ . Sl sol in  $NH_4$  salts + Aq, especially  $NH_4Cl + Aq$ , from which solution they are pptd by  $NH_4OH + Aq$ . Orthophosphates insol in  $H_2O$  are also insol in an excess of alkali orthophosphates + Aq.

All orthophosphates are insol, or very sl sol in alcohol.

(c) **Pyrophosphates** Alkali pyrophosphates are sol in  $H_2O$ , the others are insol in  $H_2O$ , but are mostly sol in an excess of Na pyrophosphate + Aq.

**Aluminum metaphosphate,  $Al_2(PO_3)_6$**

Insol in  $H_2O$  and conc acids (Maddell, A 61 59)

**Aluminum orthophosphate, basic,  $3Al_2O_3 \cdot P_2O_5 + 18H_2O$**

Min *Evansite*  
 $4Al_2O_3 \cdot 3P_2O_5 + 18H_2O$  Ppt Insol in  $H_2O$  (Rammelsberg)

$2Al_2O_3 \cdot P_2O_5$   
+  $3H_2O$  Min *Angehit*  
+  $5H_2O$  Min *Kalaite* (Turquoise) Sol in  $HCl + Aq$

+  $6H_2O$  Decomp by  $H_2O$  (Hautefeuille, J pr (2) 37 111)

Min *Pegante* More or less sol in  $HCl$ , and  $HNO_3 + Aq$

+  $8H_2O$  Ppt (Mumloc, A 159 275)

Min *Fischerite* Sl attacked by  $HCl$  or  $HNO_3 + Aq$ , sol in  $H_2SO_4 + Aq$

$3Al_2O_3 \cdot 2P_2O_5 + 8H_2O$ , or  $12H_2O$  Sol in acids, even after ignition (Millot, C R 82 89)

+  $10H_2O$  Min *Cæruleolite* Sol in acids

+  $12H_2O$  Min *Wavellite*

**Aluminum orthophosphate,  $Al(PO_4)$**

*Crystalline* Not attacked by conc  $HCl$  or  $HNO_3 + Aq$ , difficultly by hot conc  $H_2SO_4$  (de Schulten, C R 93 1583)

Ignited  $Al_2(PO_4)_3$  is sl decomp by  $H_2O$ , so that solubility determinations are variable. For an extended discussion, see original paper (Cameron and Hurst, 1904, 26 898)

+4H<sub>2</sub>O Easily sol in mineral acids, insol in acetic and other organic acids Easily sol in KOH+Aq, but is reprecipitated by NH<sub>4</sub>Cl+Aq Sol in NH<sub>4</sub>OH+Aq Sol in a large amount of alum+Aq (Rose), in aluminum acetate and other aluminum salts +Aq (Fleischer, Z anal 6 28) More sol than ferric phosphate in ammonium oxalate or citrate+Aq (Millot)

Acid NH<sub>4</sub> citrate+Aq dissolves 3% of the P<sub>2</sub>O<sub>5</sub>, neutral NH<sub>4</sub> citrate+Aq dissolves 6.6% of the P<sub>2</sub>O<sub>5</sub>, ammoniacal NH<sub>4</sub> citrate+Aq dissolves completely in 25 min (Erlenmeyer, B 14 1869)

Sol in NH<sub>4</sub>OH+Aq, especially in presence of alkali phosphates (de Koninck, Z anal 23 90)

Not pptd in presence of alkali tartrates or citrates, sugar, glycerine, etc

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Min *Variscite* Very quickly sol in warm conc HCl+Aq

+5H<sub>2</sub>O Min *Zepharovitchite*

+8H<sub>2</sub>O Min *Gibbsite*

**Aluminum orthophosphate, acid**, 2Al<sub>2</sub>O<sub>3</sub>, 3P<sub>2</sub>O<sub>5</sub>+16H<sub>2</sub>O

Insol in acids after being ignited (Millot, Bull Soc (2) 22 244)

+4H<sub>2</sub>O, and 6H<sub>2</sub>O Insol in H<sub>2</sub>O or alcohol (Hautefeuille and Margottet, J pr (2) 37 111)

Al<sub>2</sub>O<sub>3</sub>, 2P<sub>2</sub>O<sub>5</sub>+8H<sub>2</sub>O Insol in acids or aqua regia after being ignited (Millot)

2Al<sub>2</sub>O<sub>3</sub>, 5P<sub>2</sub>O<sub>5</sub>+14H<sub>2</sub>O Decomp by cold H<sub>2</sub>O into—

4Al<sub>2</sub>O<sub>3</sub>, 7P<sub>2</sub>O<sub>5</sub>+9H<sub>2</sub>O Decomp by hot H<sub>2</sub>O (Erlenmeyer, A 194 200)

Al<sub>2</sub>O<sub>3</sub>, 3P<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O=Al<sub>2</sub>(H<sub>2</sub>PO<sub>4</sub>)<sub>3</sub> Deliquescent, completely sol in a little cold H<sub>2</sub>O, and conc solution can be boiled without decomp, but dil solution (1 20) separates Al<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub> on boiling, which redissolves on cooling, the more quickly the more dilute the original solution (Erlenmeyer, A 194 198)

**Aluminum pyrophosphate**, Al<sub>4</sub>(P O)<sub>7</sub>+10H<sub>2</sub>O

Precipitate Sol in mineral acids, and Na<sub>4</sub>P<sub>2</sub>O<sub>7</sub>+Aq, insol in acetic acid Sol in KOH+Aq, sol in NH<sub>4</sub>OH+Aq, but when dissolved in HCl+Aq is reprecipitated by NH<sub>4</sub>OH+Aq, and is not redissolved in an excess thereof (Schwarzenberg, A 65 147)

Sol in alum+Aq (Rose, Pogg 76 19)

**Aluminum pyrometaphosphate**, Al<sub>2</sub>O<sub>3</sub>, 2P<sub>2</sub>O<sub>5</sub> (Hautefeuille and Margottet, C R 96 849)

**Aluminum ammonium dihydrogen orthophosphate**, NH<sub>4</sub>H<sub>2</sub>PO<sub>4</sub>, AlPO<sub>4</sub>

Partially decomp by H<sub>2</sub>O Sol in acids and alkalis Nearly insol in 50% acetic acid (Cohen, J Am Chem Soc 1907, 29 720)

**Aluminum calcium phosphate**, Al<sub>2</sub>O<sub>3</sub>, 3CaO, P<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O

Min *Tanstockite*

2Al<sub>2</sub>O<sub>3</sub>, 6CaO, 3P<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O Min *Kurro-lite*

**Aluminum calcium phosphate sulphate**, 3Al<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>+6H<sub>2</sub>O

Min *Svanbergite* Scarcely attacked by HCl+Aq, and only sl by H<sub>2</sub>SO<sub>4</sub>+Aq

**Aluminum ferrous magnesium phosphate**, (Mg, Fe) Al<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+4H<sub>2</sub>O

Min *Childrenite* Slowly sol in HCl+Aq

Min *Eosphorite* Sol in HNO<sub>3</sub> or HCl+Aq

(Mg, Fe) Al<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+H<sub>2</sub>O Min *Lazulite* Only sl attacked by acids, when not previously ignited

**Aluminum lithium phosphate**, Al(PO<sub>4</sub>)<sub>2</sub>, 4Li<sub>3</sub>PO<sub>4</sub>+30H<sub>2</sub>O

Precipitate (Berzelius)

Insol in H<sub>2</sub>O, easily sol in acids

**Aluminum magnesium phosphate**

Min *Lazulite*

See Phosphate, aluminum ferrous magnesium

**Aluminum potassium phosphate**, Al<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, 2P<sub>2</sub>O<sub>5</sub>

Insol in acids (Ouvrard, A ch (6) 16 289)

2Al<sub>2</sub>O<sub>3</sub>, 2K<sub>2</sub>O, 3P<sub>2</sub>O<sub>5</sub> (Ouvrard)

**Aluminum silver metaphosphate**, 2Al<sub>2</sub>O<sub>3</sub>, Ag<sub>2</sub>O, 4P<sub>2</sub>O<sub>5</sub>

(Hautefeuille and Margottet, C R 96 849, 1142)

**Aluminum sodium pyrophosphate**,

Al Na (P O)<sub>2</sub>

Insol in H<sub>2</sub>O and acids (Wallroth)

Nearly insol in acids (Ouvrard A ch (6) 16 338)

2Al<sub>2</sub>O<sub>3</sub>, 3Na<sub>2</sub>O, 3P<sub>2</sub>O<sub>5</sub> Sol in HNO<sub>3</sub>+Aq (Ouvrard)

Al<sub>4</sub>(P<sub>2</sub>O<sub>7</sub>)<sub>2</sub>, 2Na<sub>4</sub>P O<sub>7</sub>+30H<sub>2</sub>O

Very difficultly sol in H<sub>2</sub>O (Pahl, Bull Soc (2) 22 122)

**Aluminum phosphate lithium fluoride**,

2Al(PO<sub>4</sub>)<sub>2</sub>, 3LiF

Min *Amblygonite* Sl attacked by HCl+Aq, more easily by H<sub>2</sub>SO<sub>4</sub>+Aq

**Ammonium metaphosphate**, NH<sub>4</sub>PO<sub>3</sub>

Insol in H<sub>2</sub>O (Fleitmann, Pogg 78 345)

**Ammonium dimetaphosphate**, (NH<sub>4</sub>) (PO<sub>3</sub>)<sub>2</sub>

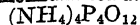
Sol in 1 15 pts cold or hot H<sub>2</sub>O (Fleitmann, Pogg 78 245) More sol in dil alcohol than Na or K salt

Sol in 0.9 pts  $H_2O$ , easily sol in acids especially by boiling with conc  $H_2SO_4$  (Glatzel, Dissert 1880)

**Ammonium trimetaphosphate,  $(NH_4)_3P_3O_9$**

Very sol in  $H_2O$  (Lindbom, Acta Lund 1873 15)

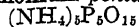
**Ammonium tetrametaphosphate,**



Sol in  $H_2O$  (Warschauer, Z anorg 1903, 36 177)

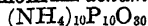
+4 $H_2O$  Much more sol in  $H_2O$  than the K or Na salt 1 pt is sol in 8 pts  $H_2O$  (Glatzel, Dissert 1880)

**Ammonium pentametaphosphate,**



Sol in  $H_2O$  (Tammann, J pr 1892, (2) 45 455)

**Ammonium dekametaphosphate,**



Very sl sol in  $H_2O$ , 100 g  $H_2O$  dissolved 1.20-1.54 g in 2 months Easily sol in hot  $H_2O$  with decomp (Tammann, J pr 1892, (2) 45 448)

+12 $H_2O$  (Tammann, J pr 1892, (2) 45 465)

**Ammonium orthophosphate,  $(NH_4)_3PO_4 + 3H_2O$**

Difficultly sol in  $H_2O$   
Less sol in  $H_2O$  than  $(NH_4)_2HPO_4$  (Berzelius)

Insol in alkalis+Aq (Berzelius)

Sl sol in  $H_2O$  Decomp in the air (Schottlander, Z anorg 1894, 7 344)

Solubility in  $H_2PO_4 + Aq$  at 25°

In 1000 g of the solution mols

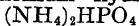
$NH_4$	$PO_4$
7 42	0 084
5 02	0 20
2 95	0 46
3 04	1 02
3 32	1 32
4 78	2 32

(D'Ans and Schreiner, Z phys Ch 1910, 75 105)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)

+5 $H_2O$  (Sestini, Gazz ch it 9 298)

**Ammonium hydrogen orthophosphate,**



Easily sol in  $H_2O$  Effloresces to form  $NH_4H_2PO_4$  (Schiff, A 112 88)

Sol in 4 pts cold, and less hot  $H_2O$  Solution loses  $NH_3$  by boiling Insol in alcohol

100 g  $H_2O$  dissolve 131 g at 15°, sp gr of sat solution = 1.343 (Greenish and Smith, Pharm J 1901, 66 774)

Solubility in  $H_2PO_4 + Aq$  at 25°

In 1000 g of the solution mols

$NH_4$	$PO_4$
6 42	3 23
6 46	3 74
6 56	4 01
6 78	4 34
7 26	4 83
7 16	4 82

(D'Ans and Schreiner, Z phys Ch 1910, 75 105)

Insol in acetone (Eidmann, C C 1899 II, 1014, Naumann, B 1904, 37 4329)

**Ammonium dihydrogen orthophosphate,  $NH_4H_2PO_4$**

Does not effloresce

Less easily sol in  $H_2O$  than  $(NH_4)_2HPO_4$  (Mitscherlich, A ch 19 385)

Sol in 5 pts cold, and less hot  $H_2O$

Solubility in  $H_2PO_4 + Aq$  at 25°

In 1000 g of the solution mols

$NH_4$	$PO_4$
6 72	4 54
5 62	3 88
4 62	3 36
2 72	2 59
2 50	2 51
2 58	4 29
2 76	6 21
3 06	7 70
3 10	7 86

(D'Ans and Schreiner, Z phys Ch 1910, 75 106)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)

**Ammonium orthophosphate, acid**

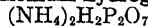
Decomp into  $NH_4H_2PO_4$  at 77-78° (Parravano and Miel, Gazz ch it 1908, 38, II 536)

**Ammonium pyrophosphate,  $(NH_4)_4P_2O_7$**

Easily sol in  $H_2O$  Alcohol precipitates it from the aqueous solution (Schwarzenberg, A 65 141)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)

**Ammonium hydrogen pyrophosphate**



Very sol in  $H_2O$  Insol in alcohol (Schwarzenberg, A 65 141)

**Ammonium barium trimetaphosphate,**  
 $(\text{NH}_4)_2\text{BaP}_3\text{O}_9 + \text{H}_2\text{O}$ Easily sol in  $\text{H}_2\text{O}$  (Lindbom)**Ammonium cadmium dimetaphosphate,**  
 $(\text{NH}_4)_2\text{O}, \text{CdO}, 2\text{P}_2\text{O}_5 + 3\text{H}_2\text{O} =$   
 $(\text{NH}_4)_2\text{Cd}(\text{P}_2\text{O}_6)_2$ 

Efflorescent (Fleitmann, Pogg 78 347)

**Ammonium cadmium orthophosphate,**  
 $\text{NH}_4\text{CdPO}_4 + 1\frac{1}{4}\text{H}_2\text{O}$ Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  and acids (Drewson, Gm K Handb 6te Aufl III 74)**Ammonium calcium dimetaphosphate,**  
 $(\text{NH}_4)_2\text{Ca}(\text{P}_2\text{O}_6)_2 + 2\text{H}_2\text{O}$ Very sl sol in  $\text{H}_2\text{O}$  Not decomp by acids (Fleitmann, Pogg 78 344)**Ammonium calcium phosphate,  $\text{NH}_4\text{CaPO}_4 + x\text{H}_2\text{O}$** 

Ppt (Herzfeld and Feuerlein, Z anal 20 191)

 $+7\text{H}_2\text{O}$  Not completely decomp by cold  $\text{H}_2\text{O}$  in  $\frac{3}{4}$  hour, rapidly by hot  $\text{H}_2\text{O}$  (Lasne, Bull Soc 1902, (3) 27 131)**Ammonium chromium orthophosphate, basic,**  
 $5(\text{NH}_4)\text{HPO}_4, 2\text{CrPO}_4, 4\text{Cr}(\text{OH})_3$ (Cohen, J Am Chem Soc 1907, 29 1196)  
 $(\text{NH}_4)_2\text{H}_2\text{PO}_4, 2\text{CrPO}_4 + 3\text{H}_2\text{O}$  Ppt (Cohen)**Ammonium chromic pyrophosphate,**  
 $\text{NH}_4(\text{CrP}_2\text{O}_7) + 6\text{H}_2\text{O}$ Sl sol in cold  $\text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}$  (Rosenheim, B 1915, 48 586)**Ammonium cobaltous metaphosphate**Extremely sol in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$  (Persoz, J pr 3 215)**Ammonium cobaltous orthophosphate,**  
 $\text{NH}_4\text{CoPO}_4 + \text{H}_2\text{O}$ Not decomp by boiling  $\text{H}_2\text{O}$  (Debray, J Pharm (3) 46 121) $+12\text{H}_2\text{O}$  Ppt (Chancel, 1862)  
 $\text{Co}(\text{NH}_4)_2\text{H}_2(\text{PO}_4)_2 + 4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Debray)**Ammonium copper dimetaphosphate,**  
 $(\text{NH}_4)_2\text{P}_2\text{O}_6, \text{CuP}_2\text{O}_6 + 2\text{H}_2\text{O}$ Very sl sol in  $\text{H}_2\text{O}$ , insol in alcohol (Fleitmann, Pogg 78 345) $+4\text{H}_2\text{O}$  Efflorescent Very sl sol in  $\text{H}_2\text{O}$ , insol in alcohol (F)Sol in 50 pts  $\text{H}_2\text{O}$  Slowly attacked by acids Only boiling  $\text{H}_2\text{SO}_4$  attacks easily (Glatzel, Dissert 1880)**Ammonium glaucinum orthophosphate,**  
 $\text{NH}_4\text{GlaPO}_4$ Insol in cold, sl sol in hot  $\text{H}_2\text{O}$  (Rossler, Z anal 17 148)**Ammonium glaucinum sodium orthophosphate,**  
 $(\text{NH}_4)_2\text{GlaNa}_2(\text{PO}_4) + 7\text{H}_2\text{O}$ 

(Scheffer, A 109 146)

**Ammonium iron (ferrous) orthophosphate,**  
 $\text{NH}_4\text{FePO}_4 + \text{H}_2\text{O}$ Insol even in boiling  $\text{H}_2\text{O}$  When still moist, easily sol in dil acids, but sparingly and slowly sol after drying, even in conc acids Decomp by  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq}$  Insol in alcohol (Otto, J pr 2 409) $(\text{NH}_4)_2\text{FeH}(\text{PO}_4)_2 + 4\text{H}_2\text{O}$  (Debray)**Ammonium iron (ferric) hydrogen orthophosphate, basic,**  
 $2(\text{NH}_4)_2\text{HPO}_4, 3\text{FePO}_4, 3\text{Fe}(\text{OH})_3$ 

Ppt Insol in 95% alcohol (Cohen, J Am Chem Soc 1907, 29 719)

**Ammonium iron (ferric) hydrogen orthophosphate,  $\text{NH}_4\text{H}_2\text{Fe}(\text{PO}_4)_2$** 

Ppt Same properties as Na salt (Weinland, Z anorg 1913, 84 356)

Partially hydrolyzed by  $\text{H}_2\text{O}$  Readily sol in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and  $\text{H}_3\text{PO}_4$  Partially hydrolyzed by cold  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in excess of hot  $\text{NH}_4\text{OH} + \text{Aq}$  Completely hydrolyzed by caustic alkalis Practically insol in 50% acetic acid (Cohen, J Am Chem Soc 1907, 29 718)**Ammonium lead dimetaphosphate,**  
 $(\text{NH}_4)_2\text{Pb}(\text{P}_2\text{O}_6)_2$ Very difficultly sol in  $\text{H}_2\text{O}$  and acids (Fleitmann, Pogg 78 343)**Ammonium lithium metaphosphate,  $\text{Li}_2\text{O}, 2(\text{NH}_4)_2\text{O}, 3\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$** Not appreciably sol in cold  $\text{H}_2\text{O}$  but rapidly and abundantly sol in  $\text{H}_2\text{O}$  at  $70^\circ$  (Lammann, J pr 1892, (2) 45 442)**Ammonium lithium phosphate,  $(\text{NH}_4)_2\text{LiPO}_4$** Sl sol in  $\text{H}_2\text{O}$  (Berzelius)**Ammonium magnesium metaphosphate,**  
 $(\text{NH}_4)_2\text{O}, 2\text{MgO}, 2\text{P}_2\text{O}_5 + 9\text{H}_2\text{O}$  (?)Sol with difficulty in  $\text{H}_2\text{O}$  or acids when heated Easily sol in  $\text{H}_2\text{O}$  before heating (Wach, Schw J 59 29)

Precipitated from aqueous solution by alcohol

**Ammonium magnesium dimetaphosphate,**  
 $(\text{NH}_4)_2\text{Mg}(\text{P}_2\text{O}_6)_2 + 6\text{H}_2\text{O}$ 

Efflorescent (Fleitmann, Pogg 78 346)

**Ammonium magnesium phosphate,**  
 $\text{NH}_4\text{MgPO}_4$ , and  $+6\text{H}_2\text{O}$ 1 l  $\text{H}_2\text{O}$  dissolves 66 mg anhydrous  $\text{NH}_4\text{MgPO}_4$  at  $15^\circ$  (Fresenius, A 55 109)1 l  $\text{H}_2\text{O}$  dissolves 741 mg anhydrous  $\text{NH}_4\text{MgPO}_4$  at  $20.5-22.5^\circ$  (Ebermayer)

1 l  $\text{H}_2\text{O}$  dissolves 106 mg anhydrous  $\text{NH}_4\text{MgPO}_4$  (Liebig)

Insol in  $\text{H}_2\text{O}$ , but when boiled with  $\text{H}_2\text{O}$  it loses  $\text{NH}_3$  and  $\text{H}_2\text{O}$  (Struve, Z anal 1898, 37 485)

Solubility of  $\text{NH}_4\text{MgPO}_4 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	G salt in 100 g $\text{H}_2\text{O}$
0	0 0231
20	0 0516
40	0 0359
50	0 0303
60	0 0401
70	0 0163
80	0 0195

(Wenger, Dissert Geneva, 1911)

Aqueous solution is precipitated by  $\text{NH}_4\text{OH}$ , but not by  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  (Fresenius)

Sol in 44,600 pts  $\text{H}_2\text{O}$  containing ammonia. More sol in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{Cl}$ , and is sol in 7548 pts of a solution containing 1 pt  $\text{NH}_4\text{Cl}$  to 5 pts  $\text{H}_2\text{O}$  and ammonia, and in 15,627 pts of a solution containing 1 pt of  $\text{NH}_4\text{Cl}$  to 7 pts  $\text{H}_2\text{O}$  and ammonia (Fresenius)

According to Kremers (J pr 55 190), a solution of 3 pts  $\text{H}_2\text{O}$  to 1 pt  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.96 sp gr is best suited for washing the precipitated  $\text{NH}_4\text{MgPO}_4$

According to Ebermayer (J pr 60 41), 1 pt anhydrous salt is sol in 13,497 pts  $\text{H}_2\text{O}$  at  $23^\circ$ , in 31,098 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (4 pts  $\text{H}_2\text{O}$  1 pt  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.961 sp gr) at  $21.25^\circ$ , in 36,764 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (3 pts  $\text{H}_2\text{O}$  1 pt  $\text{NH}_4\text{OH} + \text{Aq}$ ) at  $20.6^\circ$ , in 43,089 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (1 pt  $\text{H}_2\text{O}$  1 pt  $\text{NH}_4\text{OH} + \text{Aq}$ ) at  $22.5^\circ$ , in 45,206 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (1 pt  $\text{H}_2\text{O}$  2 pts  $\text{NH}_4\text{OH} + \text{Aq}$ ) at  $22.5^\circ$ , in 52,412 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (1 pt  $\text{H}_2\text{O}$  3 pts  $\text{NH}_4\text{OH} + \text{Aq}$ ) at  $22.5^\circ$ , in 60,883 pts pure  $\text{NH}_4\text{OH} + \text{Aq}$  (sp gr 0.961) at  $22.5^\circ$

Almost absolutely insol in  $\text{H}_2\text{O}$  containing  $\frac{1}{4}$  vol  $\text{NH}_4\text{OH} + \text{Aq}$  (sp gr 0.96) and  $\text{NH}_4\text{Cl}$ , i.e., much more insol than given by Fresenius (Kubel, Z anal 8 125)

According to Kissel (Z anal 8 173), 1 l  $\text{NH}_4\text{OH} + \text{Aq}$  (3 pts  $\text{H}_2\text{O}$  1 pt  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.96 sp gr) dissolves 4.98 mg in 24 hours, while 13.9 mg are dissolved if 18 g  $\text{NH}_4\text{Cl}$  to a litre of  $\text{H}_2\text{O}$  are also present

$(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  containing 2.2 g per litre dissolves 7.7 mg, 3.0 g, 113 mg, 10 g, 147 mg,  $\text{NaCl} + \text{Aq}$  containing 2 g  $\text{NaCl}$  per l dissolves 123.4 mg,  $\text{NaNO}_3 + \text{Aq}$  containing 3 g  $\text{NaNO}_3$  per l dissolves 93.1 mg (Liebig, A 106 196)

Completely insol in water containing ammonium phosphate or ammonium sodium phosphate (Berzelius)

800 ccm  $\text{H}_2\text{O}$ , sat with  $\text{CO}_2$ , dissolve 1.425 g (Liebig)

Easily sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$ , acetic and other

acids, also in boiling solution of ammonium citrate (Milot, Bull Soc (2) 18 20)

When in presence of Fe or Al salts it is sol to a considerable extent in  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$

6 g  $\text{NH}_4\text{Cl}$  in 100 ccm  $\text{H}_2\text{O}$  containing 10 ccm 6.34%  $\text{NH}_4\text{OH} + \text{Aq}$  dissolve pptd salt = 0.0029 g  $\text{Mg}_2\text{P}_2\text{O}_7$ , 1 g  $(\text{NH}_4)_2\text{C}_2\text{O}_4$  in 100 ccm  $\text{H}_2\text{O}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$  dissolve = 0.0061 g  $\text{Mg}_2\text{P}_2\text{O}_7$ , 2 g citric acid in excess of  $\text{NH}_4\text{OH} + \text{Aq}$  dissolve = 0.0147 g  $\text{Mg}_2\text{P}_2\text{O}_7$ . Solubility prevented by excess of magnesia mixture (Lando, C N 48 217)

Solubility of  $\text{NH}_4\text{MgPO}_4 + 6\text{H}_2\text{O}$  in salts + Aq at  $t^\circ$

(G salt dissolved in 100 g solvent)

$t^\circ$	5% $\text{NH}_4\text{NO}_3 + \text{Aq}$	5% $\text{NH}_4\text{Cl} + \text{Aq}$	1 pt $\text{NH}_4\text{OH}$ (D=0.96) + 4 pts $\text{H}_2\text{O}$
0	0 1100	0 0597	0 0087
20	0 0463	0 1055	0 0098
30	0 0546	0 1133	
40	0 0645	0 0713	0 0135
50	0 0723	0 0931	0 0153
60	0 0846	0 1728	0 0174
70	0 0834	0 1239	0 0178
80	0 1009	0 1913	0 0145

$t^\circ$	4% $\text{NH}_4\text{OH} + \text{Aq}$ and 5% $\text{NH}_4\text{Cl} + \text{Aq}$	4% $\text{NH}_4\text{OH} + \text{Aq}$ and 10% $\text{NH}_4\text{Cl} + \text{Aq}$
20	0 0165	0 0541
60	0 0274	0 0731

(Wenger, Dissert Geneva, 1911)

About 3 times as sol in  $\text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  as in  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , but solubility is prevented by excess of  $\text{MgCl}_2$  (Ville, Bull Soc (2) 18 316)

Sl sol in ammonium citrate + Aq containing 400 g ammonium citrate in a litre. Solubility = 0.457% at ord temp and 0.58% at  $50^\circ$  (Bolis, Ch Z 1903, 27 1151)

Min Struive  
+  $\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  or citric acid + Aq (Milot and Maquenne, Bull Soc (2) 23 238)

Ammonium magnesium hydrogen orthophosphate,  $(\text{NH}_4)_2\text{MgH}_2(\text{PO}_4)_2 + 3\text{H}_2\text{O}$  (?) (Graham)

Ammonium magnesium phosphate,  $5\text{MgO}$ ,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{P}_2\text{O}_5 + 24\text{H}_2\text{O}$  (Gawalovskiy, C C 1885 721)

Ammonium magnesium sodium pyrophosphate,  $(\text{NH}_4)_3\text{Mg}_2\text{Na}(\text{P}_2\text{O}_7)_4$

Insol in  $\text{H}_2\text{O}$  and not decomp thereby (Berthelot and André, A ch 1897, (3) 11 186)

**Ammonium manganous dimetaphosphate,**  
 $(\text{NH}_4)_2\text{Mn}(\text{PO}_3)_4 + 4\text{H}_2\text{O}$ 

Relatively easily attacked by acids (Glatzel, Dissert 1880)



Efflorescent (Fleitmann, Pogg 78 346)

**Ammonium manganous orthophosphate,**  
 $\text{NH}_4\text{MnPO}_4 + \text{H}_2\text{O}$ 

Sol in 32,092 pts cold, and 20,122 pts boiling  $\text{H}_2\text{O}$ , and in 17,755 pts  $\text{NH}_4\text{Cl} + \text{Aq}$  (1.4%  $\text{NH}_4\text{Cl}$ ) (Fresenius)

+7 $\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  below 70°, at 70° 100 g  $\text{H}_2\text{O}$  dissolve 0.0052 g salt, at 80°, 0.0067 (Wenger, Dissert Geneva, 1911)

Easily sol in dil acids Decomp by  $\text{KOH} + \text{Aq}$ , but not by  $\text{NH}_4\text{OH} + \text{Aq}$  or  $\text{K}_2\text{CO}_3 + \text{Aq}$  Insol in  $\text{NH}_4\text{OH}$  or  $\text{NH}_4$  salts + $\text{Aq}$  (Gibbs)

Solubility in salts + $\text{Aq}$  at  $t^\circ$   
(G in 100 g solvent)

$t^\circ$	5% $\text{NH}_4\text{NO}_3$ + $\text{Aq}$	5% $\text{NH}_4\text{Cl} + \text{Aq}$	1 pt $\text{NH}_4\text{OH}$ D = 0.96 +4 pts $\text{H}_2\text{O}$
0	0.0206	0.0020	0.0116
20	0.0200	0.0255	0.0122
30	0.0226	0.0345	
40	0.0209	0.0386	0.0118
50	0.0226	0.0355	0.0132
60	0.0270	0.0384	0.0193
70	0.0281	0.0414	0.0191
80	0.0326	0.0451	0.0197

(Wenger, l c)

Insol in alcohol

Insol in acetone (Naumann, B 1904, 37 4329)

**Ammonium manganic pyrophosphate,**  
 $\text{NH}_4\text{Mn}_2\text{P}_2\text{O}_7 + 3\text{H}_2\text{O}$ 

Decomp by cold  $\text{H}_2\text{O}$  with separation of  $\text{Mn}_2\text{O}_3$  (Rosenheim, B 1915, 48 584)

**Ammonium manganous sodium pyrophosphate,**  
 $\text{NH}_4\text{N} \cdot \text{Mn} \cdot \text{P}_2\text{O}_7 + 3\text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$  or alcohol Easily sol in very dil acids (Otto, J pr 2 418)

Formula is  $\text{N}_4(\text{NH}_4)_4\text{Mn}_2(\text{P}_2\text{O}_7)_3 + 12\text{H}_2\text{O}$ , according to Berzelius

**Ammonium mercuric metaphosphate**

Sol in  $\text{H}_2\text{O}$ , or at least in  $\text{NH}_4\text{OH} + \text{Aq}$  (Persoz, J pr 3 216)

**Ammonium nickel metaphosphate**

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , from which it is reprecipitated on evaporation of the  $\text{NH}_3$  (Persoz, J pr 3 215)

**Ammonium nickel dimetaphosphate,**  
 $(\text{NH}_4)_2\text{NiP}_2\text{O}_7 + 4\text{H}_2\text{O}$ 

Sol in 12.5 pts  $\text{H}_2\text{O}$  (Glatzel, Dissert 1880)

**Ammonium nickel orthophosphate,**  
 $\text{NH}_4\text{NiPO}_4 + 2\text{H}_2\text{O}$ 

Ppt (Debray, C R 59 40)  
+6 $\text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}$  (Debray)

**Ammonium potassium dimetaphosphate,**  
 $(\text{NH}_4)_2\text{K}_4(\text{P}_2\text{O}_6)_7$ 

More sol in  $\text{H}_2\text{O}$  than following salt (Fleitmann, Pogg 78 341)

$\text{NH}_4\text{K}_3\text{P}_4\text{O}_{12} + 2\text{H}_2\text{O}$  Difficultly sol in  $\text{H}_2\text{O}$  (Fleitmann)

**Ammonium potassium pyrophosphate,**  
 $\text{NH}_4\text{K}_2\text{HP}_2\text{O}_7 + \frac{1}{2}\text{H}_2\text{O}$ 

Deliquescent Sol in  $\text{H}_2\text{O}$  Decomp on boiling (Schwarzenberg)

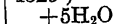
**Ammonium sodium dimetaphosphate,**  
 $\text{NH}_4\text{NaP}_2\text{O}_6 + \text{H}_2\text{O}$ 

More sol in  $\text{H}_2\text{O}$  than  $\text{Na}_2\text{P}_2\text{O}_6$ , but less than  $(\text{NH}_4)_2\text{P}_2\text{O}_6$  Less sol in alcohol than in  $\text{H}_2\text{O}$  (Fleitmann, Pogg 78 340)

**Ammonium sodium orthophosphate,**  
 $(\text{NH}_4)_2\text{NaPO}_4 + 4\text{H}_2\text{O}$ 

Decomp by  $\text{H}_2\text{O}$  Cryst from  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.96 sp gr From  $\text{H}_2\text{O}$  solution,  $\text{NaNH}_4\text{HPO}_4 + 4\text{H}_2\text{O}$  separates out (Uelsmann, Arch Pharm (2) 99 138)

Insol in acetone (Naumann, B 1904, 37 4329)



$\text{NH}_4\text{Na}_2\text{PO}_4 + 12\text{H}_2\text{O}$  (Herzfeld, Z anal 20 191)

$(\text{NH}_4)_3\text{Na}(\text{PO}_4)_2 + 6\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with decomp Cryst from hot conc  $\text{NH}_4\text{OH} + \text{Aq}$  (Uelsmann, Arch Pharm (2) 99 138)

**Ammonium sodium hydrogen phosphate (Microcosmic salt),**  
 $\text{NH}_4\text{NaHPO}_4 + 4\text{H}_2\text{O}$ 

Efflorescent Easily sol in  $\text{H}_2\text{O}$  Sol in 6 pts cold, and 1 pt boiling  $\text{H}_2\text{O}$  Insol in alcohol

Aqueous solution gives off  $\text{NH}_3$ , especially if hot

Insol in acetone (Fidmann, C C 1899, II 1014)

Min *Stercorite*

+5 $\text{H}_2\text{O}$  (Uelsmann)

The composition of the hydrates formed by this salt at different dilutions is calculated from determinations of the lowering of the fr-pt produced by the salt and of the conductivity and sp gr of its aqueous solutions (Jones Am Ch J 1905, 34 319)

$(\text{NH}_4)_3\text{Na}_2\text{H}_2(\text{PO}_4)_4 + 3\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Filhol and Senderens, C R 93 388)

**Ammonium sodium pyrophosphate,**  
 $(\text{NH}_4)_2\text{Na}_2\text{P}_2\text{O}_7 + 5\text{H}_2\text{O}$ 

Easily sol in  $\text{H}_2\text{O}$  Aqueous solution decomp by boiling (Schwarzenberg, A 65 142)  
+6 $\text{H}_2\text{O}$  (Rammelsberg)

**Ammonium sodium glucinum orthophosphate,**  
 $(\text{NH}_4)_2\text{Na}_2\text{G}(\text{PO}_4)_2 + 7\text{H}_2\text{O}$

Precipitate (Scheffer)

**Ammonium thalious orthophosphate,**  
 $(\text{NH}_4)_3\text{PO}_4$ ,  $(\text{NH}_4)_2\text{TiPO}_4$ , or  $\text{H}_2\text{NII}_2\text{PO}_4$ ,  
 $\text{HTl}_2\text{PO}_4$

Sol in  $\text{H}_2\text{O}$  (Lamy, Rammelsberg)

**Ammonium uranyl phosphate,**  
 $\text{NH}_4(\text{UO}_2)\text{PO}_4 + x\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  and  $\text{HC H}_3\text{O}_2 + \text{Aq}$  Sol in mineral acids, from which it is precipitated by  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ , in which it is insol (Knop)

+  $3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  and acetic acid Sol in all mineral acids, oxalic acid and  $\text{M}_2\text{CO}_3 + \text{Aq}$  (Lienau, Dissert 1898)

**Ammonium vanadium phosphate**

See Phosphovanadate, ammonium

**Ammonium zinc dimetaphosphate,**  
 $(\text{NH}_4)_2\text{Zn}(\text{P}_2\text{O}_5)_2 + 6\text{H}_2\text{O}$

Efflorescent (Fleitmann, Pogg 78 347)  
 +  $4\text{H}_2\text{O}$  Sol in 70 pts  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{SO}_4$  (Glatzel, Dissert 1880)

**Ammonium zinc orthophosphate, basic,**  
 $3\text{NH}_3$ ,  $2\text{ZnO}$ ,  $\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$

(Rother, A 1867, 143 356)  
 $4(\text{NH}_4)_2\text{O}$ ,  $6\text{ZnO}$ ,  $3\text{P}_2\text{O}_5 + 4\text{H}_2\text{O}$  (Schweikert, A 1868, 145 57)

**Ammonium zinc orthophosphate,  $\text{NH}_4\text{ZnPO}_4$**   
 +  $\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in acids, and caustic alkalis (Bette, A 15 129)

**Ammonium zinc hydrogen phosphate,**  
 $\text{NH}_4\text{H}_2\text{PO}_4$ ,  $\text{ZnHPO}_4 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Debray)  
 $4(\text{NH}_4)_2\text{O}$ ,  $6\text{ZnO}$ ,  $3\text{P}_2\text{O}_5$ , (Schweikert, A 145 57)  
 $3(\text{NH}_4)_2\text{O}$ ,  $4\text{ZnO}$ ,  $2\text{P}_2\text{O}_5 + 13\text{H}_2\text{O}$  (Rother, A 143 356)

**Ammonium phosphate selenate**

See Selenophosphate, ammonium

**Barium triphosphate,  $5\text{BaO}$ ,  $3\text{P}_2\text{O}_5$**

Insol in  $\text{H}_2\text{O}$ , insol in acids after heating to a high temp (Schwarz, Z anorg 1895, 9 264)

**Barium metaphosphate,  $\text{Ba}(\text{PO}_3)_2$**

Insol in  $\text{H}_2\text{O}$  or dil acids (Maddrell, A 61 61)

Not decomp by boiling with acids or alkali carbonates +  $\text{Aq}$  (Fleitmann, Pogg 78 352)

**Barium dimetaphosphate,  $\text{BaP}_2\text{O}_6 + 2\text{H}_2\text{O}$**

More difficultly sol in  $\text{H}_2\text{O}$  than  $\text{Ba}_3(\text{P}_3\text{O}_{10})_2$  Slightly attacked by boiling conc  $\text{HCl} + \text{Aq}$  or  $\text{HNO}_3 + \text{Aq}$  Easily decomp by  $\text{H}_2\text{SO}_4$  (Fleitmann, Pogg 78 254)

**Barium trimetaphosphate,  $\text{Ba}_3(\text{P}_3\text{O}_{10})_2 + 2\text{H}_2\text{O}$**

Somewhat sol in  $\text{H}_2\text{O}$  (Fleitmann, A 65 313)

+  $6\text{H}_2\text{O}$  Easily sol in  $\text{HCl} + \text{Aq}$  (Lindbom)

1 l  $\text{H}_2\text{O}$  dissolves 2 589 g at ord temp (Wiesler, Z anorg 1901, 28 198)

**Barium hexametaphosphate,  $\text{Ba}_3\text{P}_6\text{O}_{18}$  (?)**

Sol in  $\text{H}_2\text{O}$  only after boiling several hours

Nearly insol in  $\text{H}_2\text{O}$  (Ludert, Z anorg 5 15)

Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Wackenroder)

Sol in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$  Sol in  $\text{HNO}_3 + \text{Aq}$  After ignition it is nearly insol in  $\text{HNO}_3 + \text{Aq}$

**Barium orthophosphate,  $\text{Ba}_3(\text{PO}_4)_2$**

Precipitate Very sl sol or insol in  $\text{H}_2\text{O}$  (Graham, Pogg 32 49)

Sol in  $\text{HCl} + \text{Aq}$  Decomp by  $\text{SO}_2 + \text{Aq}$  Insol in methyl acetate (Naumann, B 1909, 42 3790)

**Barium hydrogen phosphate,  $\text{BaHPO}_4$**

Sol in 10,000 pts  $\text{H}_2\text{O}$  (Malaguti, A ch (3) 51 346)

Sol in 20,570 pts  $\text{H}_2\text{O}$  at  $20^\circ$  (Bischof, 1833)

Not completely soluble in water containing  $\text{CO}_2$ , but  $\text{BaCl}_2$  causes no ppt in  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  containing 7 16 g or less  $\text{Na}_2\text{HPO}_4$  in a litre after it has been saturated with  $\text{CO}_2$  (Setschenow, C C 1875 97)

Easily sol in  $\text{H}_3\text{PO}_4 + \text{Aq}$ , and dil  $\text{HCl} + \text{Aq}$   $\text{HNO}_3 + \text{Aq}$  of 1 275 sp gr if not diluted has scarcely any solvent action, but more dissolves on dilution until a maximum is reached, when 10 vols of  $\text{H}_2\text{O}$  have been added (Bischof, Schw J 67 39)

Sol in 367-403 pts acetic acid (1 032 sp gr) at  $22.5^\circ$  (Bischof, l c)

Easily sol in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4$  succinate, from which solutions it is completely pptd by  $\text{NII}_2\text{OH} + \text{Aq}$  (Rose)

Insol in  $\text{Na}_2\text{HPO}_4$  or  $\text{BaCl} + \text{Aq}$  (Rose, Pogg 76 23)

More sol in  $\text{BaCl}_2$  or  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ , 1 pt  $\text{BaHPO}_4$  being sol in 4362 pts  $\text{H}_2\text{O}$  containing 1 2%  $\text{NaCl}$  and 0 8%  $\text{BaCl}$  (Ludwig Arch Pharm (2) 56 265)

Sol in  $\text{Na citrate} + \text{Aq}$  (Spiller)

**Barium tetrahydrogen phosphate,**  
 $\text{BaH}_4(\text{PO}_4)_2$

Sol in  $\text{H}_2\text{O}$  (Mitscherlich, 1821)

Decomp by much  $\text{H}_2\text{O}$  into  $\text{BaHPO}_4$  Sol in phosphoric and certain other acids (Berzelius, A ch 2 153)

**Barium pyrophosphate,  $\text{Ba}_2\text{P}_2\text{O}_7 + x\text{H}_2\text{O}$**

Somewhat sol in  $\text{H}_2\text{O}$ , in much  $\text{H}_4\text{P}_2\text{O}_7 + \text{Aq}$ , also in  $\text{HCl} + \text{Aq}$  or  $\text{HNO}_3 + \text{Aq}$  Insol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  or  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  (Schwarzenberg)

Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Wackenroder)

**Barium hydrogen pyrophosphate**,  $\text{BaH}_2\text{P}_2\text{O}_7$ ,  
 $\text{Ba}_2\text{P}_2\text{O}_7 + 3\text{H}_2\text{O}$

Ppt (Knorre and Oppelt, B 21 773)

**Barium tetraphosphate**,  $\text{Ba}_3\text{P}_4\text{O}_{13}$

Insol in  $\text{H}_2\text{O}$  or acids when strongly heated  
 (Fleitmann and Henneberg, A 65 331)

**Barium manganic pyrophosphate**,

$\text{Ba}(\text{MnP}_2\text{O}_7)_2 + 5\text{H}_2\text{O}$

Almost insol in  $\text{H}_2\text{O}$  (Rosenheim, B 1915, 48 585)

**Barium potassium trimetaphosphate**,

$\text{BaK}_3\text{P}_3\text{O}_9 + \text{H}_2\text{O}$

Much less sol in  $\text{H}_2\text{O}$  than  $\text{NH}_4\text{BaP}_3\text{O}_9$  or  
 $\text{NaBaP}_3\text{O}_9$  (Lindbom)

Sol in  $\text{HCl} + \text{Aq}$  after ignition

**Barium potassium orthophosphate**,  $\text{BaKPO}_4$

Insol in  $\text{H}_2\text{O}$  (Ouvrard, A ch (6) 16 297)

+  $10\text{H}_2\text{O}$  (de Schulten, C R 96 706)

**Barium sodium dimetaphosphate**,

$\text{BaNa}_2(\text{P O})_2 + 4\text{H}_2\text{O}$

(Glatzel, Dissert 1880)

**Barium sodium trimetaphosphate**,  $\text{BaNaP}_3\text{O}_9$ ,  
 +  $4\text{H}_2\text{O}$

More easily sol in  $\text{H}_2\text{O}$  than  $\text{Ba}_3(\text{P}_3\text{O}_9)_2$   
 Sol in acids, unless ignited (Fleitmann and  
 Henneberg, A 65 314)

Efflorescent Sol in  $\text{HCl} + \text{Aq}$  after igni-  
 tion only by long boiling When fused it is  
 easily sol in  $\text{HCl} + \text{Aq}$  (Lindbom, Acta  
 Lund 1873 21)

**Barium sodium orthophosphate**,  $\text{BaNaPO}_4$ ,  
 +  $10\text{H}_2\text{O}$

(de Schulten, C R 96 706)

Not attacked by cold but decomp by hot  
 $\text{H}_2\text{O}$  (Villiers, C R 104 1103)

Sl sol in  $\text{H}_2\text{O}$  (Quartucci, C A 1911 2375)

**Barium sodium pyrophosphate**,

$\text{Ba}_2\text{Na}_4(\text{P O})_2$

Sol in hot  $\text{HCl}$  and  $\text{HNO}_3$  (Lammann,  
 J pr 1892, (2) 45 469)

$6\text{Ba}_2\text{P}_2\text{O}_7$ ,  $\text{Na}_4\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$  Completely  
 insol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , but not insol in  $\text{H}_2\text{O}$   
 or  $\text{NH}_4\text{OH} + \text{Aq}$  Easily sol in  $\text{HNO}_3$  or  $\text{HCl}$   
 +  $\text{Aq}$  Insol in alcohol (Baer, Pogg 75 164)

**Barium uranous metaphosphate**,  $\text{UO}_2$ ,  $\text{BaO}$ ,  
 $\text{P}_2\text{O}_5$

(Colani, A ch 1907, (8) 12 142)

**Barium uranyl orthophosphate**,  
 $\text{Ba}(\text{UO}_2)_2(\text{PO}_4)_2 + 8\text{H}_2\text{O}$

Min *Uranocircute*

**Barium phosphate chloride**,  $3\text{Ba}_3(\text{PO}_4)_2$ ,  
 $\text{BaCl}_2$

Min *Barytapatite* (Dewille and Caron, A  
 ch (3) 67 451)

$4\text{BaH}_2(\text{PO}_4)_2$ ,  $\text{BaCl}_2$  (Frlenmeyer, J B  
 1857 145)

$15\text{BaO}$ ,  $6\text{P}_2\text{O}_5$ ,  $\text{BaCl}_2 + 6\text{H}_2\text{O}$  (?) Sol in  
 18,000 pts cold  $\text{H}_2\text{O}$  Much more sol in  $\text{H}_2\text{O}$   
 containing  $\text{BaCl}_2$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{OH}$   
 (Ludwig Arch Pharm (2) 56 271)

**Bismuth orthophosphate, basic**,  $2\text{BiPO}_4$ ,  
 $3\text{Bi}_2\text{O}_3$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  (Cavazzi,  
 Gazz ch it 14 289)

**Bismuth orthophosphate**,  $\text{BiPO}_4$

Insol in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$  Sl sol in  
 $\text{NH}_4$  salts +  $\text{Aq}$  (Chancel, C R 50 416)

Not decomp by  $\text{H}_2\text{O}$  Other phosphates  
 of Bi are decomp by  $\text{H}_2\text{O}$  (Montmartin,  
 C C 1900, II 1256)

Not hydrolyzed by hot  $\text{H}_2\text{O}$ , sl sol in  $\text{BiCl}$   
 +  $\text{Aq}$ , decomp by boiling alkali (Caven,  
 J Soc Chem Ind 1897, 16 30)

More sol in  $\text{HCl} + \text{Aq}$  than in  $\text{HNO}_3 + \text{Aq}$   
 (Rose)

Sol in  $\text{UO}(\text{NO}_3)_2 + \text{Aq}$  (M'Curdy, Am J  
 Sci (2) 31 282)

Insol in  $\text{MNO}_3 + \text{Aq}$

Insol in Bi salts +  $\text{Aq}$  (Rose, Pogg 76  
 26)

Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$ , but insol in  $\text{NH}_4\text{NO}_3 +$   
 $\text{Aq}$  (Brett, 1837)

+  $1\frac{1}{2}\text{H}_2\text{O}$  (Kuhn)

+  $3\text{H}_2\text{O}$  Ppt Decomp by  $\text{H}_2\text{S}$  or  $\text{KOH}$   
 +  $\text{Aq}$  (Vannio, J pr 1906, (2) 74 151)

**Bismuth pyrophosphate, basic**,  $2\text{Bi O}_3$ ,  $\text{P O}_5$

Insol in  $\text{H}_2\text{O}$  and  $\text{HC H}_3\text{O} + \text{Aq}$  sol in  
 hot  $\text{HCl}$  and  $\text{HNO}_3 + \text{Aq}$  Insol in  $\text{Na}_2\text{P O}_7$   
 +  $\text{Aq}$ , and  $\text{NH}_4$  citrate +  $\text{Aq}$  (Passerini,  
 Cim 9 84)

**Bismuth pyrophosphate**,  $\text{Bi}_4(\text{P O})_3$

Insol in  $\text{H O}$  or  $\text{HNO}_3 + \text{Aq}$  (Chancel,  
 C R 50 416)

Decomp by  $\text{H}_2\text{O}$  (Wallroth, Bull Soc (2)  
 39 516)

Sol in  $\text{Na}_4\text{P O}_7 + \text{Aq}$  (Stromeier)

**Bismuth sodium pyrophosphate**,  $\text{NaBiP O}$   
 +  $3\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Rosenheim, B 1915, 48  
 583)

**Boron phosphate**,  $\text{BPO}_4$

Insol in  $\text{H}_2\text{O}$  Not attacked by boiling  
 alkalis (Meyer, B 22 29.9)



**Bromomolybdenum phosphate**

See under **Bromomolybdenum comps**

**Cadmium triphosphate,  $\text{Cd}_3(\text{P}_3\text{O}_{10})_2$** 

Insol in  $\text{H}_2\text{O}$  and acids (Gluhmann, Dissert 1899)

**Cadmium tetraphosphate,  $6\text{CdO}, 4\text{P}_2\text{O}_5 + 18\text{H}_2\text{O}$** 

Insol in acids (Gluhmann)

**Cadmium metaphosphate**

Verv sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Persoz, A ch 56 334)

**Cadmium dimetaphosphate,  $\text{Cd}(\text{PO}_3)_2 + 2\text{H}_2\text{O}$** 

Sol in 32 pts  $\text{H}_2\text{O}$  Scarcely attacked by acids, especially conc  $\text{H}_2\text{SO}_4$  (Glatzel, Dissert 1880)

**Cadmium tetrametaphosphate**

Insol in  $\text{H}_2\text{O}$  Easily decomp by  $\text{Na}_2\text{S} + \text{Aq}$  (Fleitmann, Pogg 78 358)

$\text{Cd}_2(\text{PO}_3)_4 + 10\text{H}_2\text{O}$  Not so very difficultly attacked by acids but insol after ignition (Glatzel, Dissert 1880)

**Cadmium orthophosphate,  $\text{Cd}_3(\text{PO}_4)_2$** 

Ppt Insol in  $\text{H}_2\text{O}$  Sol in Cd salts + Aq (Stromeyer)

Easily sol in  $\text{NH}_4$  sulphate, chloride, nitrate, or succinate + Aq (Wittstein, Repert 57 32)

$\text{H}_2\text{Cd}_3(\text{PO}_4)_4 + 4\text{H}_2\text{O}$  Sol in dil  $\text{H}_3\text{PO}_4 + \text{Aq}$  (de Schulten, Bull Soc (3) 1 473)

**Cadmium tetrahydrogen phosphate,**

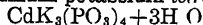
Decomp by great excess of  $\text{H}_2\text{O}$  (de Schulten)

**Cadmium pyrophosphate,  $\text{Cd}_2\text{P}_2\text{O}_7 + 2\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH}$ ,  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , or acids Insol in  $\text{KOH} + \text{Aq}$  Sol in  $\text{SO}_2 + \text{Aq}$  (Schwarzenberg, A 65 183)

**Cadmium hydrogen orthophosphate hydrate,  $\text{CdHPO}_4, 2\text{N}_2\text{H}_4$** 

Decomp by light (Franzen, Z anorg 1908, 60 283)

**Cadmium potassium tetrametaphosphate,**

Sol in 135 pts  $\text{H}_2\text{O}$  Difficultly decomp by acids (Glatzel, Dissert 1880)

**Cadmium potassium orthophosphate,**

Insol in  $\text{H}_2\text{O}$ , sol in dil  $\text{HCl} + \text{Aq}$  (Ouvrard, A ch (6) 16 321)

**Cadmium potassium pyrophosphate,**

Insol in  $\text{H}_2\text{O}$ , sol in dil  $\text{HCl} + \text{Aq}$  (Ouvrard)

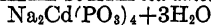
$5\text{Cd}_2\text{P}_2\text{O}_7, 4\text{K}_4\text{P}_2\text{O}_7 + 30\text{H}_2\text{O}$  Much more easily sol in  $\text{H}_2\text{O}$  than the  $\text{CdNa}$  salt (Pahl, Sv V A F 30, 7 39)

**Cadmium sodium triphosphate,  $\text{Na}_3\text{CdP}_3\text{O}_{10} + 12\text{H}_2\text{O}$** 

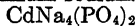
Sol in acids even after ignition (Gluhmann, Dissert 1899)

**Cadmium sodium trimetaphosphate,**

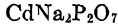
Sl sol in  $\text{H}_2\text{O}$  Insol in alcohol (Wiesler, Z anorg 1901, 28 204)

**Cadmium sodium tetrametaphosphate,**

Completely insol in  $\text{H}_2\text{O}$  (Glatzel, Dissert 1880)

**Cadmium sodium orthophosphate,**

Insol in  $\text{H}_2\text{O}$ , very sol in dil acids  $\text{CdNaPO}_4$  As above (Ouvrard)

**Cadmium sodium pyrophosphate,**

Sol in dil acids, even acetic acid (Wallroth)

$+4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Pahl, Sv V A F 30, 7 39)

**Cadmium phosphate bromide,  $3\text{Cd}_3(\text{PO}_4)_2, \text{CdBr}_2$** 

Sol in cold very dil  $\text{HNO}_3 + \text{Aq}$  (de Schulten, Bull Soc (3) 1 472)

**Cadmium phosphate chloride,  $3\text{Cd}_3(\text{PO}_4)_2, \text{CdCl}_2$** 

Sol in dil  $\text{HNO}_3 + \text{Aq}$  (de Schulten)

**Cæsium metaphosphate,  $\text{CsPO}_3$** 

Sol in  $\text{H}_2\text{O}$  (von Berg, B 1901, 34 4185)

**Cæsium orthophosphate,  $\text{Cs}_3\text{PO}_4 + 5\text{H}_2\text{O}$** 

Deliquescent, very sol in  $\text{H}_2\text{O}$  (von Berg)

**Cæsium hydrogen orthophosphate,  $\text{Cs}_2\text{HPO}_4 + \text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  (von Berg)

**Cæsium dihydrogen orthophosphate,**

Sol in  $\text{H}_2\text{O}$ , insol in alcohol (von Berg)

**Cæsium pyrophosphate,  $\text{Cs}_4\text{P}_2\text{O}_7$** 

Very sol in  $\text{H}_2\text{O}$ , very hygroscopic (von Berg)

**Calcium triphosphate,  $5\text{CaO}, 3\text{P}_2\text{O}_5$** 

Insol in  $\text{H}_2\text{O}$  (Schwarz, Z anorg 1895, 9 264)

**Calcium monometaphosphate,  $\text{Ca}(\text{PO}_3)_2$** 

Insol in  $\text{H}_2\text{O}$  and dil acids (Maddrell, A 61 61)

Not decomp by digestion with alkali carbonates + Aq (Fleitmann)

**Calcium dimetaphosphate,  $\text{Ca}_2(\text{P}_2\text{O}_5)_2 + 4\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  Decomp by warm  $\text{H}_2\text{SO}_4$ , but not appreciably by conc  $\text{HCl}$  or  $\text{HNO}_3$  + Aq (Fleitmann, Pogg 78 255)

**Calcium hexametaphosphate (?)**

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{Na}_3\text{P}_3\text{O}_{10} + \text{Aq}$  and in  $\text{HCl} + \text{Aq}$  (Rose, Pogg 76 3)

$\text{Ca}_3\text{P}_3\text{O}_{18}$  Nearly insol in  $\text{H}_2\text{O}$ , sol in dil acids (Ludert, Z anorg 5 15)

**Calcium orthophosphate, basic,  $3\text{Ca}_3(\text{PO}_4)_2 + \text{CaO}, \text{H}_2$** 

(Warrington, J B 1873 253)

$4\text{CaO}, \text{P}_2\text{O}_5$  (Hilgenstock)

**Calcium orthophosphates,**

Equilibrium in system  $\text{CaO} + \text{P}_2\text{O}_5 + \text{H}_2\text{O}$

Solubility of  $\text{CaO}$  in  $\text{P}_2\text{O}_5 + \text{Aq}$  at  $25^\circ$

g $\text{CaO}$ per l of solution	g $\text{P}_2\text{O}_5$ per l of solution	Solid phase
1 71	4 69	$\text{CaHPO}_4, 2\text{H}_2\text{O}$
7 48	22 39	
8 10	23 37	
11 57	36 14	
12 88	41 24	
18 77	59 35	
19 25	63 03	
23 31	75 95	
23 69	79 10	
32 41	109 8	
35 90	129 8	
39 81	139 6	
40 89	142 7	
43 82	154 6	
49 76	191 0	
55 52	216 5	
59 40	234 6	
70 31	279 7	
72 30	351 9	
69 33	361 1	
65 46	380 3	$\text{CaH}_4(\text{PO}_4)_2, \text{H}_2\text{O}$
63 53	395 1	
59 98	419 7	
59 25	424 6	
57 74	428 0	
53 59	451 7	
48 78	475 3	
44 52	505 8	
41 86	528 9	
39 89	538 3	

(Cameron and Seidell, J Am Chem Soc 1905, 27 1508)

Solubility of  $\text{CaO}$  in  $\text{P}_2\text{O}_5 + \text{Aq}$  at  $25^\circ$

g $\text{CaO}$ per l of solution	g $\text{P}_2\text{O}_5$ per l of solution	Solid phase
7 61	19 96	$\text{CaHPO}_4$
6 51	16 52	
5 01	12 82	
3 42	8 16	
2 42	5 75	
1 58	3 66	Solid phases are evidently solid solutions
0 544	1 516	
0 400	1 108	
0 291	0 773	
0 232	0 662	
0 145	0 381	$\text{Ca}_3(\text{PO}_4)_2$
0 062	0 109	
0 049	0 088	
0 034	0 015	
0 587	0 013	
0 789	0 012	Solid phase is probably a solid solution

(Cameron and Seidell, J Am Chem Soc 1905, 27 1513)

Solubility of  $\text{CaO}$  in  $\text{P}_2\text{O}_5 + \text{Aq}$  at  $50.7^\circ$

100 g of the solution contain		Solid phase
g $\text{P}_2\text{O}_5$	g $\text{CaO}$	
62 01	0 336	$\text{CaH}_4\text{P}_2\text{O}_8 + \text{CaH}_4\text{P}_2\text{O}_7 \cdot \text{H}_2\text{O}$
58 08	0 635	
54 67	0 939	$\text{CaH}_4\text{P}_2\text{O}_8 \cdot \text{H}_2\text{O} + \text{CaHPO}_4$
50 25	1 428	
46 15	2 100	
41 92	2 974	
37 33	3 898	
33 18	4 880	
29 61	5 725	
15 48	3 507	
9 465	2 328	
6 157	1 563	
2 946	0 852	$\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$
2 281	0 692	
0 1521	0 0588	
0 1527	0 0596	
0 1331	0 0514	
0 0942	0 0351	
0 0309	0 0106	
0 00068	0 00071	

(Bassett, Z anorg 1908, 59 15)



dissolves 190–240 mg  $\text{Ca}_3(\text{PO}_4)_2$  (Béchamp, A ch (4) 16 241)

Easily sol in  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$

100 pts very dil  $\text{HCl} + \text{Aq}$  dissolve 198–225 pts  $\text{Ca}_3(\text{PO}_4)_2$  (Crum, A 63 294)

100 pts  $\text{HCl}$  of 1.153 sp gr (containing 31%  $\text{HCl}$ ) dissolve at  $17^\circ$  when diluted with

0	1	4	7 pts $\text{H}_2\text{O}$
25 3	45 0	62 3	64 7 pts $\text{Ca}_3(\text{PO}_4)_2$
10	13	16	19 pts $\text{H}_2\text{O}$
68 0	71 9	69 5	69 7 pts $\text{Ca}_3(\text{PO}_4)_2$

(Bischof, Schw J 67 39)

Decomp by  $\text{H}_2\text{SO}_4$

Completely decomp to  $\text{CaSO}_4$  and  $\text{H}_3\text{PO}_4$  by a mixture of  $\text{H}_2\text{SO}_4$  and alcohol

Solubility in  $\text{HNO}_3 + \text{Aq}$

1 pt of  $\text{Ca}_3(\text{PO}_4)_2$  dissolves at  $16\text{--}25\text{--}17\text{--}5^\circ$  in pts  $\text{HNO}_3 + \text{Aq}$  which contain pts  $\text{H}_2\text{O}$  to 1 pt  $\text{HNO}_3$  (sp gr = 1.23)

Pts $\text{HNO}_3 + \text{Aq}$	Pts $\text{H}_2\text{O}$	Pts $\text{HNO}_3 + \text{Aq}$	Pts $\text{H}_2\text{O}$
2 72	0	30 64	10 754
4 23	0 827	26 48	13
10 25	3 309	32 14	13 236
15 45	5 791	36 06	15 718
20 34	8 273	127 81	40
20 82	10		

(Bischof, 1833)

More sol in acetic, lactic, malic, and tartaric acids than in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  (Crum)

Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$

G $\text{H}_3\text{PO}_4$ in 100 cc of $\text{H}_3\text{PO}_4 + \text{Aq}$	G $\text{Ca}_3(\text{PO}_4)_2$ dissolved by 100 cc of solvent
5	3 85
10	7 28
15	9 45
20	12 50
25	13 79
30	15 10

(Causse, C R 1892, 114 414)

Very small quantities of the salts of the alkali metals increase the solubility in  $\text{H}_2\text{O}$  (Lassaigne, J chim méd (3) 3 11)

1 litre cold  $\text{H}_2\text{O}$  with 2 g  $\text{NaCl}$  dissolves 45.7 mg  $\text{Ca}_3(\text{PO}_4)_2$ , with 3 g  $\text{NaNO}_3$ , 33 mg  $\text{Ca}_3(\text{PO}_4)_2$  (Liebig)

1 litre  $\text{H}_2\text{O}$  containing 8.75%  $\text{NaCl}$  dissolves 317.5 mg  $\text{Ca}_3(\text{PO}_4)_2$  (Lassaigne)

$\text{NH}_4$  salts have even more effect, especially  $\text{NH}_4\text{Cl} + \text{Aq}$ , which dissolves  $\text{Ca}_3(\text{PO}_4)_2$  in the cold, also ammonium nitrate and succinate (Wittstein)

$(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  dissolves  $\text{Ca}_3(\text{PO}_4)_2$  as easily as  $\text{CaSO}_4$  (Liebig, A 61 128)

1 litre  $\text{H}_2\text{O}$  containing 2 g  $\text{NaCl}$  dissolves at  $7\text{--}12\text{--}3^\circ$  45.7 mg  $\text{Ca}_3(\text{PO}_4)_2$ , 3 g  $\text{NaNO}_3$  at  $17\text{--}3^\circ$ , 33 mg  $\text{Ca}_3(\text{PO}_4)_2$ , 2.2 g  $(\text{NH}_4)_2\text{SO}_4$ , 76.7 mg  $\text{Ca}_3(\text{PO}_4)_2$  (Liebig, A 106 185)

Dry  $\text{Ca}_3(\text{PO}_4)_2$  also dissolves by long boiling with solutions of ammonium chloride, nitrate, succinate (Wittstein), or sulphate (Delkeskamp)

Sol in 89,448 pts  $\text{H}_2\text{O}$  (boiled) at  $7^\circ$ , 19,628 pts  $\text{H}_2\text{O}$  (boiled) containing 1%  $\text{NH}_4\text{Cl}$  at  $10^\circ$ , 4324 pts  $\text{H}_2\text{O}$  (boiled) containing 10%  $\text{NH}_4\text{Cl}$  at  $17^\circ$ , 1788 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  and containing 10%  $\text{NH}_4\text{Cl}$  at  $10^\circ$  and 751 mm pressure, 1351 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  and containing 1%  $\text{NH}_4\text{Cl}$  at  $12^\circ$  and 745 mm pressure, 42,313 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  and containing  $\text{CaCO}_3$  and 1%  $\text{NH}_4\text{Cl}$  at  $16^\circ$  and 746.1 mm pressure (Warrington, Chem Soc (2) 4 296)

Aqueous solutions of the following  $\text{NH}_4$  salts dissolve the given amts of  $\text{Ca}_3(\text{PO}_4)_2$ , calculated for 100 pts of the corresponding acid  $\text{NH}_4\text{Cl}$ , 0.655 pt,  $\text{NH}_4\text{NO}_3$ , 0.306 pt,  $(\text{NH}_4)_2\text{SO}_4$ , 1.050 pts,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , 0.255 pt,  $\text{NH}_4$  tartrate, 4.56 pts,  $\text{NH}_4$  citrate, 7.015 pts,  $\text{NH}_4$  malate, 1.125 pts  $\text{Ca}_3(\text{PO}_4)_2$  (Terrell, Bull Soc (2) 35 578)

Solubility in various salts +  $\text{Aq}$  under a  $\text{CO}_2$  pressure of 2 atmospheres, at  $14^\circ$

Salt	G salt per 100 g $\text{H}_2\text{O}$	G $\text{Ca}_3(\text{PO}_4)_2$ sol in 1 l of the solvent
$\text{H}_2\text{O}$		0 22848
$\text{NaCl}$	50 conc	1 3208 0 64089
$\text{MgCl}_2 + 6\text{H}_2\text{O}$	86 9 conc	1 2873 2 8923
$\text{KMgCl}_3 + 6\text{H}_2\text{O}$	79 2 conc	1 5771 1 1536
$\text{K}_2\text{SO}_4$ , $\text{MgSO}_4$ , $\text{MgCl}_2 + 6\text{H}_2\text{O}$	70 95 conc	1 7777 2 4911
$\text{NaNO}_3$	72 7 conc	1 5827 0 8638
$\text{K}_2\text{SO}_4$	74 5 conc	4 9041 4 7649
$(\text{NH}_4)_2\text{SO}_4$	56 5 conc	2 4131 5 8849
$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	137 7 conc	2 4911 3 2267
$\text{MgSO}_4 + 7\text{H}_2\text{O}$	105 3 conc	1 9728 3 6001
$\text{NH}_4\text{Cl}$	45 74 conc	1 3710 1 2929

(Ehlert and Hempel, Z Elektrochem 1912, 18 728)

$\text{Ca}_3(\text{PO}_4)_2$  is sol in  $\text{K}_2\text{C}_2\text{O}_4 + \text{Aq}$  100 ccm  $\text{K}_2\text{C}_2\text{O}_4 + \text{Aq}$  ( $1\frac{1}{2}\%$   $\text{K}_2\text{C}_2\text{O}_4$ ) dissolves 57.1% of the  $\text{P}_2\text{O}_5$  from phosphorite, 71% from guano by boiling 25 min. At ord temp bone meal gives up 50–80% of its  $\text{P}_2\text{O}_5$  to  $\text{K}_2\text{C}_2\text{O}_4 + \text{Aq}$  in 36 hours (Liebig, Landw J B 1881 603). Sol in  $\text{Ca}$  succrate +  $\text{Aq}$  (Bobierre, C R 32 859).

More sol in  $\text{H}_2\text{O}$  containing starch, glue, or other animal substances than in pure  $\text{H}_2\text{O}$  (Vauquelin, Pogg 85 126).

Sol in  $\text{H}_2\text{O}$  containing organic matter, therefore when bones decay under  $\text{H}_2\text{O}$ ,  $\text{Ca}_3(\text{PO}_4)_2$  is dissolved in considerable quantity (Hayes, Edin Phil J 5 378).

Sol in sodium citrate +  $\text{Aq}$  (Spiller).

Solubility in  $\text{NH}_4$  citrates +  $\text{Aq}$ .

Ammonium citrate solution of 1.09 sp gr at 30–35° dissolves precipitated  $\text{Ca}_3(\text{PO}_4)_2$  completely, but not phosphorite (Fresenius).

*Dried on the air, with  $2\frac{1}{8}\text{H}_2\text{O}$*  Sol in 40 min in diammonium citrate +  $\text{Aq}$  (sp gr = 1.09), triammonium citrate +  $\text{Aq}$  (sp gr =

1.09) dissolves 55.3% of the  $\text{P}_2\text{O}_5$ , citric acid +  $\text{Aq}$  ( $\frac{1}{4}\%$ ) dissolves 83.8% of the  $\text{P}_2\text{O}_5$  (Erlenmeyer, B 14 1253).

*Dried at 50°, with  $1\frac{1}{8}\text{H}_2\text{O}$*  Sol in 45 min in diammonium citrate +  $\text{Aq}$  (sp gr = 1.09), triammonium citrate +  $\text{Aq}$  dissolves 52.3% of the  $\text{P}_2\text{O}_5$  (Erlenmeyer).

*Ignited* Diammonium citrate +  $\text{Aq}$  (sp gr 1.09) dissolves 93% of the  $\text{P}_2\text{O}_5$ , triammonium citrate +  $\text{Aq}$  (sp gr 1.09) dissolves 32% of the  $\text{P}_2\text{O}_5$ , citric acid ( $\frac{1}{4}\%$ ) dissolves 53.4% of the  $\text{P}_2\text{O}_5$  (Erlenmeyer).

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827).

Insol in alcohol and ether.

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314).

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329).

Min *Apatite*

0.002 g is sol in 1 l  $\text{H}_2\text{O}$

0.014 " " " " 1 l  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  (Joffre, Bull Soc 1898, (3) 19 374).

+  $\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$ , in  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$ , and in  $\text{H}_2\text{O}$  containing  $\text{CO}_2 + \text{CaH}_2(\text{CO}_3)_2$   
Temp 16°–20°

Solvent	In 1 l of the filtrate	
	$\text{P}_2\text{O}_5$ mg	$\text{CaO}$ mg
(1) Boiled distilled $\text{H}_2\text{O}$	0 74	
(2) 1200 cc distilled $\text{H}_2\text{O} + 50$ cc $\text{H}_2\text{O}$ sat with $\text{CO}_2$	6 9	
(3) 1000 cc " " + 250 cc " " " "	48 5	
(4) 1250 cc $\text{H}_2\text{O}$ sat with $\text{CO}_2$	91 9	
Solutions of $\text{CO}_2 + \text{CaH}_2(\text{CO}_3)_2$ 1 l (filtered) contains		
(5) { Calcium carbonate	13 mg	100 0
{ Bicarbonate { Carbonate	166 "	
{ Free carbonic acid { Carbonic acid	73 "	
	9 "	
(6) { Calcium carbonate	13 "	162 3
{ Bicarbonate { Carbonate	277 "	
{ Free carbonic acid { Carbonic acid	122 "	
	49 "	
(7) { Calcium carbonate	13 "	218 8
{ Bicarbonate { Carbonate	376 "	
{ Free carbonic acid { Carbonic acid	165 "	
	105 "	
(8) { Calcium carbonate	13 "	273 3
{ Bicarbonate { Carbonate	475 "	
{ Free carbonic acid { Carbonic acid	209 "	
	206 "	
(9) { Calcium carbonate	13 "	312 7
{ Bicarbonate { Carbonate	545 "	
{ Free carbonic acid { Carbonic acid	240 "	
	301 "	

**Calcium hydrogen phosphate,  $\text{CaHPO}_4$ , and  $+2\text{H}_2\text{O}$**

Insol or nearly so in  $\text{H}_2\text{O}$  Gradually decomp by cold, more quickly by hot  $\text{H}_2\text{O}$

1000 pts  $\text{H}_2\text{O}$  dissolve 0.135–0.152 pt  $\text{CaHPO}_4 + 2\text{H}_2\text{O}$  Solution clouds up on boiling (Birnbaum)

1000 pts  $\text{H}_2\text{O}$  dissolve 0.28 pt, and if sat with  $\text{CO}_2$ , 0.66 pt  $\text{CaHPO}_4 + 2\text{H}_2\text{O}$  (Dusart and Pelouze)

When this salt dissolves in  $\text{H}_2\text{O}$ , decomp takes place and a very considerable time is necessary to establish equilibrium (Rundell, C R 1902, 134 112)

Much less decomp by  $\text{H}_2\text{O}$  than  $\text{Ca}_3(\text{PO}_4)_2$  or  $\text{CaH}_4(\text{PO}_4)_2$ , and the decomposition of this salt in water depends only slightly upon the relative amounts of solid and solvent which are present The decomposition is increased by the addition of  $\text{CO}_2$  The presence of  $\text{CaSO}_4$  or of  $\text{CaCO}_3$  decreased the amount of phosphoric acid which dissolved See original paper (Cameron and Seidell, J Am Chem Soc 1904, 26 1460)

When the ratio of  $\text{P}_2\text{O}_5$  :  $\text{CaO}$  is above 1.0 or below 1.27,  $\text{H}_2\text{O}$  dissolves 0.40–0.54 g  $\text{CaO}$  and 1.11–1.52 g  $\text{P}_2\text{O}_5$  (see original paper) (Cameron and Bell, J Am Chem Soc 1905, 27 1512)

**Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$**

G $\text{H}_3\text{PO}_4$ in 100 cc $\text{H}_3\text{PO}_4 + \text{Aq}$	G $\text{CaHPO}_4$ dissolved by 100 cc of solvent
5	4.30
10	7.15
15	9.30
20	11.86
25	13.40
30	15.10

(Causse, C R 1892, 114 415)

1 l  $\text{H}_2\text{O}$  containing 2.2 g  $(\text{NH}_4)_2\text{SO}_4$ , 2 g  $\text{NaCl}$ , or 3 g  $\text{NaNO}_3$  dissolves 79.2, 66.3, or 78.9 mg  $\text{CaH}_2\text{P}_2\text{O}_7$ , which is present in form of  $\text{CaHPO}_4$  (Liebig, A 106 185) Slowly but completely sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$  (Kraut, Arch Pharm (2) 111 102) Easily sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Gerland, J pr (2) 4 123) Very sol in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  Less sol in  $\text{HC}_2\text{H}_3\text{O}_2$  (Berzelius) More sol in dil than conc  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , but 60 pts  $\text{HC}_2\text{H}_3\text{O}_2$  (1 mol) dissolve at most 23.1 pts  $\text{P}_2\text{O}_5$  (1 mol = 142 pts) from this compound Aqueous solution of sodium acetate dissolves more easily than  $\text{H}_2\text{O}$ , and becomes turbid on boiling (Birnbaum)

Completely sol in  $\text{K}_2\text{C}_2\text{O}_4 + \text{Aq}$  (Liebig, Landw J B 1881 603)

1 l of sat solution in N/200 acid K tartrate +  $\text{Aq}$  at 25° contains 0.235 g  $\text{CaHPO}_4$

Insol in alcohol Sol in many organic substances, as starch or gelatine +  $\text{Aq}$

Insol in acetone (Eidmann, C C 1899, II 1014)

$+1/3\text{H}_2\text{O}$  (Vorbringer, Z anal 9 457)  
 $+ \text{H}_2\text{O}$  (Gerlach, J pr (2) 4 104)  
 $+ 2\text{H}_2\text{O}$  Min *Brushite*  
 $+ 3\text{H}_2\text{O}$  Min *Metabrushite*  
 $+ 5\text{H}_2\text{O}$  (Dusart, C R 66 327)

**Calcium tetrahydrogen orthophosphate,  $\text{CaH}_4(\text{PO}_4)_2 + \text{H}_2\text{O}$**

Very deliquescent Crystals take up 97.7 pts  $\text{H}_2\text{O}$  in 16 days, and 226 pts  $\text{H}_2\text{O}$  in 28 days from air saturated with moisture (Birnbaum, Zeit Ch (2) 7 131)

Not hygroscopic when pure (Stocklassa, B 23 626 R)

Completely sol in 100 pts  $\text{H}_2\text{O}$ , but decomp by 10–40 pts  $\text{H}_2\text{O}$  with separation of  $\text{CaHPO}_4$ , which slowly dissolves (Erlenmeyer, J B 1873 254)

Later (B 9 1839) Erlenmeyer says  $\text{CaH}_4(\text{PO}_4)_2 + \text{H}_2\text{O}$  is sol in 700 pts  $\text{H}_2\text{O}$  and decomp into  $\text{CaHPO}_4$  by a less amount of  $\text{H}_2\text{O}$  Wattenberg (Z anal 19 243) says that the decomposition by small amts of  $\text{H}_2\text{O}$  down to 144 pts  $\text{H}_2\text{O}$  to 1 pt salt is inappreciable

Completely sol in 200 pts  $\text{H}_2\text{O}$  if pure, and in less  $\text{H}_2\text{O}$  in presence of  $\text{H}_3\text{PO}_4$  (Stocklassa)

Sol in 25 pts  $\text{H}_2\text{O}$  at 15° Solution begins to decompose when warmed to 50° (Otto, C C 1887 1563)

Greatly decomp by  $\text{H}_2\text{O}$  and the resulting solution is to be regarded as a solution of the decomposition products rather than of the substance itself The presence of an excess of  $\text{CaSO}_4$  does not materially affect the amount of phosphoric acid entering the solution (Cameron, J Am Chem Soc 1904, 26 1462)

Violently decomp by  $\text{H}_2\text{O}$  in conc solution, only sl decomp when dissolved in 200 pts  $\text{H}_2\text{O}$  (Stocklassa, Z anorg 1892, 1 310)

**Solubility of  $\text{CaH}_2\text{P}_2\text{O}_8$  in  $\text{H}_3\text{PO}_4 + \text{Aq}$  at pressure of 745 mm at high temp**

$\frac{m}{g}$	100 g of the solution contain		Solid phase
	G $\text{P}_2\text{O}_5$	G $\text{CaO}$	
115°	43.60	5.623	$\text{CaH}_2\text{P}_2\text{O}_8, \text{H}_2\text{O} + \text{CaHPO}_4$
132°	53.43	4.327	$\text{CaH}_4\text{P}_2\text{O}_8 + \text{CaH}_2\text{P}_2\text{O}_8, \text{H}_2\text{O}$
169°	63.95	4.489	$\text{CaH}_4\text{P}_2\text{O}_8$

(Bassett, Z anorg 1908, 59 26)

Glacial  $\text{HC}_2\text{H}_3\text{O}_2$  ppts it completely from aqueous solution even in presence of  $\text{HNO}_3$  (Persoz)

Decomp by 50 pts absolute alcohol at b-pt in 1 hour, by 30 pts in 2 hours Sol in absolute ether (Erlenmeyer, l c)

**Calcium pyrophosphate,  $\text{Ca}_2\text{P}_2\text{O}_7 + 4\text{H}_2\text{O}$** 

Somewhat sol in  $\text{H}_2\text{O}$ , completely sol in mineral acids, less sol in acetic acid, and in sol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  (Schwarzenberg, A 65 145) Less sol in warm than in cold acetic acid (Baer, Pogg 75 155)

Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Wackenroder, A 41 316)

Insol in  $\text{CaCl}_2 + \text{Aq}$

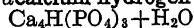
Min *Pyrophosphorite*

**Calcium hydrogen pyrophosphate,  $\text{CaH}_2\text{P}_2\text{O}_7 + 2\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Pahl, B 7 478)

$2\text{CaH}_2\text{P}_2\text{O}_7, \text{Ca}_2\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$  Decomp by boiling with  $\text{H}_2\text{O}$  into—

$\text{CaH}_2\text{P}_2\text{O}_7, \text{Ca}_2\text{P}_2\text{O}_7 + 3\text{H}_2\text{O}$  Insol in hot  $\text{H}_2\text{O}$  (Knorre and Oppelt, B 21 771)

**Tetracalcium hydrogen phosphate,**

Ppt Insol in  $\text{H}_2\text{O}$ , but decomp by boiling therewith Sol in acids (Warrington, Chem Soc (2) 4 296)

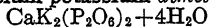
$+ 2\text{H}_2\text{O}$

**Calcium tetrphosphate,  $\text{Ca}_3\text{P}_4\text{O}_{13}$** 

Insol in acids when ignited (Fleitmann and Henneberg, A 65 331)

**Calcium lithium phosphate,  $\text{CaLiPO}_4$** 

Insol in  $\text{H}_2\text{O}$  (Rose, Pogg 77 298)

**Calcium potassium dimetaphosphate,**

As BaK comp (Glatzel, Dissert 1880)

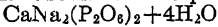
**Calcium potassium orthophosphate,  $\text{CaKPO}_4$** 

Insol in  $\text{H}_2\text{O}$  (Rose, Pogg 77 291)

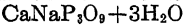
Easily sol in acids (Ouvrard, A ch (6) 16 308)

**Calcium potassium pyrophosphate,  $\text{CaK}_2\text{P}_2\text{O}_7$** 

Insol in  $\text{H}_2\text{O}$ , easily sol in dil acids (Ouvrard, C R 106 1599)

**Calcium sodium dimetaphosphate,**

As BaNa comp (Glatzel)

**Calcium sodium trimetaphosphate,**

Sl sol in  $\text{H}_2\text{O}$  (Fleitmann, A 65 315)

Easily sol in  $\text{H}_2\text{O}$  Difficultly sol in  $\text{HCl} + \text{Aq}$  when heated to redness Easily sol in boiling  $\text{HCl} + \text{Aq}$  after being fused (Findhorn)

**Calcium sodium orthophosphate,  $\text{CaNaPO}_4$** 

Insol in  $\text{H}_2\text{O}$  (Rose, Pogg 77 292)

Easily sol in dil acids (Ouvrard, A ch (6) 16 308)

$3\text{CaO}, 3\text{Na}_2\text{O}, 2\text{P}_2\text{O}_5$  Sol in dil acids (Ouvrard, C R 1888, 106 1599)

**Calcium sodium pyrophosphate,  $\text{CaNa}_2\text{P}_2\text{O}_7 + 4\text{H}_2\text{O}$** 

Insol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  Easily sol in  $\text{HCl} + \text{Aq}$ ,  $\text{HNO}_3 + \text{Aq}$ , and also in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Baer, Pogg 75 159)

$\text{Ca}_{10}\text{Na}_{16}(\text{P}_2\text{O}_7)_9$  Sol in acids (Wallroth, Bull Soc (2) 39 316)

$3\text{CaO}, 3\text{Na}_2\text{O}, 2\text{P}_2\text{O}_5$  Easily sol in acids (Ouvrard, A ch (6) 16 307)

**Calcium thorium metaphosphate,  $\text{ThO}_2, \text{CaO}, \text{P}_2\text{O}_5$** 

(Colani, C R 1909, 149 209)

**Calcium uranous metaphosphate,  $\text{UO}_2, \text{CaO}, \text{P}_2\text{O}_5$** 

Insol in acids (Colani, A ch 1907, (8) 12 140)

**Calcium uranyl phosphate,  $\text{Ca}(\text{UO}_2)_2\text{H}_2(\text{PO}_4)_2 + 2, 3, \text{ or } 4\text{H}_2\text{O}$** 

Sol in  $\text{HNO}_3 + \text{Aq}$  (Debray)

$\text{Ca}(\text{UO}_2)_2(\text{PO}_4)_2 + 8\text{H}_2\text{O}$  Min *Uranite*

Sol in  $\text{HNO}_3 + \text{Aq}$   
 $3\text{CaO}, 5\text{UO}_3, 2\text{P}_2\text{O}_5 + 16\text{H}_2\text{O}$  (Blinkoff, Dissert 1900)

**Calcium phosphate chloride,  $\text{Ca}_3(\text{PO}_4)_2, \text{CaCl}_2$** 

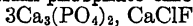
(Deville and Caron, A ch (3) 67 458)

$3\text{Ca}_3(\text{PO}_4)_2, \text{CaCl}_2$  *Chlorapatite* Insol in  $\text{H}_2\text{O}$  (Daubrée, Ann Min (4) 19 684)

$7\text{CaH}_4(\text{PO}_4)_2, \text{CaCl}_2 + 14\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$

$4\text{CaH}_4(\text{PO}_4)_2, \text{CaCl}_2 + 8\text{H}_2\text{O}$

$\text{CaH}_4(\text{PO}_4)_2, \text{CaCl}_2 + 2\text{H}_2\text{O}$  Partly sol in  $\text{H}_2\text{O}$  with decomp Also with  $8\text{H}_2\text{O}$  (Erlenmeyer, J B 1857 145)

**Calcium phosphate chloride fluoride,**

Min *Apatite* Boiling  $\text{H}_2\text{O}$  dissolves out  $\text{CaCl}_2$ , dil mineral acids dissolve easily, acetic acid with more difficulty Easily soluble in molten  $\text{NaCl}$ , crystallizing on cooling (Forchhammer)

**Calcium phosphate silicate,  $\text{Ca}_3(\text{PO}_4)_2, \text{Ca}_3\text{SiO}_4$** 

Insol in  $\text{H}_2\text{O}$ , decomp by  $\text{HCl} + \text{Aq}$  (Carnot and Richard, C R 97 316)

$4\text{Ca}_3(\text{PO}_4)_2, \text{Ca}_3\text{SiO}_5$  (Bucking and Linck, C C 1887 562)

$4\text{Ca}_3(\text{PO}_4)_2, 3\text{Ca}_3\text{SiO}_5$  (B and I)

$\text{Ca}(\text{PO}_3)_2, \text{CaSiO}_3$  (Stead and Ridsdat, Chem Soc 51 601)

**Calcium dihydrogen phosphate sulphite,  $\text{CaH}_2(\text{PO}_4)_2, \text{CaSO}_3 + \text{H}_2\text{O}$** 

Not decomp by cold, slowly by boiling  $\text{H}_2\text{O}$  Slightly sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in mineral acids Insol in cold, slowly sol in boiling acetic acid More sol in a solution of oxalic acid (Gerland, C N 20 268)

**Cerous metaphosphate,  $\text{Ce}(\text{PO}_3)_3$** 

(Rammelsberg)  
 $\text{Ce}_2\text{O}_3, 5\text{P}_2\text{O}_5$  Insol in  $\text{H}_2\text{O}$  or acids  
 (Johnsson, B 22 976)

**Cerous orthophosphate,  $\text{CePO}_4$** 

Insol in  $\text{H}_2\text{O}$  Easily sol in acids  
 (Grandeau, A ch (6) 8 193)  
 Insol in acids (Hartley, Proc Roy Soc 41 202)  
 $+2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in acids  
 (John)  
 Insol in  $\text{H}_3\text{PO}_4 + \text{Aq}$ , sl sol in  $\text{HCl}$  or  
 $\text{HNO}_3 + \text{Aq}$  (Hisinger)  
 Insol in  $\text{HNO}_3 + \text{Aq}$  (Boussingault, A ch (5) 5 178)  
 Min *Cryptolite* Completely decomp by  
 $\text{H}_2\text{SO}_4$  when finely powdered Insol in dil  
 $\text{HNO}_3 + \text{Aq}$

**Ceric orthophosphate,  $4\text{CeO}_2, 6\text{P}_2\text{O}_5 + 26\text{H}_2\text{O}$**   
Ppt (Hartley, Proc Roy Soc 41 202)**Cerous pyrophosphate,  $\text{Ce}_2\text{H}_4(\text{P}_2\text{O}_7)_6 + 6\text{H}_2\text{O}$**   
Sol in cerous nitrate + Aq  
 $\text{Ce}_4(\text{P}_2\text{O}_7)_3 + 12\text{H}_2\text{O}$  Sol in excess of  
sodium pyrophosphate + Aq Easily sol in  
 $\text{HCl}$  (Rosenheim, B 1915, 48 592)**Cerous lanthanum thorium phosphate,**  
 $(\text{Ce}, \text{La}, \text{Th})_2(\text{PO}_4)_2$ 

Min *Monazite* Sol in  $\text{HCl} + \text{Aq}$  with  
 white residue

**Cerous potassium orthophosphate,  $2\text{Ce}_2\text{O}_3, 3\text{K}_2\text{O}, 3\text{P}_2\text{O}_5 = 2\text{CePO}_4, \text{K}_3\text{PO}_4$**   
Insol in  $\text{H}_2\text{O}$ , sol in acids (Ouvrard, C R 107 37)**Cerous sodium orthophosphate,  $\text{Ce}_2\text{O}_3, 3\text{Na}_2\text{O}, 2\text{P}_2\text{O}_5 = \text{CePO}_4, \text{Na}_3\text{PO}_4$**   
Insol in  $\text{H}_2\text{O}$  (Ouvrard, C R 107 37)**Cerous sodium pyrophosphate,  $\text{CeNaP}_2\text{O}_7$**   
Insol in acetic, and cold dil mineral acids  
Sol in warm acids (Wallroth)**Chromous phosphate,  $\text{Cr}_3(\text{PO}_4)_2$** 

Insol in  $\text{H}_2\text{O}$  Easily sol in citric, tartaric  
 and acetic acids Sl sol in  $\text{H}_2\text{CO}_3 + \text{Aq}$   
 (Moissan, A ch 1882, (5) 25 415)  
 $+ \text{H}_2\text{O}$  Precipitate Easily sol in acids  
 (Mobeig, Moissan, A ch (5) 21 199)

**Chromic metaphosphate,  $\text{Cr}_2(\text{PO}_3)_6$** 

Insol in  $\text{H}_2\text{O}$  or conc acids (Maddrell, A 61 53)

**Chromic orthophosphate,  $\text{CrPO}_4$** 

Hydrolyzed by hot  $\text{H}_2\text{O}$  Somewhat sol  
 in  $\text{NH}_4\text{OH} + \text{Aq}$  and in  $\text{Cr}_2(\text{SO}_4)_3 + \text{Aq}$   
 (Caven, J Soc Chem Ind 1897, 16 29)  
 Insol in methyl acetate (Naumann, B

1909, 42 3790), ethyl acetate (Naumann,  
 B 1910, 43 314)

**Chromic phosphate,  $\text{Cr}_2(\text{PO}_4)_3 + 12\text{H}_2\text{O}$** 

*Violet modification* Precipitate (Ram-  
 melsberg, Pogg 68 383)  
 $+ 6\text{H}_2\text{O}$  *Green modification* Very sl  
 sol in  $\text{H}_2\text{O}$  and still less in  $\text{NH}_4\text{NO}_3$  or  
 $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Carnot, C R 94 1313)  
 Insol in acetic, but easily sol in mineral  
 acids Easily sol in cold  $\text{KOH}$  or  $\text{NaOH} +$   
 $\text{Aq}$ , from which it is separated on boiling  
 (Dowling and Plunkett, Chem Gaz 1858  
 220)

**Chromic hydrogen phosphate,  $\text{Cr}_2\text{H}_6(\text{PO}_4)_4 + 16\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Haushofer)

**Chromic pyrophosphate,  $\text{Cr}_4(\text{P}_2\text{O}_7)_3$** 

*Anhydrous* Insol in  $\text{H}_2\text{O}$  or acids (Ouv-  
 rard, A ch (6) 16 344)  
 $+ 7\text{H}_2\text{O}$  Precipitate Sol in strong  
 mineral acids,  $\text{SO}_2 + \text{Aq}$ ,  $\text{KOH} + \text{Aq}$ , and  
 $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  (Schwarzenberg, A 65 149)  
 Insol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  (Stromeyer)

**Chromic potassium phosphate,  $\text{Cr}_2\text{O}_3, \text{K}_2\text{O}, 2\text{P}_2\text{O}_5$** 

Insol in  $\text{H}_2\text{O}$  and in acids (Ouvrard, A  
 ch (6) 16 289)

**Chromic potassium pyrophosphate,**  
 $\text{K}(\text{CrP}_2\text{O}_7) + 5\text{H}_2\text{O}$ 

Sl sol in cold  $\text{H}_2\text{O}$  Decomp by boiling  
 $\text{H}_2\text{O}$  (Rosenheim, B 1915, 48 586)  
 $\text{Cr}_2\text{K}_2\text{H}_4(\text{P}_2\text{O}_7)_3$  Insol in  $\text{H}_2\text{O}$ , acids, or  
 alkalis Sl decomp by boiling conc  $\text{H}_2\text{SO}_4$   
 (Schjerning, J pt (2) 45 515)

**Chromic silver phosphate,  $2\text{Cr}_2\text{O}_3, 2\text{Ag}_2\text{O}, 5\text{P}_2\text{O}_5$** 

(Hautefeuille and Murgottet, C R 96  
 1142)

**Chromic sodium orthophosphate,  $\text{Na}_2\text{HPO}_4, 2\text{CrPO}_4 + 5\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  (Cohen, J Am Chem  
 Soc 1907, 29 1197)

**Chromic sodium pyrophosphate,**  
 $\text{Cr}_2\text{Na}(\text{P}_2\text{O}_7)_2$ 

Insol in acids (Wallroth, Bull Soc (2)  
 39 316)  
 $+ 10\text{H}_2\text{O}$ , and  $16\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$   
 Decomp by boiling  $\text{H}_2\text{O}$  (Rosenheim, B  
 1915, 48 586)

**Cobaltous monometaphosphate,  $\text{Co}(\text{PO}_3)_2(?)$** 

Insol in  $\text{H}_2\text{O}$  and dil acids Sl in conc  
 $\text{HCl} + \text{Aq}$  (Maddrell, A 58 61)



**Cobaltous dimetaphosphate,  $\text{Co}_2(\text{P}_2\text{O}_5)_2$** 

Insol in cold conc  $\text{H}_2\text{SO}_4$ , sl sol on warming, but sol in  $\text{H}_2\text{O}$  after treating with  $\text{H}_2\text{SO}_4$ . Sol in conc  $\text{NH}_4\text{OH} + \text{Aq}$ . Scarcely attacked by boiling  $\text{Na}_2\text{S} + \text{Aq}$  (Fleitmann)

**Cobaltous hexametaphosphate (?)**

Ppt Sol in sodium hexametaphosphate +  $\text{Aq}$  (Rose, Pogg 76 4)

**Cobaltous orthophosphate,  $\text{Co}_3(\text{PO}_4)_2 + x\text{H}_2\text{O}$** 

Sol in  $\text{H}_3\text{PO}_4 + \text{Aq}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ , sl sol in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Salvetat, C R 48 295) Sol in Co salts +  $\text{Aq}$  +  $2\text{H}_2\text{O}$  (Debray, A ch (3) 61 438) +  $8\text{H}_2\text{O}$  (Revnoso, C R 34 795)

**Cobaltous hydrogen orthophosphate,**

$\text{CoHPO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$   
Ppt (Debray)  
+  $2\frac{1}{2}\text{H}_2\text{O}$  Ppt Insol in  $\text{H}_2\text{O}$  Sol in  $\text{H}_3\text{PO}_4 + \text{Aq}$  (Bodeker, A 94 357)

**Cobaltous tetrahydrogen orthophosphate,  $\text{CoH}_4(\text{PO}_4)_2$** 

Sol in  $\text{H}_2\text{O}$  (Reynoso)

**Cobaltous pyrophosphate**

Ppt Sol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  (Stromeyer)  
Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Schwarzenberg)

**Cobaltous pyrometaphosphate,  $3\text{CoO}, 2\text{P}_2\text{O}_5$** 

(Braun)  
 $6\text{CoO}, 5\text{P}_2\text{O}_5$  (Braun)

**Cobaltous potassium phosphate,  $\text{CoKPO}_4$** 

Insol in  $\text{H}_2\text{O}$ , easily sol in dil acids (Ouvrard, C R 106 1729)  
 $3\text{CoO}, 3\text{K}_2\text{O}, 2\text{P}_2\text{O}_5$  As above

**Cobaltous sodium triphosphate,  $\text{NaCo}_2\text{P}_3\text{O}_{10}$** 

(Schwarz, Z anorg 1895, 9 260)  
 $\text{Na}_3\text{CoP}_3\text{O}_{10} + 12\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$ , decomp in aq solution Sol in acids (Schwarz, Z anorg 1895, 9 258)

**Cobaltous sodium metaphosphate,**

$\text{Co}_3\text{Na}_2(\text{PO}_3)_3$   
Insol in  $\text{H}_2\text{O}$  or acids, even conc  $\text{H}_2\text{SO}_4$  (Watts' Dict)

**Cobaltous sodium monometaphosphate,**

$6\text{Co}(\text{PO}_3)_2, 2\text{NaPO}_3$   
Insol in  $\text{H}_2\text{O}$  and dil acids Sol in conc  $\text{H}_2\text{SO}_4$  (Maddrell, A 61 57)

**Cobaltous sodium trimetaphosphate,**

$\text{CoNa}_3(\text{PO}_3)_3 + 8\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Fleitmann and Henneberg, A 65 315)

**Cobaltous sodium orthophosphate,  $\text{CoNaPO}_4$** 

Insol in  $\text{H}_2\text{O}$  (Ouvrard, C R 106 1729)  
 $\text{Co}_3(\text{PO}_4)_2, 2\text{Na}_2\text{HPO}_4 + 8\text{H}_2\text{O}$  (Debray, J Pharm (3) 46 119)

**Cobaltous sodium pyrophosphate,**

$\text{Co}_{10}\text{Na}_{18}(\text{P}_2\text{O}_7)_3$   
Insol in  $\text{H}_2\text{O}$  Sol in acids (Wallroth)  
+  $x\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Stromeyer)

**Cobaltous zinc phosphate,  $\text{Co}_3(\text{PO}_4)_2, 3\text{Zn}_3(\text{PO}_4)_2 + 12\text{H}_2\text{O}$** 

Ppt Sol in acids (Gentele)  
 $\text{CoZn}_2(\text{PO}_4)_2 + 6\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$

**Columbium phosphate (?)**

Insol in  $\text{H}_2\text{O}$  (Blomstrand)

**Cupric dimetaphosphate,  $\text{Cu}_2(\text{P}_2\text{O}_5)_2$** 

Insol in  $\text{H}_2\text{O}$  Sol in conc  $\text{H}_2\text{SO}_4$  (Maddrell, A 61 62) Insol in most conc acids and in alkalies, except hot  $\text{NH}_4\text{OH} + \text{Aq}$  or conc  $\text{H}_2\text{SO}_4$ , in which it is moderately sol. Not decomp by  $\text{H}_2\text{S}$ , but by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ , less easily by  $\text{Na}_2\text{S}$ , and  $\text{K}_2\text{S} + \text{Aq}$  (Fleitmann, Pogg 78 242)  
+  $8\text{H}_2\text{O}$  Completely insol in  $\text{H}_2\text{O}$  (Fleitmann)

**Cupric hexametaphosphate (?)**

Sol in  $\text{Na}_4\text{P}_6\text{O}_{18} + \text{Aq}$  or  $\text{CuCl}_2 + \text{Aq}$  (Rose, Pogg 76 5)  
 $\text{Cu}_2\text{P}_6\text{O}_{18}$  Easily sol in  $\text{H}_2\text{O}$  or acids, especially when freshly pptd (Ludert, Z anorg 5 15)

**Cupric orthophosphate, basic,  $6\text{CuO} \cdot \text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$** 

Min *Phosphocalcite*  
 $5\text{CuO}, \text{P}_2\text{O}_5 + 2\text{H}_2\text{O}$  Min *Dihydrate*  
+  $3\text{H}_2\text{O}$  Min *Ehrlite* Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , and  $\text{HNO}_3 + \text{Aq}$   
 $4\text{CuO}, \text{P}_2\text{O}_5 + \text{H}_2\text{O}$  Slowly sol in  $\text{NH}_4\text{OH}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , insol in cold  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Steinschneider, C C 1891, II 51)  
Sl sol in  $\text{CuCl}_2 + \text{Aq}$  and  $\text{CuSO}_4 + \text{Aq}$   
Decomp by boiling  $\text{H}_2\text{O}$  and boiling  $\text{Aq}$  potash (Caven, J Soc Chem Ind 1897, 16 29)

Min *Labethenite* Sol in acids and  $\text{NH}_4\text{OH} + \text{Aq}$   
+  $2\text{H}_2\text{O}$  Min *Pseudolabethenite* Sol in acids and  $\text{NH}_4\text{OH} + \text{Aq}$   
+  $3\text{H}_2\text{O}$  Min *Taqbite* Sol in acids and  $\text{NH}_4\text{OH} + \text{Aq}$

**Cupric triphosphate,  $5\text{CuO}, 3\text{P}_2\text{O}_5 + 13\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  (Schwarz, Z anorg 1895, 9 262)

**Cupric dimetaphosphate,  $\text{CuP}_2\text{O}_6 + 4\text{H}_2\text{O}$** 

Sol in 78 pts  $\text{H}_2\text{O}$  Easily decomp by hot conc  $\text{H}_2\text{SO}_4$  (Glatzel, Dissert 1880)

**Cupric trimetaphosphate**,  $\text{Cu}_3(\text{P}_3\text{O}_9)_2 + 9\text{H}_2\text{O}$ 

Verv sl sol in  $\text{H}_2\text{O}$  (0.04 g in 1 l at  $20^\circ$ )  
(Tammann, J pr 1892, (2) 45 425)

**Cupric tetrametaphosphate**,  $\text{Cu}_2\text{P}_4\text{O}_{12}$ 

Insol in  $\text{H}_2\text{O}$  and in  $\text{HCl}$  Sl sol in boiling  $\text{HNO}_3$  Very sol in boiling conc  $\text{H}_2\text{SO}_4$   
(Glatzel)

+  $8\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$  Slowly attacked by acids except conc  $\text{H}_2\text{SO}_4$   
(Glatzel)

**Cupric orthophosphate**,  $\text{Cu}_3(\text{PO}_4)_2 + 3\text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$ , easily sol in acids, even  $\text{H}_3\text{PO}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{SO}_3 + \text{Aq}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Sl sol in  $\text{NH}_4$  salts +  $\text{Aq}$   
Sl sol in  $\text{Cu}$  salts +  $\text{Aq}$  (Rose, Pogg 76 25)

Sol in cold  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Steinschneider, C C 1891, II, 51)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 827)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

**Cupric hydrogen phosphate**,  $\text{CuHPO}_4 + \frac{1}{2}\text{H}_2\text{O} (?)$ 

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{H}_3\text{PO}_4 + \text{Aq}$ , and  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  Insol in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett, Phil Mag (3) 10 98)

**Cupric pyrophosphate, basic**,  $\text{Cu}_2\text{P}_2\text{O}_7, 2\text{CuO}, \text{H}_2\text{O} + 3\text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$  (Pahl, J B 1873 229)

**Cupric pyrophosphate**,  $\text{Cu}_2\text{P}_2\text{O}_7$ 

*Anhydrous* Insol in  $\text{H}_2\text{O}$ , and very sl sol in conc acids (Fleitmann, Pogg 78 244)

As insol as  $\text{Cu}$  metaphosphate, but decomp by  $\text{H}_2\text{S}$  (Rose, Pogg 76 14)

+  $2\text{H}_2\text{O}$  Sol in mineral acids, and  $\text{NH}_4\text{OH} + \text{Aq}$ , also in  $\text{Na}_4\text{F}_2\text{O}_7 + \text{Aq}$  (Schwarzenberg, A 65 156)

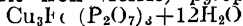
Sol in cold  $\text{H}_2\text{SO}_3 + \text{Aq}$  without decomp, crystallizing out on boiling

Decomp by boiling  $\text{KOH} + \text{Aq}$

Sol in large excess of  $\text{CuSO}_4 + \text{Aq}$

+  $2\frac{1}{2}\text{H}_2\text{O}$  (Pahl, Sv V A F 30, 7 40)

+  $5\text{H}_2\text{O}$  Verv sl sol in  $\text{H}_2\text{O}$   
Sol in dil acids (Wiesler, Z anorg 1901, 28 202)

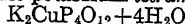
**Cupric iron (ferric) pyrophosphate**,

Ppt (Pascal, C R 1908, 146 233)

**Cupric potassium phosphate**,  $4\text{CuO}, \text{K}_2\text{O}, 3\text{P}_2\text{O}_5$ 

Insol in  $\text{H}_2\text{O}$  (Ouvrard, C R 111 177)

$\text{CuKPO}_4$  As above

**Cupric potassium tetrametaphosphate**,

Sol in 58 pts  $\text{H}_2\text{O}$  Easily attacked by acids (Glatzel, Dissert 1880)

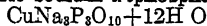
**Cupric potassium pyrophosphate**,  $\text{CuK}_2\text{P}_2\text{O}_7$ 

Extremely easily sol in  $\text{H}_2\text{O}$  (Persoz, A ch (3) 20 315)

$\text{Cu}_2\text{P}_2\text{O}_7, 3\text{K}_4\text{P}_2\text{O}_7 + 4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$   
(Pahl, Sv V A F 30, 7 44)

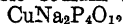
**Cupric sodium phosphate**,  $\text{Cu}_2\text{Na}_6(\text{PO}_4)_4$ 

Insol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  Sol in conc acids (Wallroth, Bull Soc (2) 39 316)

**Cupric sodium triphosphate**,

Sl sol in  $\text{H}_2\text{O}$ , very unstable

Easily sol in acids (Stange, Z anorg 1896, 12 458)

**Cupric sodium tetrametaphosphate**,

As insol in  $\text{H}_2\text{O}$  as  $\text{Cu}$  dimetaphosphate  
Difficultly decomp by digestion with  $\text{Na}_2\text{S} + \text{Aq}$  (Fleitmann, Pogg 78 355)

+  $4\text{H}_2\text{O}$  Sol in 45 pts  $\text{H}_2\text{O}$  (Glatzel, Dissert 1880)

**Cupric sodium orthophosphate**,  $3\text{Cu}_3(\text{PO}_4)_2, \text{Na}_4\text{H}_2\text{P}_4\text{O}_{12}$ 

Decomp by  $\text{H}_2\text{O}$  to  $4\text{CuO}, \text{P}_2\text{O}_5$  (Steinschneider, C C 1891, II 52)

$2\text{Cu}_3(\text{PO}_4)_2, \text{Na}_4\text{HPO}_4$  Decomp by  $\text{H}_2\text{O}$  into—

$3\text{Cu}_3(\text{PO}_4)_2, \text{Na}_4\text{HPO}_4$  Decomp by  $\text{H}_2\text{O}$  (S)

$\text{Cu}_4(\text{PO}_4)_2, \text{Na}_4\text{H}_2\text{P}_4\text{O}_{12}$  Decomp by  $\text{H}_2\text{O}$  (S)

$6\text{Cu}_3(\text{PO}_4)_2, 2\text{Na}_3\text{PO}_4$  Decomp by  $\text{H}_2\text{O}$  (S)

**Cupric sodium pyrophosphate**,  $\text{CuNa}_2\text{P}_2\text{O}_7$ 

Insol in  $\text{H}_2\text{O}$  (Fleitmann and Henneberg, A 65 387)

+  $\frac{2}{3}\text{H}_2\text{O}$  (F and H) Much more sol than the next salt (Pahl)

+  $6\text{H}_2\text{O}$  (Persoz, A ch (3) 20 315)

$\text{CuP}_2\text{O}_7, \text{CuNa}_2\text{P}_2\text{O}_7 + 3\frac{1}{2}\text{H}_2\text{O}$  Verv efflorescent, insol in  $\text{H}_2\text{O}$  (F and H)

+  $10\frac{1}{2}\text{H}_2\text{O}$  (Pahl, Sv V A F 30, 7 42)

$\text{CuNa}_2\text{P}_2\text{O}_7, \text{Na}_4\text{P}_2\text{O}_7$  Sol in  $\text{H}_2\text{O}$  (F and H)

+  $2\text{H}_2\text{O}$  (F and H)

+ 12, and 16  $\text{H}_2\text{O}$  Very efflorescent, and sol in  $\text{H}_2\text{O}$  (Pahl)

$\text{Cu}_3\text{Na}_2\text{P}_4\text{O}_{14} + 10\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl}$  and  $\text{HNO}_3$  even after heating

(Stange, Z anorg 1896, 12 456)

**Cupric uranyl phosphate**,  $(\text{UO}_2)_2\text{Cu}(\text{PO}_4)_2 + 8\text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$ , easily sol in acids (Debray)

Min *Chalcolite* Sol in  $\text{HNO}_3 + \text{Aq}$

**Cupric orthophosphate ammonia**,  $\text{Cu}_3(\text{PO}_4)_2 \cdot 4\text{NH}_3$ 

Sl sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$  (Schiff, A 123 41)

$2\text{CuO}$ ,  $3\text{P}_2\text{O}_5$ ,  $20\text{NH}_3 + 21\text{H}_2\text{O}$  Easily sol in cold  $\text{H}_2\text{O}$ , with subsequent decomp (Metzner, A 149 66)

$2\text{CuO}$ ,  $\text{P}_2\text{O}_5$ ,  $6\text{NH}_3$  (Maumené)

**Cupric pyrophosphate ammonia**,  $8\text{CuO}$ ,  $3\text{P}_2\text{O}_5$ ,  $4\text{NH}_3 + 4\text{H}_2\text{O}$ 

Sl sol in  $\text{H}_2\text{O}$  (Schwarzenberg, A 65 133)

$\text{Cu}_2\text{P}_2\text{O}_7$ ,  $4\text{NH}_3 + \text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Schiff, A 123 1)

**Didymium metaphosphate**,  $\text{D}_1(\text{PO}_3)_3$ 

Precipitate (Smith)

$\text{D}_1\text{O}_3$ ,  $5\text{P}_2\text{O}_5$  Insol in  $\text{H}_2\text{O}$  (Cleve)

**Didymium phosphate**,  $2\text{D}_1\text{O}_3$ ,  $3\text{P}_2\text{O}_5$ 

Insol in  $\text{H}_2\text{O}$  (Ouvrard, C R 107 37)

**Didymium orthophosphate**,  $\text{D}_1\text{PO}_4$ 

Insol in  $\text{H}_2\text{O}$  Very sl sol in dil, easily sol in conc acids (Marignac) Insol in  $\text{H}_2\text{O}$  (Wallroth, Bull Soc (2) 39 316)

$+\text{H}_2\text{O}$  (Frerichs and Smith, A 191 355)

**Didymium trihydrogen phosphate**,

$\text{D}_1\text{H}_3(\text{PO}_4)_3$

Precipitate (Frerichs and Smith)

Existence is doubtful (Cleve, B 12 910)

**Didymium hexahydrogen phosphate**,

$\text{D}_1\text{H}_6(\text{PO}_4)_2 + \text{H}_2\text{O}$

Precipitate (Hermann)

**Didymium pyrophosphate**,  $\text{D}_1(\text{P}_2\text{O}_7)_3 + 6\text{H}_2\text{O}$ 

Precipitate (Cleve)

**Didymium hydrogen pyrophosphate**,

$\text{D}_1\text{H}_3(\text{P}_2\text{O}_7)_3$

Precipitate Sol in disodium pyrophosphate + Aq (Frerichs and Smith, A 191 355)

Does not exist (Cleve)

**Didymium potassium phosphate**,  $2\text{D}_1\text{O}_3$ ,

$3\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5 = 2\text{D}_1\text{PO}_4$ ,  $\text{K}_3\text{PO}_4$

Insol in  $\text{H}_2\text{O}$  (Ouvrard, C R 107 37)

**Didymium sodium orthophosphate**,  $\text{D}_1\text{O}_3$ ,

$3\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5 = \text{D}_1\text{PO}_4$ ,  $\text{Na}_3\text{PO}_4$

Insol in  $\text{H}_2\text{O}$  (Ouvrard)

**Didymium sodium pyrophosphate**,  $\text{D}_1\text{O}_3$ ,

$\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5 = \text{D}_1\text{NaP}_2\text{O}_7$

Insol in  $\text{H}_2\text{O}$  (Ouvrard C R 107 37)

**Dysprosium orthophosphate**,  $\text{DyPO}_4 + 5\text{H}_2\text{O}$ 

Nearly insol in  $\text{H}_2\text{O}$

Easily sol in dil acids or acetic acid (Jantsch, B 1911, 44 1276)

**Erbium phosphate**,  $\text{ErPO}_4 + \text{H}_2\text{O}$ 

Precipitate

**Erbium pyrophosphate**,  $\text{ErHP}_2\text{O}_7 + 3\frac{1}{2}\text{H}_2\text{O}$ 

Scarcely sol in boiling  $\text{H}_2\text{O}$  Slowly sol in acids

**Erbium sodium pyrophosphate**,  $\text{ErNaP}_2\text{O}_7$ 

Precipitate (Wallroth)

**Glucinum metaphosphate**,  $\text{Gl}(\text{PO}_3)_2$ 

Insol in  $\text{H}_2\text{O}$  and acids (Bleyer, Z anorg 1912, 79 274)

**Glucinum orthophosphate, basic**

$2\text{Gl}_3\text{P}_2\text{O}_8$ ,  $\text{GlO} + 13\text{H}_2\text{O}$

Ppt (Bleyer, Z anorg 1912, 79 268)

**Glucinum orthophosphate**,  $\text{Gl}_3(\text{PO}_4) + 6\text{H}_2\text{O}$ 

Precipitate Insol in  $\text{H}_2\text{O}$  Sol in acids (Atterberg, Sv V A Handl 12, 5 33)

1 l 2%  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  dissolves 0.55 g of the anhydrous salt, 1 l 10%  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  dissolves 1.725 g (Sestini, Gazz ch it 20 313)

$+7\text{H}_2\text{O}$  (Atterberg)

**Glucinum hydrogen orthophosphate**,  $\text{GlHPO}_4 + 3\text{H}_2\text{O}$ 

$\text{GlH}_4(\text{PO}_4)_2$  hygroscopic (Bleyer, Z anorg 1912, 79 266)

Precipitated by alcohol (Atterberg)

**Glucinum phosphate**,  $5\text{GlO}$ ,  $2\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$ 

Ppt Sol in  $\text{H}_2\text{O}$  with decomp (Scheffer)  $3\text{GlO}$ ,  $\text{P}_2\text{O}_5$ ,  $3\text{H}_2\text{O} + \text{H}_2\text{O}$  (Sestini, Gazz ch it 20 313)

**Glucinum pyrophosphate**,  $\text{Gl}_2\text{P}_2\text{O}_7 + 5\text{H}_2\text{O}$ 

Ppt (Scheffer)

St  $\backslash$   $\text{P}_2\text{O}_7 + \text{Aq}$  (Stromeyer)

**Glucinum potassium phosphate**,  $\text{GlKPO}_4$ 

Insol in  $\text{H}_2\text{O}$  (Ouvrard, C R 110 1333)

**Glucinum sodium phosphate**,  $\text{GlNaPO}_4$ 

Sl sol in cold, easily sol in hot acids (Wallroth) Insol in acetic acid

Min Beryllonite

$\text{GlO}$ ,  $2\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$  Insol in  $\text{H}_2\text{O}$  (Ouvrard, C R 110 1333)

**Gold (Auric) sodium pyrophosphate** (?),

$\text{Au}_4(\text{P}_2\text{O}_7)_3$ ,  $2\text{Na}_4\text{P}_2\text{O}_7 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Persoz)

**Gold sodium pyrophosphate, ammonia,**  
 $14\text{Au}_2\text{O}_3, 6\text{P}_2\text{O}_5, 3\text{Na}_2\text{O}, 14\text{NH}_3 + 24\text{H}_2\text{O}$   
 Insol in  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 1895,  
 17 172)

**Iron (ferrous) trimetaphosphate,  $\text{Fe}(\text{P}_3\text{O}_9)_3 + 12\text{H}_2\text{O}$**

Rather sl sol in cold, more easily in hot  $\text{H}_2\text{O}$ . After ignition sol in  $\text{HCl} + \text{Aq}$  only after long boiling (Lindbom, Acta Lund 1873 17)

**Ferrous hexametaphosphate,  $\text{Fe}_3\text{P}_6\text{O}_{18}$**

When freshly pptd is sol in  $\text{H}_2\text{O}$ , and very sol in least traces of acids, or  $\text{Na}_6\text{P}_6\text{O}_{18} + \text{Aq}$  (Ludert, Z anorg 5 15)

**Ferrous phosphate, basic,  $7\text{FeO}, 2\text{P}_2\text{O}_5 + 9\text{H}_2\text{O}$**

Min *Ludlamite* Sol in dil  $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$  Decomp by boiling  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$

**Ferrous orthophosphate,  $\text{Fe}_2(\text{PO}_4)_2$**

Insol in  $\text{H}_2\text{O}$ , sol in acids  
 Sol in 1000 pts  $\text{H}_2\text{O}$  containing more than 1 vol  $\text{CO}_2$  (Pierre)  
 Sol in an excess of ferrous salts +  $\text{Aq}$   
 Sol in 560 pts  $\text{H}_2\text{O}$  containing  $\frac{1}{500}$  pt  $\text{HCl} \cdot \text{H}_2\text{O}_2$  Sol in 1666 pts  $\text{H}_2\text{O}$  containing 150 pts  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  (Pierre, A ch (3) 36 78)

Sol in  $\text{NH}_4$  salts +  $\text{Aq}$   
 Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  Not pptd in presence of Na citrate

Insol in acetone (Naumann, B 1904, 37 4329)

+  $\text{H}_2\text{O}$  (Debray, A ch (3) 61 437)  
 +  $8\text{H}_2\text{O}$  Min *Vivianite* Easily sol in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  Boiling  $\text{KOH} + \text{Aq}$  dissolves out phosphoric acid Sol in cold citric acid +  $\text{Aq}$  (Bolton, C N 37 14)

Insol in  $\text{H}_2\text{O}$  Sol in acids (Evans, C C 1897, I 580)

**Ferrous hydrogen orthophosphate,  $\text{FeHPO}_4 + \text{H}_2\text{O}$**

Ppt (Debray, A ch (3) 61 437)  
 Is impure  $\text{Fe}_3(\text{PO}_4)_2$  (Erlenmeyer and Heinrichs, A 194 176)

**Ferrous tetrahydrogen orthophosphate,  $\text{FeH}_4(\text{PO}_4)_2 + \text{H}_2\text{O}$**

Easily sol in  $\text{H}_2\text{O}$  Not changed by alcohol (Erlenmeyer and Heinrichs, A 194 176)

**Ferrous pyrophosphate**

Ppt Sol in an excess of  $\text{Na}_4\text{P}_2\text{O}_7$  or  $\text{FeSO}_4 + \text{Aq}$  (Schwarzenberg, A 65 153)

**Ferric metaphosphate,  $\text{Fe}_3(\text{PO}_3)_3$  or  $\text{Fe}(\text{PO}_3)_3$**

Insol in  $\text{H}_2\text{O}$  or dil acids Sol in conc  $\text{H}_2\text{SO}_4$  (Maddrell, Phil Mag (3) 30 322)

**Iron (ferric) orthophosphate, basic,  $2\text{Fe}_2\text{O}_3, \text{P}_2\text{O}_5 + x\text{H}_2\text{O}$**

Insol in  $\text{NH}_4$  citrate, sol in  $\text{NH}_4$  tartrate +  $\text{Aq}$  (Wittstein)

+  $3\text{H}_2\text{O}$  Min *Kraurite* Easily sol in  $\text{HCl} + \text{Aq}$

+  $4\text{H}_2\text{O}$  Ppt (Millot, C R 82 89)

+  $5\text{H}_2\text{O}$  Min *Dufrenoyte*

+  $12\text{H}_2\text{O}$  Min *Cacoxene* Sol in  $\text{HCl} + \text{Aq}$

+ 18, or  $24\text{H}_2\text{O}$  Min *Delvauxite*

$5\text{Fe}_2\text{O}_3, 3\text{P}_2\text{O}_5 + 14\text{H}_2\text{O}$  Min *Beraunite*

Sol in  $\text{HCl} + \text{Aq}$

$3\text{Fe}_2\text{O}_3, 2\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$  Min *Eleonorite*

Sol in  $\text{HCl} + \text{Aq}$

**Ferric orthophosphate,  $\text{Fe}_3(\text{PO}_4)_2 + x\text{H}_2\text{O}$ , or  $2\text{Fe}_2\text{O}_3, 3\text{P}_2\text{O}_5 + x\text{H}_2\text{O}$**

+ 4, or  $8\text{H}_2\text{O}$  (Pptd ferric phosphate)

Insol in  $\text{H}_2\text{O}$  Sol in 1500 pts boiling  $\text{H}_2\text{O}$  (Bergmann, 1815) Sol in pure  $\text{H}_2\text{O}$  when all traces of soluble salts are absent (Frese-nius) Verv sl sol in, but decomp by  $\text{H}_2\text{O}$  (Lachowicz, W A B 101, 2b 374) For an extended discussion of solubility in and decomposition by  $\text{H}_2\text{O}$  and effect of salts see Cameron and Hurst, (J Am Chem Soc 1904, 26 888)

Easily sol in dil mineral acids, excepting  $\text{H}_3\text{PO}_4 + \text{Aq}$  Insol in cold  $\text{HCl} \cdot \text{H}_2\text{O}_2 + \text{Aq}$  (Wittstein) 100 cem cold  $\text{H}_2\text{O}$  containing 10%  $\text{HCl} \cdot \text{H}_2\text{O}_2$  dissolve 0.007 g salt (Sestini, Gazz ch it 5 252) When freshly pptd easily sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$ , or  $(\text{NH}_4)_2\text{SO}_3 + \text{Aq}$  (Berthier) Easily sol in tartaric or citric acid +  $\text{Aq}$ , also in  $\text{NH}_4$  salts of those acids, and Na citrate +  $\text{Aq}$  (Heydenreich, C N 4 158) See below

Sol in 12,500 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}$  (Pierre, A ch (3) 36 78)

Insol in  $\text{NH}_4$  salts +  $\text{Aq}$  (Wittstein) Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  in presence of  $\text{Na}_2\text{HPO}_4$  insol in hot  $\text{Na}_2\text{HPO}_4 + \text{Aq}$ , sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Berzelius)  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  dissolve out  $\text{H}_3\text{PO}_4$

Sol in ferric salts +  $\text{Aq}$ , even ferric acetate, but insol in ferrous acetate +  $\text{Aq}$

Partially sol in large amt of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  Not pptd in presence of Na citrate (Spiller) Arth (Bull Soc (3) 2 324) obtained a modification of  $\text{Fe}(\text{PO}_4)_3$  insol in  $\text{HNO}_3 + \text{Aq}$ , but sol in hot conc  $\text{HCl} + \text{Aq}$

+  $4\text{H}_2\text{O}$  Min *Strengite* Easily sol in  $\text{HCl} + \text{Aq}$ , insol in  $\text{HNO}_3 + \text{Aq}$

+  $5\text{H}_2\text{O}$  Only sl sol in  $\text{H}_2\text{O}$  Slowly sol in  $\text{HNO}_3$ , easily sol in  $\text{HCl}$  (Weinland, Z anorg 1913, 84 361)

Diammonium citrate +  $\text{Aq}$  dissolves  $4.8\%$  of the  $\text{P}_2\text{O}_5$ , triammonium citrate,  $5.8\%$   $\text{P}_2\text{O}_5$ , and with an excess of  $\text{NH}_4\text{OH}$ ,  $21.2\%$   $\text{P}_2\text{O}_5$  is dissolved (Erlenmeyer, B 14 1253)

+  $9\text{H}_2\text{O}$  Dissolves in 35 min in diammonium citrate +  $\text{Aq}$  (sp gr 1.09) in 55 min in triammonium citrate +  $\text{Aq}$  (sp gr 1.09), citric acid +  $\text{Aq}$  ( $\frac{1}{4}\%$  citric acid) dissolves 17.5% of the  $\text{P}_2\text{O}_5$  (Erlenmeyer, l c)

**Iron (ferric) phosphate, acid,  $8\text{Fe}_2\text{O}_3, 9\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Rumpler, Z anal 12 151)  
 $6\text{Fe}_2\text{O}_3, 7\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$   
 $4\text{Fe}_2\text{O}_3, 5\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$   
 $2\text{Fe}_2\text{O}_3, 3\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$  Ppt Decomp by  
 $\text{H}_2\text{O}$  finally into  $\text{Fe}_2(\text{PO}_4)_2$  (Erlenmeyer and  
 Heinrich, A 194 176)

$8\text{Fe}_2\text{O}_3, 11\text{P}_2\text{O}_5 + 9\text{H}_2\text{O}$  As above (E and H)

$4\text{Fe}_2\text{O}_3, 7\text{P}_2\text{O}_5 + 9\text{H}_2\text{O}$  As above (E and H)

$\text{Fe}_2\text{O}_3, 2\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  or  
 $\text{HCl}$ ,  $\text{H}_2\text{O}_2$  + Aq, sol in  $\text{NH}_4$  citrate, alkali  
 hydrates, or carbonates + Aq (Winkler)  
 Slowly decomp by  $\text{H}_2\text{O}$  (E and H)

+  $10\text{H}_2\text{O}$  (Waite, C N 36 132)  
 $2\text{Fe}_2\text{O}_3, 5\text{P}_2\text{O}_5 + 17\text{H}_2\text{O}$

$\text{Fe}_2\text{O}_3, 3\text{P}_2\text{O}_5 + 6\text{H}_2\text{O} = \text{FeH}_2(\text{PO}_4)_2$  Delu-  
 quescent Insol in  $\text{H}_2\text{O}$ , but decomp into  
 $\text{Fe}_2(\text{PO}_4)_2$  (E and H)

+  $4\text{H}_2\text{O}$  (Hautefeuille and Margottet,  
 C R 106 135)

**Ferric pyrophosphate,  $\text{Fe}_4(\text{P}_2\text{O}_7)_3$** 

*Two modifications* — (a) Sol in acids,  
 $\text{Na}_4\text{P}_2\text{O}_7$  + Aq,  $\text{FeCl}_3$  + Aq,  $\text{NH}_4\text{OH}$  + Aq, and  
 in  $(\text{NH}_4)_2\text{CO}_3$  + Aq

Insol in acetic, sulphurous acid, or  $\text{NH}_4\text{Cl}$   
 + Aq Sol in  $\text{NH}_4$  citrate + Aq (Schwarzen-  
 berg, A 65 153)

(b) Insol in dil acids,  $\text{Na}_4\text{P}_2\text{O}_7$  + Aq,  $\text{FeCl}_3$   
 + Aq Sol in  $\text{NH}_4\text{OH}$  + Aq (Gladstone,  
 Chem Soc (2) 5 435)

**Solubility of  $\text{Fe}_4(\text{P}_2\text{O}_7)_3$  in  $\text{NH}_4\text{OH}$  + Aq at  $0^\circ$** 

100 g sat solution contain		100 g sat solution contain	
G $\text{NH}_3$	G $\text{Fe}_4(\text{P}_2\text{O}_7)_3$	G $\text{NH}_3$	G $\text{Fe}_4(\text{P}_2\text{O}_7)_3$
0 884	5 606	5 92	14 71
1 59	9 75	8 26	13 89
3 71	14 85	10 55	7 40
4 72	15 94	15 96	2 52
5 93	13 92	18 83	0 445
7 91	14 61		

(Pascal, A ch 1909, (8) 16 374)

Insol in acetone (Krug and M'F'roy, J  
 Anal Appl Ch 6 184)

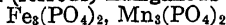
Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch  
 J 1598, 20 828)

**Ferroferric orthophosphate,  $2\text{Fe}_3(\text{PO}_4)_2, 3(\text{Fe}_2\text{O}_3, 2\text{P}_2\text{O}_5) + 16\text{H}_2\text{O}$** 

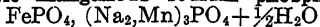
Ppt Sol in  $\text{HCl}$  + Aq Ppt in  $\text{H}_2\text{O}$   
 $4\text{Fe}_2\text{O}_3, 6\text{FeO}, 5\text{P}_2\text{O}_5 + 40\text{H}_2\text{O}$  Sol in 40  
 min in diammonium citrate + Aq (sp gr =  
 1.09), triammonium citrate + Aq (sp gr =  
 1.09) dissolves 55.7% of the  $\text{P}_2\text{O}_5$  (Erlen-  
 meyer, B 14 1253)

**Ferroferric lithium phosphate,  $\text{Li}_3\text{PO}_4, \text{Fe}_3(\text{PO}_4)_2$** 

Min *Triphylite* Easily sol in acids, not  
 wholly decomp by  $\text{KOH}$  + Aq

**Iron (ferrous) manganous phosphate,**

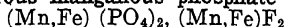
Min *Triphite* Easily sol in  $\text{HCl}$  + Aq  
 $5(\text{Mn}, \text{Fe})\text{O}, 2\text{P}_2\text{O}_5 + 5\text{H}_2\text{O}$  Min *Hur-*  
*evulite* Sol in acids

**Ferric manganous sodium phosphate,**

Min — (?)

**Ferrous manganous phosphate chloride,**

(Deville and Caron)

**Ferrous manganous phosphate fluoride,**

Min *Triphite, Zurelesite* Sol in  $\text{HCl}$  + Aq  
 $3(\text{Mn}, \text{Fe})_3(\text{PO}_4)_2, \text{MnF}_2$  (Deville and  
 Caron, C R 47 985)

**Ferric potassium phosphate,  $2\text{Fe}_2\text{O}_3, 3\text{K}_2\text{O}, 3\text{P}_2\text{O}_5$** 

Not attacked by boiling  $\text{H}_2\text{O}$  (Ouvrard,  
 A ch (6) 16 289)

$\text{Fe}_2\text{O}_3, \text{K}_2\text{O}, 2\text{P}_2\text{O}_5$  Insol in  $\text{H}_2\text{O}$ , verv sl  
 attacked by acids (Ouvrard)

**Ferric silver metaphosphate,  $2\text{Fe}_2\text{O}_3, 2\text{Ag}_2\text{O}, 5\text{P}_2\text{O}_5$** 

(Hautefeuille and Margottet, C R 96  
 1142)

**Ferric silver pyrophosphate,  $\text{Fe}_2\text{Ag}_6(\text{P}_2\text{O}_7)_3 + 4\text{H}_2\text{O}$** 

Ppt (Pascal, C R 1908, 146 232)

**Ferric sodium phosphate,  $2\text{Fe}_2\text{O}_3, 3\text{Na}_2\text{O}, 3\text{P}_2\text{O}_5$** 

Decomp by  $\text{H}_2\text{O}$  (Ouvrard)

**Ferrous sodium triphosphate,  $\text{Fe}(\text{Na}_2\text{P}_3\text{O}_{10}) + 11\frac{1}{2}\text{H}_2\text{O}$** 

Stable dry, sol in  $\text{HNO}_3$ , decomp in con-  
 tact with  $\text{H}_2\text{O}$  (Stange, Z anorg 1596, 12  
 451)

**Ferric sodium hydrogen orthophosphate,  $\text{Fe}(\text{PO}_4)\text{H}_2\text{N} + \text{H}_2\text{O}$** 

Difficultly sol in  $\text{H}_2\text{O}$  Slowly decomp by  
 boiling with  $\text{H}_2\text{O}$  Sol in dil  $\text{HCl}$  and dil  
 $\text{HNO}_3$  Decomp by alkalis and alkali car-  
 bonates (Weinland / anorg 1913, 84 354)

$\text{Fe}(\text{PO}_4)\text{H}_2\text{N} + \text{H}_2\text{O}$  Difficultly sol in  
 $\text{H}_2\text{O}$  Decomp by boiling with  $\text{H}_2\text{O}$  Sol in  
 dil  $\text{HCl}$  and in dil  $\text{HNO}_3$  Decomp by al-  
 kalies and alkali carbonates (Weinland, Z  
 anorg 1913, 84 358)

**Ferric sodium pyrophosphate,  $\text{Fe}_4(\text{P}_2\text{O}_7)_3, 2\text{Na}_4\text{P}_2\text{O}_7 + 7\text{H}_2\text{O}$** 

Slowly but completely sol in  $\text{H}_2\text{O}$  Pptd  
 by alcohol (Milek, J B 1865 263)

Very sol in  $\text{H}_2\text{O}$  (Fleitmann and Henne-  
 berg)

+5, and  $6\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$ , especially if warm (Pahl, J B 1873 229)

$\text{FeNaP}_2\text{O}_7$  Insol in  $\text{H}_2\text{O}$ , dil HCl, or  $\text{HNO}_3$ +Aq, sl sol in conc HCl+Aq, decomp by conc hot  $\text{H}_2\text{SO}_4$  without solution (Jorgensen, J pr (2) 16 342)

Insol in acetone (Naumann, B 1904, 37 4329)

$\text{Na}_2\text{Fe}_2(\text{P}_2\text{O}_7)_3 + 9\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Rosenheim, B 1915, 48 586)

$\text{Fe}_4(\text{P}_2\text{O}_7)_3$ ,  $5\text{Na}_4\text{P}_2\text{O}_7 + 7\text{H}_2\text{O}$  (Pahl, J B 1873 229)

**Iron (ferric) phosphate sulphate**,  $3\text{Fe}_2(\text{PO}_4)_3$ ,  $2\text{Fe}_2(\text{SO}_4)_3$ ,  $2\text{Fe}_2\text{O}_3\text{H}_6$

Min *Dyaochite*

**Lanthanum metaphosphate**,  $\text{La}_2(\text{PO}_3)_6$

Precipitate (Frerichs and Smith)

$\text{La}_2\text{O}_3$ ,  $5\text{P}_2\text{O}_5$  Insol in  $\text{H}_2\text{O}$ , dil, or conc acids (Johnsson, B 22 976)

**Lanthanum orthophosphate**,  $\text{LaPO}_4$

Precipitate (Hermann)

Insol in  $\text{H}_2\text{O}$  and acids (Ouvrard, C R 107 37)

**Lanthanum hydrogen phosphate**,

$\text{La}_2\text{H}_3(\text{PO}_4)_3$

Precipitate (Frerichs, B 7 799)

Existence is doubtful (Cleve, B 11 910)

**Lanthanum phosphate, acid**,  $\text{La}_2\text{O}_3$ ,  $2\text{P}_2\text{O}_5$

Precipitate (Hermann)

**Lanthanum pyrophosphate**,  $\text{LaHP}_2\text{O}_7 + 3\text{H}_2\text{O}$  (Cleve)

$\text{La}_2\text{H}_6(\text{P}_2\text{O}_7)_3$  Precipitate (Frerichs and Smith)

Does not exist (Cleve)

**Lanthanum potassium orthophosphate**,

$2\text{La}_2\text{O}_3$ ,  $3\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5 = 2\text{LaPO}_4$ ,  $\text{K}_3\text{PO}_4$

Insol in  $\text{H}_2\text{O}$  (Ouvrard, C R 107 37)

**Lanthanum sodium orthophosphate**,  $\text{La}_2\text{O}_3$ ,  $3\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$

Insol in  $\text{H}_2\text{O}$  (Ouvrard)

**Lanthanum sodium pyrophosphate**,

$\text{La}_2\text{NaP}_2\text{O}_7$

Insol in  $\text{H}_2\text{O}$ , and dil cold mineral acids  
Sol in warm dil acids (Wallroth)

**Lead dimetaphosphate**,  $\text{PbP}_2\text{O}_6$

Ppt Almost insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$ +Aq (Fleitmann, Pogg 78 253)

**Lead trimetaphosphate**,  $\text{Pb}_3(\text{P}_3\text{O}_9)_2 + 3\text{H}_2\text{O}$

Nearly insol in  $\text{H}_2\text{O}$  Less sol in  $\text{H}_2\text{O}$  than the corresponding Ag salt (Fleitmann and Henneberg, A 65 304)

Most insol of the *trimetaphosphates* (Lundbom, Acta Lund 1873 12)

Anhydrous salt is insol in  $\text{H}_2\text{O}$ , easily sol in  $\text{HNO}_3$ +Aq (Lundbom)

**Lead tetrametaphosphate**,  $\text{Pb}_4\text{P}_4\text{O}_{12}$

Insol in  $\text{H}_2\text{O}$

More easily decomp by acids than the other insol metaphosphates Easily decomp by alkali hydrosulphides+Aq in the cold (Fleitmann, Pogg 78 353)

**Lead hexametaphosphate**,  $\text{Pb}_6\text{P}_6\text{O}_{18}$

Nearly insol in  $\text{H}_2\text{O}$ , sol in acids (Lüdt, Z anorg 5 15)

**Lead orthophosphate, basic**,  $4\text{PbO}$ ,  $\text{P}_2\text{O}_5$

(Gerhardt, A 72 85)

**Lead orthophosphate**,  $\text{Pb}_3(\text{PO}_4)_2$

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HNO}_3$ +Aq Insol in  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq

Sl sol in  $\text{H}_2\text{O}$   $1.35 \times 10^{-4}$  g is contained in 1 litre of sat solution at  $20^\circ$  (Böttger, Z phys Ch 1903, 46 604)

Not hydrolyzed by boiling  $\text{H}_2\text{O}$  Sol in boiling  $\text{KOH}$ +Aq insol in  $\text{NH}_4\text{OH}$ +Aq Insol in  $\text{Pb}(\text{NO}_3)_2$ +Aq (Caven, J Soc Chem Ind 1897, 16 30)

Sol in 782.9 pts  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq containing 38.94 pts pure  $\text{HC}_2\text{H}_3\text{O}_2$  (Bertrand, Monit Scient (3) 10 477)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

**Lead hydrogen phosphate**,  $\text{PbHPO}_4$

Insol in  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{SO}_4$ , or  $\text{HCl}$ +Aq Sol in  $\text{HNO}_3$ , or in  $\text{KOH}$  or  $\text{NaOH}$ +Aq Insol in  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq Sol in cold  $\text{NH}_4\text{Cl}$ +Aq (Brett) from which it can be completely precipitated by a great excess of  $\text{NH}_4\text{OH}$ +Aq

More sol in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ +Aq at  $18.8$ – $25^\circ$  than in pure  $\text{H}_2\text{O}$  (Wappen)

Sol in sat  $\text{NaCl}$ +Aq, but less than  $\text{PbSO}_4$  (Bequerel, C R 20 1524)

Insol in Pb salts+Aq

Not pptd in presence of Na citrate (Spiller)

**Lead pyrophosphate**,  $\text{Pb}_2\text{P}_2\text{O}_7 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$ , or  $\text{KOH}$ +Aq Insol in  $\text{NH}_4\text{OH}$ +Aq,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{SO}_2$ +Aq (Schwarzenberg, A 65 133) Sol in  $\text{Na}_2\text{P}_2\text{O}_7$ +Aq (Stromeyer)

Insol in acetone (Naumann, B 1904, 37 4329)

**Lead potassium phosphate**,  $\text{PbKPO}_4$

Decomp by hot  $\text{H}_2\text{O}$  (Ouvrard, C R 110 1333)

**Lead sodium phosphate**,  $\text{PbNaPO}_4$

Very sol in dil acids (Ouvrard, C R 110 1333)

$10\text{PbO}$ ,  $8\text{Na}_2\text{O}$ ,  $9\text{P}_2\text{O}_5$  (Ouvrard)

**Lead sodium pyrophosphate,  $\text{PbNa}_2\text{P}_2\text{O}_7$** 

Insol in hot  $\text{H}_2\text{O}$  (Gerhardt, A ch (3) 22 506)

**Lead triphosphate sodium pyrophosphate,  $\text{Pb}_2\text{Na}_4\text{P}_5\text{O}_{27} + 10\text{H}_2\text{O}$** 

Sol in  $\text{HNO}_3$  after melting (Stange, Z anorg 1896, 12 459)

**Lead phosphate chloride,  $2\text{PbHPO}_4$ ,  $\text{PbCl}_2$** 

Insol in boiling  $\text{H}_2\text{O}$ , sol in dil  $\text{HNO}_3$  + Aq (Gerhardt, A ch (3) 22 505)

$2\text{Pb}_3(\text{PO}_4)_2$ ,  $\text{PbCl}_2$  Ppt (Heintz, Pogg 73 119)

$3\text{Pb}_3(\text{PO}_4)_2$ ,  $\text{PbCl}_2$  Min *Pyromorphite*

Sol in  $\text{HNO}_3$ , and  $\text{KOH} + \text{Aq}$   
Sl sol in cold citric acid + Aq (Bolton, C N 37 14)

+  $\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in dil  $\text{HNO}_3$  + Aq (Heintz)

**Lithium metaphosphate,  $\text{LiPO}_3$** 

Insol in boiling  $\text{H}_2\text{O}$  Scarcely sol in acetic acid Easily sol in mineral acids (Merling, Z anal 1879, 18 565)

**Lithium tetrametaphosphate,  $\text{Li}_4\text{P}_4\text{O}_{12} + 4\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  (Warschauer, Z anorg 1903, 36 180)

**Lithium orthophosphate,  $\text{Li}_3\text{PO}_4$** 

Very slightly sol in  $\text{H}_2\text{O}$

Sol in 2539 pts pure  $\text{H}_2\text{O}$  and 3920 pts ammoniacal  $\text{H}_2\text{O}$ , much more readily in  $\text{H}_2\text{O}$  containing  $\text{NH}_4$  salts Easily sol in  $\text{HCl} + \text{Aq}$  or  $\text{HNO}_3 + \text{Aq}$  (Mayer, A 98 193)  
Easily sol in carbonic acid water (Troost)  
Sol in dil acids or acetic acid (de Schulten, Bull Soc (3) 1 479)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in acetone (Naumann, B 1904, 37 4329; Eidmann, C C 1899, II 1014)

+  $\frac{1}{2}\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$

**Lithium hydrogen phosphate,  $\text{Li}_2\text{HPO}_4$** 

Nearly insol in  $\text{H}_2\text{O}$  (Gmelin) Sol in 933 pts  $\text{H}_2\text{O}$  at  $12^\circ$  (Rammelsberg)

$\text{Li}_5\text{H}(\text{PO}_4)_2 + \text{H}_2\text{O}$  Sol in 200 pts  $\text{H}_2\text{O}$  (Rammelsberg)

**Lithium dihydrogen phosphate,  $\text{LiH}_2\text{PO}_4$** 

Deliquescent, and very sol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Heptalithium dihydrogen phosphate,  $\text{Li}_7\text{H}_2(\text{PO}_4)_3$** 

+  $1\text{H}_2\text{O}$ , or  $2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Lithium pentahydrogen phosphate,  $\text{LiH}_5(\text{PO}_4)_2 + \text{H}_2\text{O}$** 

$\text{LiH}_5(\text{PO}_4)_2 + \text{H}_2\text{O}$

Deliquescent, and sol in  $\text{H}_2\text{O}$

**Lithium pyrophosphate,  $\text{Li}_4\text{P}_2\text{O}_7 + 2\text{H}_2\text{O}$** 

(Rammelsberg, B A B 1883 21)

**Lithium manganous phosphate,  $\text{Li}_3\text{PO}_4$ ,  $\text{Mn}_3(\text{PO}_4)_2$** 

Min *Lithophilite*

**Lithium potassium metaphosphate,  $\text{Li}_2\text{O}$ ,  $2\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5 + 4\text{H}_2\text{O}$** 

As  $\text{NH}_4$  comp (Tammann, J pr 1892, (2) 45 443)

**Lithium potassium pyrophosphate,  $\text{Li}_3\text{KP}_2\text{O}_7$** 

(Kraut, A 1876, 182 170)

**Lithium sodium phosphate,  $3\text{Li}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$** 

Insol in  $\text{H}_2\text{O}$  Sol in dil acids (Ouvrard, C R 110 1333)

$2\text{Li}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$  As above (Ouvrard)

**Lithium sodium pyrophosphate,  $\text{Li}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$** 

$5\text{Li}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$   
 $4\text{Li}_2\text{O}$ ,  $6\text{Na}_2\text{O}$ ,  $5\text{P}_2\text{O}_5$  (Kraut, A 1876, 182 168)

**Magnesium metaphosphate,  $\text{Mg}(\text{PO}_3)_2$** 

Insol in  $\text{H}_2\text{O}$  or dil acids, but sol in  $\text{H}_2\text{SO}_4$  + Aq (Maddrell, A 61 62)

Not decomp by very long digestion with alkali carbonates, or orthophosphates + Aq (Fleitmann)

**Magnesium dimetaphosphate,  $\text{Mg}_2(\text{P}_2\text{O}_5)_2 + 9\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , decomp by acids (Fleitmann, Pogg 78 259)

**Magnesium trimetaphosphate,  $\text{Mg}_3(\text{P}_3\text{O}_9)_2$** 

Sl sol in cold  $\text{H}_2\text{O}$ , more easily in hot  $\text{H}_2\text{O}$   
When ignited, insol in boiling  $\text{HCl} + \text{Aq}$  (Lindbom)

Cryst with 12, or  $15\text{H}_2\text{O}$

**Magnesium tetrametaphosphate,  $\text{Mg}_4\text{P}_4\text{O}_{12}$** 

Insol in  $\text{H}_2\text{O}$ , somewhat sol in  $\text{HCl} + \text{Aq}$   
More easily sol in  $\text{HNO}_3 + \text{Aq}$ , especially easily sol in conc  $\text{H}_2\text{SO}_4$  (Glatzel, Dissert 1880)

+  $10\text{H}_2\text{O}$  Sol in 70 pts  $\text{H}_2\text{O}$  (Glatzel)

**Magnesium orthophosphate,  $\text{Mg}_3(\text{PO}_4)_2$ , and +5, or  $7\text{H}_2\text{O}$** 

1 litre  $\text{H}_2\text{O}$  dissolves 0.1 g ignited  $\text{Mg}_3(\text{PO}_4)_2$  in 7 days, but 0.205 g if freshly precipitated (Volcker, J B 1862 131)

1 l  $\text{H}_2\text{O}$  with 2 g  $\text{NaCl}$  dissolves 75.8 mg, 1 l  $\text{H}_2\text{O}$  with 3 g  $\text{NaNO}_3$  dissolves 61.9 mg  $\text{Mg}_3(\text{PO}_4)_2$  (Liebig, A 106 185)

Easily sol in acids, except in acetic acid (Schaffner, A 50 145)

Easily sol in  $\text{H}_2\text{O}$  in presence of alkali salts

+6½H<sub>2</sub>O Sol in 30 min in diammonium citrate+ Aq (sp gr = 1.09), triammonium citrate+ Aq (sp gr = 1.09) dissolves 37.5% of the P<sub>2</sub>O<sub>5</sub> (Erlenmeyer, B 14 1253)

+20H<sub>2</sub>O Sol in 10 min in diammonium citrate+ Aq (sp gr = 1.09), triammonium citrate+ Aq (sp gr = 1.09) dissolves 23.2% of the P<sub>2</sub>O<sub>5</sub>, sol in 15 min in ¼% citric acid + Aq (Erlenmeyer, l c)

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 328)

### Magnesium hydrogen phosphate, MgHPO<sub>4</sub>+7H<sub>2</sub>O

Sol in 322 pts cold H<sub>2</sub>O in several days. If heated to 40° becomes milky, and separates a precipitate out at 100° of same salt, so that solution at 100° contains only 1 pt salt in 498 pts H<sub>2</sub>O. Much more sol in H<sub>2</sub>O containing traces of acids, even dil oxalic or acetic acids (Graham, Phil Mag Ann 2 20). Easily sol in H<sub>2</sub>SO<sub>4</sub>+Aq (Gerland, J pr (2) 4 127)

Sol in aqueous solution of Mg salts, but insol in Na<sub>2</sub>HPO<sub>4</sub>+Aq (Rose). Sol in sodium citrate+ Aq (Spiller). When freshly precipitated it is sol in hot NH<sub>4</sub>Cl+ Aq, and NH<sub>4</sub>OH+ Aq does not completely reprecipitate it, less sol in NH<sub>4</sub>NO<sub>3</sub>+Aq (Brett, Phil Mag (3) 10 96). Insol in alcohol (Berzelius)

For solubility in H<sub>3</sub>PO<sub>4</sub>, see under MgO

+½H<sub>2</sub>O (Debray)

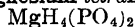
+H<sub>2</sub>O Easily sol in dil acids (de Schulten, C R 100 263)

+3H<sub>2</sub>O Sl sol in H<sub>2</sub>O, easily in acids (Stoklasa, Z anorg 3 67)

+4½H<sub>2</sub>O (Bergmann)

+6H<sub>2</sub>O (Debray)

### Magnesium tetrahydrogen phosphate,



Not hygroscopic. Sol in 5 pts H<sub>2</sub>O without decomp (Stoklasa, Z anorg 3 67)

+2H<sub>2</sub>O Not hygroscopic. Sol in H<sub>2</sub>O without decomp (Stoklasa, Z anorg 1 307)

Decomp by alcohol into MgHPO<sub>4</sub>+3H<sub>2</sub>O

### Magnesium pyrophosphate, Mg<sub>2</sub>P<sub>2</sub>O<sub>7</sub>

Nearly insol in H<sub>2</sub>O, readily sol in HCl or HNO<sub>3</sub>+Aq (Presenius)

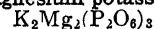
+3H<sub>2</sub>O Sl sol in H<sub>2</sub>O, easily in HCl or HNO<sub>3</sub>+Aq, sol in H<sub>2</sub>SO<sub>4</sub>+Aq, and Na<sub>4</sub>P<sub>2</sub>O<sub>7</sub>+Aq (Schwarzenberg)

Sol in MgSO<sub>4</sub>+Aq, and (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq

### Magnesium tetraphosphate, Mg<sub>3</sub>P<sub>4</sub>O<sub>13</sub>

Insol in H<sub>2</sub>O (Fleitmann and Henneberg, A 65 331)

### Magnesium potassium dimetaphosphate,



Verv sol in dil acids (Ouvrard, C R 1888, 106 1729)

+4H<sub>2</sub>O Sol in 10.2 pts H<sub>2</sub>O (Glatzel)

### Magnesium potassium orthophosphate, MgKPO<sub>4</sub>

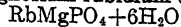
Sl sol in H<sub>2</sub>O. Decomp by H<sub>2</sub>O. Easily sol in acids

+6H<sub>2</sub>O

2MgO, K<sub>2</sub>O, 3P<sub>2</sub>O<sub>5</sub> Insol in H<sub>2</sub>O, sol in dil HCl+ Aq (Ouvrard, C R 106 1729)

Mg<sub>2</sub>HK(PO<sub>4</sub>)<sub>2</sub>+15H<sub>2</sub>O (Haushofer)

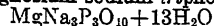
### Magnesium rubidium orthophosphate,



Easily sol in warm dil HCl+ Aq

Not decomp by boiling H<sub>2</sub>O (Erdmann, A 1897, 294 73)

### Magnesium sodium triphosphate,

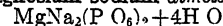


Decomp in the air (Stange, Z anorg 189b, 12 454)

### Magnesium sodium metaphosphate, 3MgO, Na<sub>2</sub>O, 4P<sub>2</sub>O<sub>5</sub>

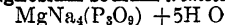
Insol in H<sub>2</sub>O or H<sub>3</sub>PO<sub>4</sub>+Aq. Scarcely sol in HCl+ Aq, or aqua regia. Not decomp by (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq. Sol in conc H<sub>2</sub>SO<sub>4</sub> (Maddrell, A 61 53)

### Magnesium sodium dimetaphosphate,



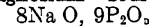
Sol in 25 pts H<sub>2</sub>O (Glatzel, Dissert 1880)

### Magnesium sodium trimetaphosphate,



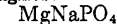
Sl sol in H<sub>2</sub>O. After ignition is insol in H<sub>2</sub>O (Lindbom)

### Magnesium sodium phosphate, 10MgO,



Insol in H<sub>2</sub>O, easily sol in dil acids (Ouvrard, C R 106 1729)

### Magnesium sodium orthophosphate,



Insol in H<sub>2</sub>O (Rose)

+9H<sub>2</sub>O (Schoecker and Violet, A 140 232)

MgO, 2Na<sub>2</sub>O, P<sub>2</sub>O<sub>5</sub> Insol in H<sub>2</sub>O (Ouvrard)

3MgO, 3Na<sub>2</sub>O, 2P<sub>2</sub>O<sub>5</sub> Insol in H<sub>2</sub>O (Ouvrard)

### Magnesium sodium pyrophosphate, basic (?)

Precipitate, sl sol in H<sub>2</sub>O. Easily in HCl+ Aq, HNO<sub>3</sub>+Aq, and Na<sub>2</sub>PO<sub>4</sub>+ Aq (Baer, Pogg 75 168)

Sol in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq, and in MgSO<sub>4</sub>+Aq

Insol in alcohol

### Magnesium phosphate chloride, Mg<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>, MgCl<sub>2</sub>

(Deville and Caron, A ch (3) 67 455)



**Magnesium pyrophosphate nitrogen dioxide,**  
 $\text{Mg}_2\text{P}_2\text{O}_7, \text{H}_2\text{O}, \text{NO}_2$ 

Scarcely sol in water (Luck, Z anal 13 255)

**Magnesium phosphate fluoride,**  $\text{Mg}_3(\text{PO}_4)_2$ ,  
 $\text{MgF}_2$ 

Min *Wagnerite* Slowly sol in hot  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4$

**Magnesium phosphate calcium fluoride,**  
 $2\text{Mg}_3(\text{PO}_4)_2, \text{CaF}_2$ 

Min *Kjerulfite*

**Manganous dimetaphosphate,**  $\text{Mn}_2(\text{P}_2\text{O}_6)_2$ 

*Anhydrous* Insol in  $\text{H}_2\text{O}$  and dil acids (Fleitmann) Sol in conc  $\text{H}_2\text{SO}_4$  (Madrell) Scarcely attacked by warm  $\text{Na}_2\text{S} + \text{Aq}$ , and not much more by  $(\text{NH}_4)_2\text{S} + \text{Aq}$  Decomp by  $\text{Na}_2\text{CO}_3 + \text{Aq} + 8\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  and dil acids (Fleitmann, Pogg 78 257)

**Manganous trimetaphosphate,**  $\text{Mn}_3(\text{P}_3\text{O}_{10})_2 + 11\text{H}_2\text{O}$ 

Difficultly sol in cold or warm  $\text{H}_2\text{O}$  More easily sol in cold, very easily in warm  $\text{HCl} + \text{Aq}$  When ignited, is insol in acids, even aqua regia (Lindbom)

**Manganous hexametaphosphate**

Sol in sodium hexametaphosphate +  $\text{Aq}$  (Rose, Pogg 76 4)

$\text{Mn}_3\text{P}_6\text{O}_{18}$  Nearly insol in  $\text{H}_2\text{O}$ , easily sol in acids (Ludert, Z anorg 5 15)

**Manganic metaphosphate,**  $\text{Mn}(\text{PO}_3)_3$ 

Insol in  $\text{H}_2\text{O}$  or acids, decomp by alkalis (Schjerming, J pr (2) 45 515)

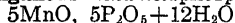
Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl}$ , decomp by alkalis +  $\text{Aq}$  (Barbier, C R 1902, 135 1055)

+  $\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  or acids, except  $\text{HCl} + \text{Aq}$  Sl decomp by boiling with  $\text{H}_2\text{SO}_4$  (Hermann, Pogg 74 303)

**Manganous tetrametaphosphate,**  $\text{Mn}(\text{PO}_3)_4$ 

Not attacked by acids (Glatzel, Dissert 1880)

+  $10\text{H}_2\text{O}$  Sol only in boiling conc  $\text{H}_2\text{SO}_4$  (Glatzel)

**Manganous dekametaphosphate,**

Ppt (Tammann, J pr 1892, (2) 45 450)

**Manganous orthophosphate,**  $\text{Mn}_3(\text{PO}_4)_2$ 

+  $\text{H}_2\text{O}$  (Debray)

+  $3\text{H}_2\text{O}$  Sol in 20 min in diamonium citrate +  $\text{Aq}$  (sp gr = 1.09), triammonium citrate +  $\text{Aq}$  (sp gr = 1.09) dissolves 30.2% of the  $\text{P}_2\text{O}_5$  (Erlenmeyer, B 14 1253)

+  $4\frac{1}{2} - 5\frac{1}{2}\text{H}_2\text{O}$  Efflorescent (Erlenmeyer and Heinrich, A 190 208)

+  $7\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Berzelius)

Easily sol in mineral acids, sol in  $\text{HC}_2\text{H}_3\text{O}_2$

+  $\text{Aq}$  Easily sol in  $\text{SO}_2 + \text{Aq}$  (Gerland, J pr (2) 4 97)

Somewhat sol in boiling  $(\text{NH}_4)\text{CO}_3 + \text{Aq}$ , but deposited on cooling (Berzelius)

Partly sol in cold  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett)

Sol in cold or hot solutions of ammonium sulphate or succinate (Wittstein)

Sl sol in Mn salts +  $\text{Aq}$  (Rose, Pogg 76 25)

Insol in alcohol

Sol in 10 min in diammonium citrate +  $\text{Aq}$  (sp gr = 1.09), triammonium citrate +  $\text{Aq}$  (sp gr = 1.09) dissolves 53% of the  $\text{P}_2\text{O}_5$  (Frlenmeyer, B 14 1253)

**Manganous dihydrogen orthophosphate,**  
 $\text{MnHPO}_4 + 3\text{H}_2\text{O}$ 

Sl sol in  $\text{H}_2\text{O}$  Solution decomp at  $100^\circ$  (Debray) Slowly decomp by cold  $\text{H}_2\text{O}$  into  $\text{Mn}_3(\text{PO}_4)_2$  (Erlenmeyer and Heinrich, A 190 208)

Easily sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Gerland)

Sl sol in  $\text{HC}_2\text{H}_3\text{O}_2$ , easily in conc mineral acids (Heintz) Sol in  $(\text{NH}_4)\text{CO}_3 + \text{Aq}$ , from which it is reprecipitated on boiling Decomp by boiling  $\text{KOH} + \text{Aq}$

Insol in alcohol

$\text{Mn}_3(\text{PO}_4)_2, 2\text{MnHPO}_4 + 4\text{H}_2\text{O}$  (de Schulten, C C 1905, I 188)

**Manganous tetrahydrogen phosphate,**  
 $\text{MnH}_4(\text{PO}_4)_2 + 2\text{H}_2\text{O}$ 

Deliquescent Easily sol in  $\text{H}_2\text{O}$ , with decomp to  $\text{MnHPO}_4$  (Erlenmeyer and Heinrich, A 190 208)

Not decomp by  $\text{H}_2\text{O}$  (Otto, C C 1887 1563)

$\text{H}_2\text{O}$  decomp it into  $\text{MnHPO}_4$  and  $\text{H}_3\text{PO}_4$  containing some dissolved salt The less  $\text{H}_2\text{O}$  used, the more  $\text{MnHPO}_4$  separates The acid filtrate separates  $\text{MnHPO}_4$  on boiling At  $0^\circ$  the decomp increases in proportion to the amt of salt, but 1 g of the salt is unchanged in 100 g  $\text{H}_2\text{O}$  With less than 20 g of salt to 100 g  $\text{H}_2\text{O}$  the decomp is analogous to that of  $\text{CaH}_4(\text{PO}_4)_2$ , but with larger amts of salt it is the opposite ss with increasing amts of the C R 1899, 129 412)

Alcohol dissolves out  $\text{H}_3\text{PO}_4$  (Heintz)

**Pentamanganous dihydrogen phosphate,**  
 $\text{Mn}_5\text{H}_2(\text{PO}_4)_4 + 4\text{H}_2\text{O}$ 

Not decomp by boiling  $\text{H}_2\text{O}$  (Frlenmeyer and Heinrich, A 190 208)

**Manganic orthophosphate, basic,**  $\text{Mn}_2\text{P}_2\text{O}_7 + \text{H}_2\text{O}$ 

Sl sol in  $\text{H}_2\text{O}$

**Manganic orthophosphate,  $\text{MnPO}_4 + \text{H}_2\text{O}$** 

Sol in acids (Christensen, J pr (2) 28 1)

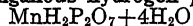
**Manganous pyrophosphate,  $\text{Mn}_2\text{P}_2\text{O}_7$** 

Anhydrous (Lewis, Sill Am J (3) 14 281)

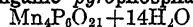
+ $\text{H}_2\text{O}$   
+ $3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Insol in  $\text{MnSO}_4 + \text{Aq}$ , but sol in  $\text{Na}_4\text{F}_2\text{O}_7 + \text{Aq}$  (Rose)

Difficultly sol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , but easily sol in  $\text{K}_4\text{P}_2\text{O}_7 + \text{Aq}$  (Pahl) Decomp by  $\text{KOH} + \text{Aq}$  Sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  (Schwarzenberg)

Insol in acetone (Naumann, B 1904, 37 4329)

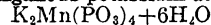
**Manganous hydrogen pyrophosphate,**

Sol in  $\text{H}_2\text{O}$  (Pahl)

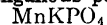
**Manganic pyrophosphate,**

Sol in  $\text{H}_2\text{SO}_4$ , and  $\text{H}_3\text{PO}_4$  (Auger, C R 1901, 133 95)

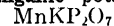
$\text{MnHP}_2\text{O}_7$  Insol in  $\text{H}_2\text{O}$ , very sl attacked by dil  $\text{HCl} + \text{Aq}$ , easily by conc Sol in conc  $\text{H}_2\text{SO}_4$  (Schjerning, J pr (2) 45 515)

**Manganous potassium dimetaphosphate,**

Sol in 95 pts  $\text{H}_2\text{O}$  When ignited is not attacked by acids (Glatzel, Dissert 1880)

**Manganous potassium orthophosphate,**

Insol in  $\text{H}_2\text{O}$ , easily sol in dil acids (Ouvrard)

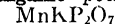
**Manganic potassium pyrophosphate,**

+ $5\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$   
+ $3\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$  (Rosenheim B 1915, 48 584)

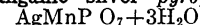
**Manganous potassium phosphate,  $\text{MnK}_2\text{P}_2\text{O}_7$** 

Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Ouvrard, C R 106 1729)

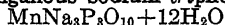
+ $8\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Pahl)  
 $\text{Mn}_2\text{P}_2\text{O}_7, 2\text{K}_4\text{P}_2\text{O}_7 + 10\text{H}_2\text{O}$  Difficultly sol in  $\text{H}_2\text{O}$  (Pahl)

**Manganic potassium pyrophosphate,**

Insol in  $\text{H}_2\text{O}$  Decomp by acids and bases (Schjerning)

**Manganic silver pyrophosphate,**

Almost insol in  $\text{H}_2\text{O}$  (Rosenheim, B 1915, 48 585)

**Manganous sodium triphosphate,**

Sl sol in  $\text{H}_2\text{O}$ , the melt obtained by heating the salt is readily sol in  $\text{H}_2\text{SO}_4$  (Stange, Z anorg 1896, 12 455)

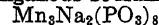
**Manganous sodium dimetaphosphate,**

Easily sol in boiling  $\text{H}_2\text{SO}_4$ , but not attacked by acids after boiling (Glatzel, Dissert 1880)

**Manganous sodium trimetaphosphate,**

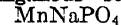
Sol in  $\text{H}_2\text{O}$  (Fleitmann and Henneberg)

$\text{MnNa}(\text{PO}_3)_3$  Insol in  $\text{H}_2\text{O}$ , dil acids, or alkalies (Schjerning, J pr (2) 45 515)

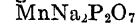
**Manganous sodium octometaphosphate,**

Insol in acids except conc  $\text{H}_2\text{SO}_4$  (Tammann, J pr 1892, (2) 45 469)

+ $5\text{H}_2\text{O}$  Almost insol in cold  $\text{H}_2\text{O}$   
Decomp by boiling  $\text{H}_2\text{O}$  with separation of  $\text{Mn}_2\text{O}_3$  (Rosenheim, B 1915, 48 584)

**Manganous sodium orthophosphate,**

Insol in  $\text{H}_2\text{O}$  (Ouvrard, C R 106 1729)  
 $\text{MnO}, 2\text{Na}_2\text{O}, \text{P}_2\text{O}_5$  As above

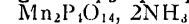
**Manganous sodium pyrophosphate,**

Insol in  $\text{H}_2\text{O}$ , easily sol in dil acids (Wallroth)

+ $4\frac{1}{2}\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Pahl)  
 $3\text{Mn}_2\text{P}_2\text{O}_7, 2\text{Na}_4\text{P}_2\text{O}_7 + 24\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Pahl)

**Manganic sodium pyrophosphate,  $\text{MnNaP}_2\text{O}_7$** 

(Christensen, J pr (2) 28 1)

**Manganic dipyrophosphate ammonia,**

Insol in  $\text{H}_2\text{O}$   
Decomp by  $\text{HCl}$  and by alkalies (Birch, C R 1902, 135 1109)

**Manganous phosphate chloride,  $\text{Mn}_3(\text{PO}_4)_3$** 

Insol in  $\text{H}_2\text{O}$  (Deville and Caron, A ch (3) 67 459)  
 $3\text{Mn}(\text{PO}_4)_2, \text{MnCl}_2$  Insol in  $\text{H}_2\text{O}$  (Deville and Caron)

**Mercurous hexametaphosphate (?)**

Ppt Sol in sodium hexametaphosphate +  $\text{Aq}$  (Rose)

$\text{Hg}_6\text{P}_6\text{O}_{18}$  Insol in  $\text{H}_2\text{O}$ , very sl sol in acids (Ludert, Z anorg 5 15)

Moderately sol in  $\text{H}_2\text{O}$  when freshly pptd  
More sol in acids than the mercurous salt (Ludert)

**Mercurous or hophosphate,  $(\text{Hg}_2)_2(\text{PO}_4)_2$** 

Ppt Decomp by boiling with  $\text{H}_2\text{O}$  (Gerhardt)

Sol in  $\text{HNO}_3 + \text{Aq}$  Sol in  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$  Insol in  $\text{H}_3\text{PO}_4 + \text{Aq}$

**Mercuric orthophosphate,  $\text{Hg}_2(\text{PO}_4)_2$** 

Insol in  $\text{H}_2\text{O}$  Sl sol in hot  $\text{H}_2\text{O}$ , crystallizing out on cooling (Haack, A 262 185) Slowly sol in cold dil., quickly in hot dil or cold conc  $\text{HCl} + \text{Aq}$  Less easily sol in  $\text{HNO}_3 + \text{Aq}$  Sol in  $\text{H}_3\text{PO}_4 + \text{Aq}$  (Berzelius) Insol in  $\text{H}_3\text{PO}_4 + \text{Aq}$  (Haack) Decomp by  $\text{NaCl} + \text{Aq}$  into insol  $\text{HgCl}_2$ ,  $3\text{Hg}_2\text{O}$ , but sol in  $\text{NaCl} + \text{Aq}$ , containing  $\text{HNO}_3$  (Haack)

Sol in 6 pts  $\text{NH}_4\text{Cl}$  in aqueous solution by heating (Trommsdorff)

Sol in  $(\text{NH}_4)_2\text{CO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Wittstein)

Insol in alcohol

**Mercuriomercuric orthophosphate,  $7\text{Hg}_2\text{O}$ ,**

$14\text{HgO}$ ,  $2\text{P}_2\text{O}_5 + 20\text{H}_2\text{O}$

(Brooks, Pogg 66 63)

**Mercurous pyrophosphate,  $\text{Hg}_2\text{P}_2\text{O}_7 + \text{H}_2\text{O}$** 

Sol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , when recently pptd Insol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , when heated to  $100^\circ$  Sol in  $\text{HNO}_3 + \text{Aq}$  Decomp by  $\text{HCl} + \text{Aq}$  (Schwarzenberg, A 65 133)

**Mercuric pyrophosphate,  $\text{Hg}_2\text{P}_2\text{O}_7$** 

Sol in acids, insol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , after being heated to  $100^\circ$  Sol in  $\text{NaCl} + \text{Aq}$ , quickly decomp by  $\text{NaOH} + \text{Aq}$ , and  $\text{Na}_2\text{HPO}_4 + \text{Aq}$

Sol in 6 pts  $\text{NH}_4\text{Cl} + \text{Aq}$  (Trommsdorff)

Sol in  $\text{NH}_4\text{NO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , also in  $\text{KI} + \text{Aq}$

**Mercurous silver orthophosphate,  $\text{AgHg}_2\text{PO}_4$** 

Sol in  $\text{HNO}_3$  (Jacobsen, Bull Soc 1909, (4) 5 949)

**Molybdenum phosphate,  $\text{Mo}_2(\text{PO}_4)_2$  (?)**

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{MoCl} + \text{Aq}$

**Molybdenum sodium pyrophosphate,**

$\text{Na}(\text{MoP}_2\text{O}_7) + 12\text{H}_2\text{O}$

Ppt (Rosenheim, B 1915, 48 589)

**Nickel dimetaphosphate,  $\text{NiP}_2\text{O}_6$** 

Insol in  $\text{H}_2\text{O}$  or dil acids Sol in conc  $\text{H}_2\text{SO}_4$  Not decomp by boiling alkali carbonates or sulphides +  $\text{Aq}$  (Maddrell, A 61 58)

+  $4\text{H}_2\text{O}$  Sol in cold acids (Glatzel, Dissert 1880)

**Nickel tetrametaphosphate,  $\text{Ni}_2\text{P}_4\text{O}_{12}$** 

Insol in  $\text{HCl}$  Sol in conc  $\text{HNO}_3$  and pecially sol in  $\text{H}_2\text{SO}_4$  on boiling (Glatzel)

**Nickel tetrametaphosphate,  $\text{Ni}_2\text{P}_4\text{O}_{12} + 12\text{H}_2\text{O}$** 

Easily sol in acids (Glatzel)

**Nickel orthophosphate,  $\text{Ni}_3(\text{PO}_4)_2 + 7\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  Sol in acids (Rammelsberg, Pogg 68 383)

Sol in  $\text{Ni}$  salts +  $\text{Aq}$  (Rose, Pogg 76 25)

Insol in  $\text{NaHPO}_4 + \text{Aq}$  (Tupputi, 1811)

Very sl sol in hot  $(\text{NH}_4)_2\text{HPO}_4 + \text{Aq}$

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethylacetate (Naumann, B 1910, 43 314)

**Nickel pyrophosphate,  $\text{Ni}_2\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , sol in mineral acids,  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$  Not pptd from  $\text{Ni}_2\text{P}_2\text{O}_7 + \text{Aq}$  by alcohol (Schwarzenberg, A 65 158)

**Nickel potassium dimetaphosphate,**

$\text{NiK}_2\text{P}_2\text{O}_{12} + 6\text{H}_2\text{O}$

Sol in 130 pts  $\text{H}_2\text{O}$  (Glatzel)

**Nickel potassium orthophosphate,  $\text{NiKPO}_4$** 

Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Ouvrard, R 106 1729)

$3\text{NiO}$ ,  $3\text{K}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$  As above

**Nickel sodium triphosphate,  $\text{Na}_3\text{NiP}_3\text{O}_{13} + 12\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$ , decomp in  $\text{Aq}$  solution (Schwarz, Z anorg 1895, 9 261)

**Nickel sodium metaphosphate,  $3\text{Ni}(\text{PO}_3)_2$ ,  $\text{Na}_3\text{PO}_3$** 

Insol in  $\text{H}_2\text{O}$  and dil acids Sol in conc  $\text{H}_2\text{SO}_4$  (Maddrell, A 61 56)

$\text{NiNa}_4(\text{PO}_3)_3 + 8\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Lindbom)

**Nickel sodium dimetaphosphate,  $\text{NiNa}_2\text{P}_2\text{O}_{12} + 6\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  Moderately sol in acids (Glatzel, Dissert 1880)

**Nickel sodium trimetaphosphate,**

$\text{Ni}_2\text{Na}_2(\text{P}_3\text{O}_9)_2 + 9\text{H}_2\text{O}$

1 l  $\text{H}_2\text{O}$  dissolves 0.6 g at  $20^\circ$  (Lamann, J pr 1892, (2) 45 426)

$\text{Na}_3\text{NiP}_3\text{O}_{10} + 12\text{H}_2\text{O}$  Insol and not decomp by  $\text{H}_2\text{O}$  Sol in acids (Schwartz, Z anorg 1895, 9 261)

**Nickel sodium octometaphosphate,**

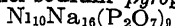
$\text{Na}_2\text{Ni}_3(\text{PO}_3)_8$

(Lamann, J pr 1892, (2) 45 469)

**Nickel sodium orthophosphate,  $\text{NiNaPO}_4 + 7\text{H}_2\text{O}$** 

Ppt (Debray, C R 59 40)

$\text{NiO}$ ,  $2\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$  Insol in  $\text{H}_2\text{O}$  Easily sol in dil acids (Ouvrard)

**Nickel sodium pyrophosphate,**

Insol in  $\text{H}_2\text{O}$  Moderately sol in acids (Wallroth)

**Osmium phosphate (?)**

Sl sol in  $\text{H}_2\text{O}$ , sol in  $\text{HNO}_3 + \text{Aq}$  (Berzelius)

**Palladium orthophosphate (?)**

Ppt

**Phosphorus phosphate,  $4\text{P}_4\text{O}$ ,  $3\text{P}_4\text{O}_5$  (?)**

Decomp spontaneously Sol in  $\text{H}_2\text{O}$  and alcohol when fresh, insol in ether (le Verrier, A 27 167, Reinitzer, B 14 1884)

**Platinum phosphate,  $\text{PtP}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , acids and alkalies Decomp by fusing with potassium carbonate (Barnett, C N 1895, 71 256)

**Potassium monometaphosphate,  $\text{KPO}_3$** 

Nearly insol in  $\text{H}_2\text{O}$ , sol in weak acids, even in acetic acid (Maddrell, A 61 62)

Insol in  $\text{H}_2\text{O}$  and weak acids (Fleitmann, Pogg 78 250)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

**Potassium dimetaphosphate,  $\text{K}_2\text{P}_2\text{O}_6 + \text{H}_2\text{O}$** 

Sol in 1 2 pts cold  $\text{H}_2\text{O}$ , but not more in hot  $\text{H}_2\text{O}$  (Fleitmann, Pogg 78 250)

**Potassium trimetaphosphate,  $\text{K}_3\text{P}_3\text{O}_9$** 

Very sol in cold  $\text{H}_2\text{O}$  before it is fused (Lindbom, Acta I und 1873 14)

**Potassium orthophosphate,  $\text{K}_3\text{PO}_4$** 

Not deliquescent Very sol in  $\text{H}_2\text{O}$  (Graham, Pogg 32 47)

Very sl sol in cold, easily in hot  $\text{H}_2\text{O}$  (Darraq)

**Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $25^\circ$** 

In 1000 g of the solution mols

K	$\text{PO}_4$
9 14	3 13
8 84	3 22
8 42	3 44
7 52	3 78
6 90	4 15
6 85	4 12

(D'Ans and Schreiner, Z phys Ch 1910, 75 103)

Insol in alcohol

**Potassium hydrogen orthophosphate,**

Very unstable, very sol in  $\text{H}_2\text{O}$  with decomp Identical with the substance de-

scribed as dipotassium phosphate by Berzelius (Staudenmaier, Z anorg 1894, 5 389)

$3\text{K}_2\text{HPO}_4, \text{KH}_2\text{PO}_4 + 2\text{H}_2\text{O}$  Verv unstable, very sol in  $\text{H}_2\text{O}$  with decomp (Staudenmaier)

**Potassium hydrogen orthophosphate,**

Deliquescent Very sol in  $\text{H}_2\text{O}$  and alcohol

**Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $25^\circ$** 

In 1000 g of the solution mols

K	$\text{PO}_4$
6 80	4 08
6 80	4 05
6 76	3 96
6 50	3 81
6 16	3 61
5 24	3 25
4 42	2 94

(D'Ans and Schreiner, Z phys Ch 1910, 75 103)

**Potassium dihydrogen phosphate,  $\text{KH}_2\text{PO}_4$** 

Deliquescent Easily sol in  $\text{H}_2\text{O}$  (Vauquelin, A ch 74 96)

1 l sat aq solution at  $7^\circ$  contains 249 g  $\text{KH}_2\text{PO}_4$  (Muthmann and Kuntze, Z Kryst Min 1894, 23 308)

**Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $25^\circ$** 

In 1000 g of the solution mols

K	$\text{PO}_4$
2 90	2 36
1 70	1 71
1 60	1 67
1 48	1 46
1 78	3 15
2 18	4 65
2 54	6 32
2 66	6 76
2 98	8 03
3 32	8 80

(D'Ans and Schreiner, Z phys Ch 1910, 75 103)

Sp gr of  $\text{KH}_2\text{PO}_4 + \text{Aq}$  at  $18^\circ$  containing  
 5 10 15%  $\text{KH}_2\text{PO}_4$   
 1 0341 1 0691 1 1092

(Kohlrausch, W Ann 1879 1)

Sol in 20%  $\text{KC H}_3\text{O}_2 + \text{Aq}$  (Stromeyer)  
 For solubility in  $\text{H}_2\text{O}$ , see  $\text{K}_2\text{HPO}_4$ ,  $\text{H}_3\text{PO}_4$   
 Insol in alcohol

**Potassium orthophosphate, acid,  $\text{KH}_2\text{PO}_4$**   
 $\text{H}_3\text{PO}_4$

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	% $\text{KH}_2\text{PO}_4$ , $\text{H}_3\text{PO}_4$	Solid phase
— 0 6	3 337	Ice
— 2 5	12 13	"
— 6 7	29 43	"
— 9 2	36 98	"
— 13	44	Ice + $\text{KH}_2\text{PO}_4$
0 (?)	45 8	$\text{KH}_2\text{PO}_4$
+10 9	50 3	"
65 2	68 44	"
78	72 43	"
87 5	77 6	"
105 5	85 9	"
120	92 1	" + $\text{KH}_2\text{PO}_4$ , $\text{H}_3\text{PO}_4$
135	96 1	$\text{KH}_2\text{PO}_4$ , $\text{H}_3\text{PO}_4$
139	100	"

(Parravano and Miel, Gazz ch it 38 II, 536)

Solubility in anhydrous  $\text{H}_3\text{PO}_4$  at  $t^\circ$

$t^\circ$	% $\text{KH}_2\text{PO}_4$ , $\text{H}_3\text{PO}_4$
32 5	18 17
	58 42
	77 53
	92 26

(Parravano and Miel)

**Potassium pyrophosphate,  $\text{K}_4\text{P}_2\text{O}_7 + 3\text{H}_2\text{O}$**

Very deliquescent, and sol in  $\text{H}_2\text{O}$

Precipitated from aqueous solution by alcohol (Schwarzenberg, A 65 136)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

**Potassium hydrogen pyrophosphate,**

$\text{K}_2\text{H}_2\text{P}_2\text{O}_7$

Very deliquescent, and sol in  $\text{H}_2\text{O}$  Insol in alcohol (Schwarzenberg)

**Potassium silver metaphosphate,**

$\text{K}_2\text{Ag}_4(\text{PO}_3)_6 + \text{H}_2\text{O}$

(Tammann, J pr 1892, (2) 45 417)

**Potassium sodium dimetaphosphate,**

$\text{KNaP}_2\text{O}_6 + \text{H}_2\text{O}$

Sol in 24 pts  $\text{H}_2\text{O}$  (Fleitmann, Pogg 78 339)

**Potassium sodium phosphate,  $\text{KNaHPO}_4 + 7\text{H}_2\text{O}$**

Not efflorescent Sol in  $\text{H}_2\text{O}$

**Tripotassium trisodium hexahydrogen phosphate,  $\text{H}_3\text{Na}_3\text{K}_3(\text{PO}_4)_4 + 22\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  (Fihol and Senderens, C R 3 388)

**Potassium sodium pyrophosphate,**

$\text{K}_2\text{Na}_2\text{P}_2\text{O}_7 + 12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Schwarzenberg, A 65 140)

**Potassium strontium dimetaphosphate,**

$\text{K}_2\text{Sr}(\text{P}_2\text{O}_6)_2 + 4\text{H}_2\text{O}$

As the KBa comp (Glatzel, Dissert 1880)

**Potassium strontium hexametaphosphate,**

$\text{K}_2\text{Sr}_2\text{P}_6\text{O}_{18}$

(Tammann, J pr 1892, (2) 45 435)

**Potassium strontium orthophosphate,**

$\text{KSrPO}_4$

Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Grandeau, A ch (6) 8 193)

**Potassium strontium pyrophosphate,**

$\text{K}_2\text{SrP}_2\text{O}_7$

Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Ouvrard, C R 106 1599)

**Potassium thorium phosphate,  $\text{K}_2\text{O}$ ,  $4\text{ThO}_3$ ,  $3\text{P}_2\text{O}_5$**

Insol in  $\text{HCl}$ ,  $\text{HNO}_3$ , or aqua regia (Troost and Ouvrard, C R 102 1422)

$\text{K}_2\text{O}$ ,  $1\text{hO}_3$ ,  $\text{P}_2\text{O}_5$  Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HNO}_3 + \text{Aq}$  (Troost and Ouvrard)

$6\text{K}_2\text{O}$ ,  $3\text{ThO}_3$ ,  $4\text{P}_2\text{O}_5$  Sol in acids (Troost and Ouvrard)

**Potassium tin (stannic) phosphate,  $\text{K}_2\text{O}$ ,**

$4\text{SnO}_2$ ,  $3\text{P}_2\text{O}_5$

(Ouvrard, C R 111 177)

$\text{K}_2\text{O}$ ,  $2\text{SnO}_2$ ,  $\text{P}_2\text{O}_5$  (Ouvrard)

**Potassium titanium phosphate,  $\text{K}_2\text{O}$ ,  $4\text{TiO}_3$ ,**

$3\text{P}_2\text{O}_5$

(Ouvrard C R 111 177)

$\text{K}_2\text{O}$ ,  $2\text{TiO}_3$ ,  $\text{P}_2\text{O}_5$  (Ouvrard)

**Potassium uranous phosphate,  $4\text{UO}_2$ ,  $\text{K}_2\text{O}$ ,**

$3\text{P}_2\text{O}_5$

Practically insol in conc  $\text{HNO}_3$  and  $\text{HCl}$ , even when the acids are boiling. Attacked by  $\text{HF} + \text{HNO}_3$  (Colani, A ch 1907, (8) 12 133)

**Potassium uranous metaphosphate,  $\text{UO}_2$ ,**

$\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$

Easily sol in  $\text{HNO}_3$  Sol in conc  $\text{HCl}$  (Colani)

**Potassium uranous pyrophosphate,  $3\text{UO}_2$ ,**

$6\text{K}_2\text{O}$ ,  $4\text{P}_2\text{O}_5$

Sol in acids (Colani)

**Potassium uranyl phosphate,  $\text{K}_2\text{O}$ ,  $\text{UO}_3$ ,**

$\text{P}_2\text{O}_5$

(Ouvrard, C R 110 1333)

$2\text{K}_2\text{O}$ ,  $\text{UO}_3$ ,  $\text{P}_2\text{O}_5$  (Ouvrard)

$\text{K}_2\text{O}$ ,  $2\text{UO}_3$ ,  $\text{P}_2\text{O}_5$  (Ouvrard)

- Potassium uranyl orthophosphate**,  $K(UO_2)PO_4 + 3H_2O$   
As  $NH_4$  comp (Lienau, Dissert 1898)
- Potassium vanadium phosphate**  
See Phosphovanadate, potassium
- Potassium yttrium phosphate**,  $3K_2O, Y_2O_3, 2P_2O_5$   
 $K_2O, Y_2O_3, 2P_2O_5$   
 $3K_2O, 5Y_2O_3, 6P_2O_5$  (Duboin C R 107 622)
- Potassium zinc tetrametaphosphate**,  $K_2Zn(PO_3)_4 + 6H_2O$   
Sol in 70 pts  $H_2O$  (Glatzel, Dissert 1880)
- Potassium zinc phosphate**,  $KZnPO_4$   
Insol in  $H_2O$  Sol in dil acids (Ouvrard, C R 106 1729)  
 $K_2ZnP_2O_7$  As above
- Potassium zirconium phosphate**,  $K_2O, 4ZrO_2, 3P_2O_5$   
Insol in acids or aqua regia (Troost and Ouvrard, C R 102 1422)  
 $K_2O, ZrO_2, P_2O_5$  Insol in  $H_2O, HNO_3, HCl$ , or aqua regia Sol in hot conc  $H_2SO_4$  (Troost and Ouvrard)
- Potassium phosphate selenate**  
See Selenophosphate, potassium
- Potassium hydrogen phosphate sulphate**,  $KH_2PO_4, KH_2SO_4$   
Decomp by  $H_2O$  and alcohol (Jacquelin)
- Rhodium phosphate, basic**,  $4Rh_2O_3, 3P_2O_5 + 32H_2O$   
Insol in  $H_2O$  or acids (Claus)  
 $Rh_2O_3, P_2O_5 + 6H_2O = Rh_2(PO_4)_3 + 3H_2O$  Sol in  $H_2O$  (Claus)
- Rubidium metaphosphate**,  $RbPO_3$   
Sol in  $H_2O$  (von Berg, B 1901 34 4183)
- Rubidium orthophosphate**,  $Rb_3PO_4 + 4H_2O$   
Hydroscopic, sol in  $H_2O$  pptd by alcohol (von Berg, B 1901 34 4183)
- Rubidium hydrogen orthophosphate**,  $Rb_2HPO_4 + H_2O$   
Sol in  $H_2O$ , insol in conc  $NH_4OH + Aq$ , insol in alcohol (von Berg)
- Rubidium dihydrogen orthophosphate**,  $RbH_2PO_4$   
Very sol in  $H_2O$ , pptd by alcohol (von Berg)
- Rubidium pyrophosphate**,  $Rb_4P_2O_7$   
Hydroscopic, sol in  $H_2O$  (von Berg)
- Samarium anhydrometaphosphate**,  $Sm_5P_2O_8$   
Insol in  $H_2O$  or  $HNO_3 + Aq$  (Cleve)
- Samarium orthophosphate**,  $SmPO_4$   
Scarcely attacked by boiling  $HNO_3 + 2H_2O$  (Cleve)
- Samarium pyrophosphate**,  $SmHP_2O_7 + 1\frac{1}{2}H_2O$   
(Cleve)
- Silicon phosphate**  
See Silicophosphoric acid
- Silver metaphosphate**,  $Ag_2O, 2P_2O_5 + H_2O$   
(Kroll, Z anorg 1912, 76 408)
- Silver dimetaphosphate**,  $Ag_2P_2O_6$   
Very sl sol in  $H_2O$  (Fleitmann, P 78 253)  
Sol in cold aniline metaphosphate + (Nicholson)  
Very sl sol in  $H_2O$  (Waischner, I sert 1903)  
 $+ H_2O$  Very sol in  $H_2O$  (Langheld, 1912, 45 3760)
- Silver trimetaphosphate**,  $Ag_3P_3O_9$   
Sol in 60 pts cold  $H_2O$  Can be crystallized from conc  $HNO_3 + Aq$  (Fleitmann Henneberg)  
 $+ H_2O$  (Lindbom)
- Silver hexametaphosphate**,  $Ag_6P_6O_{18}$   
Insol in  $H_2O$  Sol in  $HNO_3$  or  $NH_4OH$  Aq, and in a large excess of sodium hexametaphosphate + Aq (Rose)  
Easily decomp by  $NH_3 + Aq$   
Decomp gradually by hot  $H_2O$  1  $Ag_5P_4O_{13}$   
When freshly pptd, easily sol in  $H_2O$  Easily sol in dil acids (Ludert, Z anorg 5 15)
- Silver orthophosphate**,  $Ag_3PO_4$   
Very sl sol in  $H_2O$  1 l  $H_2O$  disso 6.5  $\times 10^{-3}$  g  $Ag_3PO_4$  at 19.46° (Pottger phys Ch 1903 46 603)  
Sol in  $H_3PO_4, HNO_3$ , or  $HCl$   $H_2O + Aq$   $NH_4OH$  or  $(NH_4)_2CO_3 + Aq$  Less easily ammonium nitrate or succinate and completely in  $(NH_4)_2SO_4 + Aq$  (Jussigne Pharm (3) 16 289)  
Insol in  $NaHPO_4 + Aq$  (Stromeyer)  
Not pptd in presence of  $Na$  citri (Spiller)  
If 1 mol  $Ag_3PO_4$  is boiled with 1 l  $Na_2CO_3$ , 44% of it is decomp (Muller)  
Readily sol in soluble hyposulphites + with decomp (Herschel)  
Insol in  $Ag$  salts + Aq (Rose)  
Insol in liquid  $NH_3$  (Gott Am Ch 1898, 20 829)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)

Insol in methyl acetate (Naumann, B 1909, 42 3790) ethyl acetate (Naumann, B 1910, 43 314)

**Silver hydrogen orthophosphate,  $\text{Ag}_2\text{HPO}_4$**

Decomp by  $\text{H}_2\text{O}$  or alcohol into  $\text{H}_3\text{PO}_4$  and  $\text{Ag}_3\text{PO}_4$  (Joly, C R 103 1071)

Sol in  $\text{H}_3\text{PO}_4 + \text{Aq}$ , insol in ether (Schwarzenberg, A 65 162)

**Silver pyrophosphate,  $\text{Ag}_4\text{P}_2\text{O}_7$**

Insol in hot or cold  $\text{H}_2\text{O}$  Sol in cold  $\text{HNO}_3 + \text{Aq}$  without decomp Decomp by hot  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$  into orthophosphate Decomp by  $\text{HCl} + \text{Aq}$  into  $\text{AgCl}$  and  $\text{H}_3\text{PO}_4$  Insol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp (Stromeyer, Schw J 58 126)

Insol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  Very sl sol in  $\text{AgNO}_3 + \text{Aq}$  (Schwarzenberg, A 65 161)

Not completely insol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  (Rose)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)

**Silver hydrogen pyrophosphate,  $\text{Ag}_2\text{H}_2\text{P}_2\text{O}_7$**

Decomp by  $\text{H}_2\text{O}$  into  $\text{Ag}_4\text{P}_2\text{O}_7$  (Hurtzig and Geuther, A 111 160)

Decomp by cold  $\text{H}_2\text{O}$  (Cavaliere, C R 1904, 139 285)

**Silver hydrogen pyrophosphate metaphosphate,  $2\text{Ag}_2\text{HP}_2\text{O}_7, \text{HPO}_3$**

Decomp by  $\text{H}_2\text{O}$  Easily sol in  $\text{HNO}_3 + \text{Aq}$  (H and G)

**Silver tetraphosphate,  $6\text{Ag}_2\text{O}, 4\text{P}_2\text{O}_5 = \text{Ag}_6\text{P}_4\text{O}_{17}$**

Insol in, but gradually decomp by boiling  $\text{H}_2\text{O}$  (Berzelius)

Sol in large excess of the corresponding  $\text{Na}$  salt +  $\text{Aq}$

**Silver dekaposphate,  $\text{Ag}_{10}\text{P}_{10}\text{O}_{41}$**

Easily sol in sodium dekaposphate +  $\text{Aq}$  (Fleitmann and Henneberg, A 65 330)

**Silver ultraphosphate,  $\text{Ag}_6\text{O}, 3\text{P}_2\text{O}_5$**

(Kroll, Z anorg 1912 76 107)

**Silver sodium dimetaphosphate,  $\text{AgNa}_2\text{P}_2\text{O}_5$**

Sol in  $\text{H}_2\text{O}$  (Fleitmann and Henneberg, Pogg 65 310)

**Silver sodium pyrophosphate,  $6\text{Ag}_2\text{P}_2\text{O}_7, \text{Na}_4\text{P}_2\text{O}_7 + 4\text{H}_2\text{O}$**

Not completely sol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  Easily sol in  $\text{HNO}_3 + \text{Aq}$  (Bur, Pogg 75 152)

Easily sol in  $\text{H}_2\text{O}$  (Stromeyer)

$\text{Ag}_3\text{Na}_2\text{P}_2\text{O}_7 + \frac{1}{2}\text{H}_2\text{O}$  Ppt (Stange, Z anorg 1896, 12 460)

**Silver uranyl phosphate,  $2\text{Ag}_2\text{O}, 6\text{UO}_3, 3\text{P}_2\text{O}_5 + 30\text{H}_2\text{O}$**

(Blinkoff Dissert 1900)

**Silver phosphate ammonia,  $\text{Ag}_3\text{PO}_4, 4\text{NH}_3$**   
(Widmann, B 17 2284)

**Sodium triphosphate,  $\text{Na}_5\text{P}_3\text{O}_{10}$**

Very sol in  $\text{H}_2\text{O}$ , decomp easily in a solution at  $100^\circ$  (Schwarz, Z anorg 189 9 253)

**Sodium monometaphosphate,  $\text{NaPO}_3$**

Insol in  $\text{H}_2\text{O}$  Sol in dil and conc acid (Maddrell, A 61 63)

Insol in acids (Graham)

Gradually decomp by alkalis

**Sodium dimetaphosphate,  $\text{Na}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$**

Deliquescent Sol in 72 pts of cold or h  $\text{H}_2\text{O}$  Verv sol in conc  $\text{HCl} + \text{Aq}$  Sol  $\text{NaOH} + \text{Aq}$  Insol in strong, verv sl sol dilute alcohol (Fleitmann Pogg 78 246)

**Sodium trimetaphosphate,  $\text{Na}_3\text{P}_3\text{O}_9 + 6\text{H}_2\text{O}$**

Sol in 4 5 pts cold  $\text{H}_2\text{O}$  Insol in stror very sl sol in dil alcohol (Fleitmann a Henneberg, A 65 307)

Decomp by boiling  $\text{H}_2\text{O}$  (Lindbom)

**Sodium tetrametaphosphate,  $\text{Na}_4\text{P}_4\text{O}_{12}$**

Sol in  $\text{H}_2\text{O}$ , cryst with about  $4\text{H}_2\text{O}$  I sol in alcohol than in  $\text{H}_2\text{O}$  (Fleitmann, Pogg 78 851)

**Sodium hexametaphosphate,  $\text{Na}_6\text{P}_6\text{O}_{18}$**

Deliquescent Very sol in  $\text{H}_2\text{O}$  Insol in alcohol (Graham Pogg 32 56)

**Sodium orthophosphate,  $\text{Na}_3\text{PO}_4 + 12\text{H}_2\text{O}$**

Not deliquescent in dry air

100 pts  $\text{H}_2\text{O}$  dissolve 19 6 pts crystals at  $15^\circ$  (Graham)

100 pts  $\text{H}_2\text{O}$  dissolve 28 3 pts  $\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$  at  $15^\circ$  (Schiff)

**Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $25^\circ$**

In 1000 g of the solution in g

$\text{Na}$	$\text{H}_3\text{PO}_4$
1 28	0 040
3 24	0 183
2 21	0 752
2 73	1 08

(D'Ans and Schreiner, Z phys Ch 1910, 101)

Sp gr of  $\text{Na}_3\text{PO}_4 + \text{Aq}$  at  $15^\circ$

$c = c, \text{Na}_3\text{PO}_4 + 12\text{H}_2\text{O}$

	Sp gr		Sp gr	c	Sp gr
1	1 0043	9	1 0399	17	1 073
2	1 0086	10	1 0455	18	1 087
3	1 0130	11	1 0492	19	1 093
4	1 0174	12	1 0539	20	1 098
5	1 0218	13	1 0586	21	1 103
6	1 0263	14	1 0633	22	1 108
7	1 0308	15	1 0681	23	1 113
8	1 0353	16	1 0729	24	1 117

(Schiff, calculated by Gerlach, Z anal 8 2)

Insol in CS<sub>2</sub> (Arctowski, Z anorg 1894, 6 257)  
 Insol in methyl acetate (Naumann, B 1909, 42 3790)  
 +10H<sub>2</sub>O (Rammelsberg)  
 Could not be obtained (Hall, J pr 94 237)  
 +7H<sub>2</sub>O (Hall)  
 Melts in crystal water at 76.6° (Graham)

Sodium hydrogen phosphate, Na<sub>2</sub>HPO<sub>4</sub>

Sol in H<sub>2</sub>O with evolution of heat

100 pts H<sub>2</sub>O dissolve at t°

t°	Pts Na <sub>2</sub> HPO <sub>4</sub>	t°	Pts Na <sub>2</sub> HPO <sub>4</sub>	t°	Pts Na <sub>2</sub> HPO <sub>4</sub>
0	1 55	40	30 88	80	81 29
10	4 10	50	43 31	90	95 02
20	11 08	60	55 29	100	108 20
30	19 95	70	68 72	106 2	114 43

(Poggiale J Pharm (3) 44 273)

100 pts H<sub>2</sub>O at 13° dissolve 3.4 pts Na<sub>2</sub>HPO<sub>4</sub>  
 (Ferein Ph Viertel, 7 244) at 15° 5.9 pts (Neese)  
 at 16° 6.3 pts (Mulder) at 16° 8.4 pts (Müller J  
 pr 95 52) at 20° 6.8 pts (Neese Russ Z Pharm 1  
 101) at 25° 12.5 pts (ibid)

Solubility in 100 pts H<sub>2</sub>O at t°

t°	Pts Na <sub>2</sub> HPO <sub>4</sub>	t°	Pts Na <sub>2</sub> HPO <sub>4</sub>	t°	Pts Na <sub>2</sub> HPO <sub>4</sub>
0	2 5	35	39 3	69	94 8
1	2 6	36	43 6	70	95 0
2	2 6	37	49 5	71	95 1
3	2 7	38	55 5	72	95 2
4	2 7	39	60 6	73	95 4
5	2 8	40	63 9	74	95 6
6	3 0	41	66 2	75	95 8
7	3 2	42	68 6	76	96 0
8	3 4	43	70 8	77	96 1
9	3 6	44	72 9	78	96 3
10	3 9	45	74 8	79	96 5
11	4 2	46	76 5	80	96 6
12	4 5	47	78 2	81	96 8
13	4 9	48	79 7	82	96 9
14	5 3	49	81 2	83	97 0
15	5 8	50	82 5	84	97 1
16	6 3	51	83 7	85	97 2
17	6 9	52	84 8	86	97 4
18	7 6	53	85 8	87	97 5
19	8 4	54	86 7	88	97 6
20	9 3	55	87 7	89	97 7
21	10 3	56	88 6	90	97 8
22	11 4	57	89 4	91	97 9
23	12 6	58	90 2	92	98 0
24	14 0	59	90 9	93	98 1
25	15 4	60	91 6	94	98 2
26	16 9	61	92 2	95	98 4
27	18 5	62	92 7	96	98 5
28	20 2	63	93 1	97	98 6
29	22 0	64	93 5	98	98 7
30	24 1	65	93 8	99	98 8
31	26 4	66	94 1	105	82 5
32	29 1	67	94 4	105 57	80 7
33	32 1	68	94 6	106 4	79 2
34	35 5				

(Mulder, Scheek Verhandl 1864 103)

Solubility in H<sub>2</sub>O at t°

t°	G Na <sub>2</sub> HPO <sub>4</sub> in 100 g H <sub>2</sub> O
10 26	3 55
25 15	12 02
40 29	54 88
60 23	83 00
99 77	102 15

Three breaks in the curve at 36.45°, transition from dodecahydrate to heptahydrate, at 48°, transition from heptahydrate to the dihydrate, at 95.2°, transition from dihydrate to the monohydrate (Shiom, C C 1909, II 106)

Solubility of Na<sub>2</sub>HPO<sub>4</sub> in H<sub>2</sub>O at t°

t°		Solid phase
-0 43	1 42	Ice
-0 24	0 70	"
-0 5*		
+0 05	1 67	Na <sub>2</sub> HPO <sub>4</sub> +12H <sub>2</sub> O
20 0	7 66	"
25 0	12 0	"
32 0	25 7	"
34 0	33 8	"
35 2*		
39 2	51 8	Na <sub>2</sub> HPO <sub>4</sub> +7H <sub>2</sub> O
45 0	67 3	"
48 3*		
50 0	80 2	Na <sub>2</sub> HPO <sub>4</sub> +2H <sub>2</sub> O
60 0		
80 0	82 9	"
90 0	92 4	"
95*	101 0	"
96 2	104 6	Na <sub>2</sub> HPO <sub>4</sub>
105 0	102 3	"
120	99 2	"

(Menzies and Humphery, Int Cong App Chem 1912, 2 177)

\* Transition points

Solubility in H<sub>2</sub>O at t°

t	100 g H <sub>2</sub> O dissolve g Na <sub>2</sub> HPO <sub>4</sub>	Solid phase
0°	2 51	Na HPO <sub>4</sub> , 12H <sub>2</sub> O
25	12 47	"
35 4*	46 11	Na HPO <sub>4</sub> , 7H <sub>2</sub> O
40 3	54 80	"
48 35*	79 00	Na HPO <sub>4</sub> , 2H <sub>2</sub> O
59 7	91 3	
71	95 1	
91	98 15	

(D'Ans and Schreiner Z phys Ch 1911, 75 99)

\*Transition points

The composition of the hydrates formed by this salt at different dilutions is calculated



from determinations of the lowering of the fr-pt produced by the salt and of the conductivity and sp gr of its aqueous solutions (Jones, Am Ch 1 1905, 34 318)

$\text{Na}_2\text{HPO}_4 + \text{Aq}$  saturated at  $15^\circ$  has 1 0469 sp gr (Michel and Krafft), saturated at  $16^\circ$ , 1 0511 (Stolba)

Sp gr of  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  at  $19^\circ$

% $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$	Sp gr	% $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$	Sp gr	% $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$	Sp gr
1	1 0041	5	1 0208	9	1 0376
2	1 0083	6	1 0250	10	1 0418
3	1 0125	7	1 0292	11	1 0460
4	1 0166	8	1 0332	12	1 0503

(Schiff, A 110 70)

Saturated solution freezes at  $-0.45^\circ$  (Rudorff, Pogg 122 337), and boils at  $105^\circ$  (Griffiths),  $105-106.4^\circ$  (Mulder),  $108.5^\circ$  (Legrand)

Sat  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  boils at  $105.5^\circ$  (Griffiths) at  $106.5^\circ$ , and contains 113.2 pts  $\text{Na}_2\text{HPO}_4$  to 100 pts  $\text{H}_2\text{O}$  (Legrand), forms a crust at  $106.4^\circ$ , and contains 108.8 pts  $\text{Na}_2\text{HPO}_4$  to 100 pts  $\text{H}_2\text{O}$  highest temp observed,  $106.8^\circ$  (Gerlach, Z anal 26 127)

B-pt of  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  containing pts  $\text{Na}_2\text{HPO}_4$  to 100 pts  $\text{H}_2\text{O}$  G=according to Gerlach (Z anal 26 450), L=according to Legrand (A ch (2) 69 426)

B-pt	G	L	B pt	G	L
100 $5^\circ$	8 6	11 0	104 $^\circ$	68 4	76 4
101	17 2	21 0	104 5	76 9	84 2
101 5	25 8	31 0	105	85 3	91 5
102	34 4	40 8	105 5	93 7	98 4
102 5	42 9	50 3	106	102 1	105 0
103	51 4	59 4	106 5	110 5	111 4
103 5	59 9	68 1	106 6		112 6

+ $\text{H}_2\text{O}$  Transition point,  $95.2^\circ$  (Shiomi)

+ $2\text{H}_2\text{O}$  Transition point,  $48.35^\circ$  (D'Ans and Schreiner),  $48^\circ$  (Shiomi),  $48.3^\circ$  (Menzies and Humphrey)

+ $7\text{H}_2\text{O}$  Not efflorescent Sol in  $\text{H}_2\text{O}$  with absorption of heat

Sol in 8 pts  $\text{H}_2\text{O}$  at  $23^\circ$  (Necse, J B 1863 181)

Transition point,  $35.4^\circ$  (D'Ans and Schreiner),  $36.45^\circ$  (Shiomi),  $35.2^\circ$  (Menzies and Humphrey)

Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $25^\circ$

In 1000 g of the solution mols	
Na	$\text{PO}_4$
6 31	4 63
6 76	4 88
7 31	5 55

(D'Ans and Schreiner, Z phys Ch 1910, 1 101)

See also above

+ $12\text{H}_2\text{O}$  Efflorescent Sol in  $\text{H}_2\text{O}$  with absorption of heat

14 pts  $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$  mixed with 1 pts  $\text{H}_2\text{O}$  at  $10.8^\circ$  lower the temperature 3 (Rudorff, B 2 68)

Sol in 8.48 pts  $\text{H}_2\text{O}$  at  $17^\circ$  or 100 pts  $\text{H}_2\text{O}$  dissoc

11.8 pts at  $17^\circ$  and solution has sp gr = 1 0422 (Schiff)

Sol in 4 pts cold and 2 pts boiling  $\text{H}_2\text{O}$  (Page)

Sol in 4 pts  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abl)

100 pts  $\text{H}_2\text{O}$  dissolve 12 735 pts  $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$

(Michel and Krafft)

100 pts  $\text{H}_2\text{O}$  dissolve 6.5 pts  $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$  at  $0^\circ$ , 27.5 pts at  $30^\circ$  (Tilden, Chem Soc 45 409)

Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $25^\circ$

In 1000 g of the solution mols	
Na	$\text{PO}_4$
2 62	1 09
1 56	0 78
2 38	1 60
3 18	2 24
4 65	3 55
5 63	3 87

(D'Ans and Schreiner, Z phys Ch 1910, 1 101)

See also above

Melts in crystal water below  $100^\circ$ , and easily forms supersaturated solutions (Cf. Tassart)

Melts in crystal  $\text{H}_2\text{O}$  at  $34.6^\circ$  (Perron),  $35^\circ$  (Kopp),  $40-41^\circ$  (Mulder)

Melts in crystal  $\text{H}_2\text{O}$  at  $35^\circ$  (Tilden, Chem Soc 45 409)

Supersaturated solutions are brought to crystallization by addition of a crystal of  $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$  or an isomorphous substance as  $\text{Na}_2\text{HAsO}_4 + 12\text{H}_2\text{O}$  (Thomson, Chem Soc 35 200)

Insol in alcohol

Sodium dihydrogen phosphate,  $\text{NaH}_2\text{PO}_4 + \text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Insol in alcohol (Graham)

+ $2\text{H}_2\text{O}$  Unchanged on air Very so in  $\text{H}_2\text{O}$ , and solubility increases rapidly with the temperature (Joly and Dufet, C R 12 1391)

100 pts  $\text{H}_2\text{O}$  dissolve 59.9 pts at  $0^\circ$ , 84.6 pts at  $18^\circ$  (Joly and Dufet)

Solubility of  $\text{NaH}_2\text{PO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$   
G of anhydrous  $\text{NaH}_2\text{PO}_4$  in 100 g  $\text{H}_2\text{O}$   
Solid phase,  $\text{NaH}_2\text{PO}_4 + 2\text{H}_2\text{O}$

$t^\circ$	G $\text{NaH}_2\text{PO}_4$	$t^\circ$	G $\text{NaH}_2\text{PO}_4$
0 1	57 86	28 0	101 71
1 0	59 08	30 0	106 45
3 0	61 47	31 0	108 93
5 0	63 82	33 0	114 31
10 0	69 87	34 0	117 14
15 0	76 72	35 0	120 44
20 0	85 21	37 0	126 76
25 0	94 63	40 2	138 16
26 0	96 73	40 55	110 83
27 0	99 20		

40  $8^\circ$ , transition point

Solid phase,  $\text{NaH}_2\text{PO}_4 + \text{H}_2\text{O}$

41	142 55	52	163 84
42	143 83	55	170 85
45	148 20	56	173 23
50	158 61	57	175 81

57  $4^\circ$ , transition point

Solid phase,  $\text{NaH}_2\text{PO}_4$

58	177 24	69	190 24
60	179 33	80	207 29
62	181 35	90	225 31
65	184 99	99 1	246 56

(Imadzu, Chem Soc 1912, **33** 359)

Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$  at  $25^\circ$

In 1000 g of the solution mols

Na	$\text{PO}_4$
6 19	4 68
6 01	4 67
5 12	4 36
4 81	4 22
4 36	4 08
4 06	4 03
4 19	4 38
4 32	4 96
4 65	5 89
4 58	6 40

(D'Ans and Schreiner, Z phys Ch 1910, **75** 101)

Trisodium trihydrogen phosphate,  
 $\text{Na}_3\text{H}(\text{PO}_4)_2$

Not hygroscopic. Sol in  $\text{H}_2\text{O}$  in all proportions (Joulie, C R 1902, **134** 604)  
 $+1\frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Filhol and Senderens, C R **93** 388)

$+7\text{H}_2\text{O}$  (Salzer, Arch Pharm 1894, **232** 365)

$+7\frac{1}{2}\text{H}_2\text{O}$  (Joulie)

Sodium orthophosphate acid,  $\text{NaH}_2\text{PO}_4$ ,  $\text{H}_3\text{PO}_4$

Hygroscopic. Decomp by alcohol (Staudenmaier, Z anorg 1894, **5** 395)

Solubility of  $\text{NaH}_2\text{PO}_4$ ,  $\text{H}_3\text{PO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	% $\text{NaH}_2\text{PO}_4$ , $\text{H}_3\text{PO}_4$	Solid phase
- 5 7	20 77	Ice
- 7 9	26 92	"
-11 4	34 15	"
-38	56 66	"
-34	80 46	$\text{NaH}_2\text{PO}_4$
+41	81 82	"
51 7	83 68	"
79 7	87 48	"
85	88 65	"
101 7	91 47	" + $\text{NaH}_2\text{PO}_4$ , $\text{H}_3\text{PO}_4$
104 5	92 67	$\text{NaH}_2\text{PO}_4$ , $\text{H}_3\text{PO}_4$
110	95 79	"
119	97 99	"
126 5	100	"

(Parravano and Miel, Gazz ch it **38**, II 536)

Solubility in anhydrous  $\text{H}_3\text{PO}_4$

$t^\circ$	% $\text{NaH}_2\text{PO}_4$ , $\text{H}_3\text{PO}_4$
98 5	52 72
111	69 59
119	77 55
122	81 71
123	87 20

(Parravano and Miel)

$+ \text{H}_2\text{O}$  Very deliquescent (Salzer, Arch Pharm 1894, **232** 369)

Sodium pyrophosphate,  $\text{Na}_4\text{P}_2\text{O}_7$ , and  
 $+10\text{H}_2\text{O}$

Less sol in  $\text{H}_2\text{O}$  than sodium hydrogen orthophosphate (Clark, Ed J Sci **7** 298)

100 pts  $\text{H}_2\text{O}$  dissolve (a) pts  $\text{Na}_4\text{P}_2\text{O}_7$ , (b) pts  $\text{Na}_4\text{P}_2\text{O}_7 + 10\text{H}_2\text{O}$  at

	$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$	$40^\circ$	$50^\circ$
a	3 16	3 95	6 23	9 95	13 50	17 41
b	5 41	6 81	10 92	18 11	24 97	33 25

	$60^\circ$	$70^\circ$	$80^\circ$	$90^\circ$	$100^\circ$
a	21 83	25 62	30 04	35 11	40 26
b	44 07	52 11	63 40	77 47	93 11

(Poggiale)

Sol in  $\text{H}_2\text{SO}_4$  (Walden, Z anorg 1902, **29** 384)

Crystallizes unchanged from  $\text{NH}_4\text{Cl} + \text{Aq}$  (Winkler), or conc  $\text{NH}_4\text{OH} + \text{Aq}$  (Uelsmann)  
Decomp into orthophosphate by heating with  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_3\text{PO}_4 + \text{Aq}$   
Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)  
Insol in alcohol Insol in methyl acetate (Naumann, B 1909, 42 3790)

**Sodium hydrogen pyrophosphate**,  $\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$   
Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  containing  $\text{HC}_2\text{H}_3\text{O}_2$  without decomp (Bayer, J pr 106 501)

Sl sol in alcohol Much more sol in  $\text{H}_2\text{O}$  than  $\text{NaH}_2\text{PO}_4$   
 $+6\text{H}_2\text{O}$  (Rammelsberg, B A B 1883 21)

100 g sat solution contain 14.95 g  $\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$  at  $18^\circ$  (Giran, A ch 1902, (7) 30 249)

$\text{NaH}_2\text{P}_2\text{O}_7$  Very hygroscopic (Salzer, Arch Pharm 1894, 232 369)

100 g sat solution contain 62.7 g at  $18^\circ$  (Giran, A ch 1902, (7) 30 249)

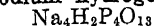
$\text{Na}_2\text{HP}_2\text{O}_7 + \text{H}_2\text{O}$  Sol in 3 pts  $\text{H}_2\text{O}$  (Salzer, Arch Pharm 1894, 232 366)

$+6\text{H}_2\text{O}$  100 g sat solution contain 28.17 g  $\text{Na}_2\text{HP}_2\text{O}_7$  at  $18^\circ$  (Giran)

**Sodium tetraphosphate**,  $\text{Na}_6\text{P}_4\text{O}_{13}$

Slowly sol in 2 pts cold  $\text{H}_2\text{O}$  Easily decomp  
 $+18\text{H}_2\text{O}$  (Uelsmann)

**Sodium hydrogen tetraphosphate**,

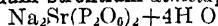


Sol in  $\text{H}_2\text{O}$

**Sodium dekaphosphate**,  $\text{Na}_4\text{P}_{10}\text{O}_{31}$

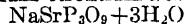
Sol in  $\text{H}_2\text{O}$  (Fleitmann and Henneberg, A 65 333)

**Sodium strontium dimetaphosphate**,



As the  $\text{NaBa}$  comp (Glatzel, Dissert 1880)

**Sodium strontium trimetaphosphate**,



Easily sol in  $\text{H}_2\text{O}$  and acids (Fleitmann, A 65 315)

**Sodium strontium orthophosphate**,  $\text{NaSrPO}_4$   
 $+ \text{H}_2\text{O}$

Scarcely sol in  $\text{H}_2\text{O}$ , sol in acids

$+9\text{H}_2\text{O}$  (Joly, C R 104 905)

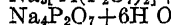
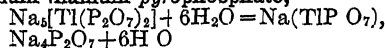
**Sodium strontium pyrophosphate** (?)

Sl sol in  $\text{H}_2\text{O}$  Insol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  (Baei, Pogg 75 166)

Easily sol in  $\text{HCl} + \text{Aq}$ , or  $\text{HNO}_3 + \text{Aq}$

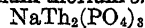
Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Sodium thallium pyrophosphate**,



Decomp by  $\text{H}_2\text{O}$  (Rosenheim, B 1915, 48 588)

**Sodium thorium orthophosphate**,



Insol in acids (Wallroth, Bull Soc (2) 39 316)

**Sodium thorium phosphate**,  $\text{Na}_2\text{O}$ ,  $4\text{ThO}_2$ ,  $3\text{P}_2\text{O}_5$

Insol in  $\text{HNO}_3$ ,  $\text{HCl}$ , or aqua regia (Troost and Ouvrard, C R 105 30)

$5\text{Na}_2\text{O}$ ,  $2\text{ThO}_2$ ,  $3\text{P}_2\text{O}_5$  Sol in  $\text{HNO}_3 + \text{Aq}$  (T and O)

$\text{Na}_2\text{O}$ ,  $\text{ThO}_2$ ,  $\text{P}_2\text{O}_5$  (T and O)

**Sodium thorium pyrophosphate**,  $\text{Na}_4\text{P O}_7$ ,  $\text{ThP}_2\text{O}_7 + 2\text{H}_2\text{O}$

(Cleve)

**Sodium tin (stannic) phosphate**,  $\text{NaSn}_2(\text{PO}_4)_3$

(Ouvrard, C R 111 177)

$\text{Na}_2\text{Sn}(\text{PO}_4)_2$  (Wunder, J pr (2) 4 339)

$6\text{Na}_2\text{O}$ ,  $3\text{SnO}_2$ ,  $4\text{P}_2\text{O}_5$  (Ouvrard)

**Sodium titanium phosphate**,  $\text{NaTi}_2(\text{PO}_4)_3$

Insol in acids (Rose, J B 1867 9)

$6\text{Na}_2\text{O}$ ,  $\text{TiO}_2$ ,  $4\text{P}_2\text{O}_5$  (Ouvrard, C R 111 177)

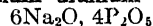
**Sodium uranium phosphate**,  $\text{UO}_2$ ,  $\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$

Easily attacked by acids (Colani, A ch 1907, (8) 12 137)

**Sodium uranium metaphosphate**,  $4\text{UO}$ ,  $\text{Na}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$

Insol in boiling  $\text{HNO}_3$  (Colani)

**Sodium uranium pyrophosphate**,  $3\text{UO}$ ,



Sol in acids (Colani)

**Sodium uranyl phosphate**,  $\text{Na}_2\text{O}$ ,  $\text{UO}_3$ ,  $\text{P}_2\text{O}_5$

(Ouvrard, C R 110 1333)

$2\text{Na}_2\text{O}$ ,  $\text{UO}_3$ ,  $\text{P}_2\text{O}_5$  (Ouvrard)

$\text{Na}_2\text{O}$ ,  $5\text{UO}_3$ ,  $2\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , decomp by acetic acid (Werther, A 68 312)

**Sodium uranyl pyrophosphate**

Very sol in  $\text{H}_2\text{O}$  (Persoz, A ch (3) 20 322)

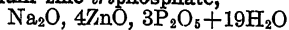
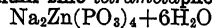
**Sodium ytterbium pyrophosphate**,  $\text{NaYbP}_2\text{O}_7$

Easily sol in the strong acids (Wallroth)

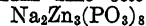
**Sodium yttrium pyrophosphate**,  $\text{NaYP}_2\text{O}_7$

Sol in  $\text{H}_2\text{O}$  (Stromeyer)

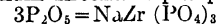
Insol in  $\text{H}_2\text{O}$  Easily sol in strong acids (Wallroth)

**Sodium zinc triphosphate,**Sol in  $\text{H}_2\text{O}$  (Schwarz, Z anorg 1895, 9 266)**Sodium zinc trimetaphosphate,  $\text{Na}_2\text{O}, 2\text{ZnO}, 3\text{P}_2\text{O}_5$** Ppt Sol in  $\text{H}_2\text{O}$  (Fleitmann and Henneberg, A 65 304)**Sodium zinc tetrametaphosphate,**

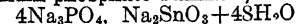
As K comp (Glatzel, Dissert 1880)

**Sodium zinc octometaphosphate,**

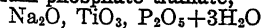
Insol in acids

Sol in conc  $\text{H}_2\text{SO}_4$  (Tammann, J pr 1892, (2) 45 420)**Sodium zinc orthophosphate,  $\text{NaZnPO}_4$** Difficultly sol in  $\text{H}_2\text{O}$  or acetic acid Easily sol in dil mineral acids (Scheffer, A 145 53) $2\text{Na}_2\text{O}, \text{ZnO}, \text{P}_2\text{O}_5$  Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Ouvrard, C R 106 1796)**Sodium zinc pyrophosphate,  $\text{Na}_2\text{ZnP}_2\text{O}_7$** Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Wallroth) $3\text{Na}_4\text{P}_2\text{O}_7, \text{Zn}_2\text{P}_2\text{O}_7 + 24\text{H}_2\text{O}$  Very efflorescent (Pahl) $\text{Na}_4\text{P}_2\text{O}_7, \text{Zn}_2\text{P}_2\text{O}_7 + 2\frac{1}{2}, 3, 3\frac{1}{2}, \text{and } 8\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  (Pahl, Sv V A F 30, 7 35) $4\text{Na}_4\text{P}_2\text{O}_7, 5\text{Zn}_2\text{P}_2\text{O}_7 + 20\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Pahl) $\text{Na}_4\text{P}_2\text{O}_7, 4\text{Zn}_2\text{P}_2\text{O}_7 + 12\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Pahl)**Sodium zirconium phosphate,  $\text{Na}_2\text{O}, 4\text{ZrO}_2,$** 

Insol in acids or aqua regia (Troost and Ouvrard, C R 105 30)

 $6\text{Na}_2\text{O}, 3\text{ZrO}_2, 4\text{P}_2\text{O}_5$  Sol in acids (T and O) $4\text{Na}_2\text{O}, \text{ZrO}_2, 2\text{P}_2\text{O}_5$  Sol in acids (T and O)**Sodium phosphate fluoride,  $\text{Na}_3\text{PO}_4, \text{NaF} + 12\text{H}_2\text{O}$** 100 pts  $\text{H}_2\text{O}$  dissolve, at  $25^\circ$ , 12 pts salt and form solution of 1.0329 sp gr, at  $70^\circ$ , 57.5 pts salt and form solution of 1.1091 sp gr (Brigleb, A 97 95) $2\text{Na}_3\text{PO}_4, \text{NaF} + 19\text{H}_2\text{O}$ , and  $22\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Baumgarten, J B 1865 219)**Sodium phosphate stannate,**

(Prandtl, B 1907 40 2132)

**Sodium phosphate titanate,**

Hygroscopic (Mazzuchelli and Pantanelli, C C 1909, II 420)

**Sodium phosphate vanadate**

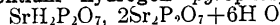
See Phosphovanadate, sodium

**Strontium monometaphosphate,  $\text{Sr}(\text{PO}_3)_2$** Insol in  $\text{H}_2\text{O}$  and acids Not decomp by alkali carbonates + Aq (Maddrell, A 61 61)**Strontium hexametaphosphate**Nearly insol in  $\text{H}_2\text{O}$ , easily sol in acids (Ludert, Z anorg 5 15)**Strontium orthophosphate, basic,  $\text{Sr}(\text{OH})_2, \text{Sr}_3(\text{PO}_4)_2$** 

(Woczyński, Z anorg 1894, 6 311)

**Strontium orthophosphate,  $\text{Sr}_3(\text{PO}_4)_2$** Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  (Erlenmeyer, J B 1857 145)**Strontium hydrogen phosphate,  $\text{SrHPO}_4$** Insol in  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{PO}_4, \text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$  (Vauquelin) Easily sol in cold ammonium nitrate, chloride, or succinate + Aq, but is partly precipitated by a little  $\text{NH}_4\text{OH} + \text{Aq}$  (Brett)Sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$  (Fuchs, 1834)

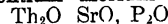
Sol in Na citrate + Aq (Spiller)

Partly decomp by boiling  $\text{Na CO}_3$ , and  $\text{K}_2\text{CO}_3 + \text{Aq}$  (Dulong) $\text{SrH}_4(\text{PO}_4) + 2\text{H}_2\text{O}$  Decomp by treating with  $\text{H}_2\text{O}$ , leaving 4.29%  $\text{SrHPO}_4$  (Barthe)**Strontium phosphate, acid,  $\text{H}_2\text{O}, 2\text{SrO}, 3\text{P}_2\text{O}_5 + x\text{H}_2\text{O}$** Entirely sol in  $\text{H}_2\text{O}$  (Barthe C R 114 1267)**Strontium pyrophosphate,  $\text{Sr P}_2\text{O}_7 + \text{H}_2\text{O}$** Somewhat sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  Insol in  $\text{HClO}_4$  or  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  (Schwarzenberg A 65 144) +  $2\frac{1}{2}\text{H}_2\text{O}$  (Knorre and Oppelt B 21 773)**Strontium hydrogen pyrophosphate,**

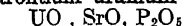
Ppt (Knorre and Oppelt B 21 772)

 $\text{SrH}_2\text{P}_2\text{O}_7, 3\text{Sr}_2\text{P}_2\text{O}_7 + \text{H}_2\text{O}$ , and  $+2\text{H}_2\text{O}$  (Knorre and Oppelt) $\text{Sr}_2\text{H}_2(\text{P}_2\text{O}_7)_3 + 8\text{H}_2\text{O}$ , and  $+12\text{H}_2\text{O}$ 

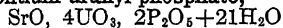
Ppt (Pahl, Gm - K 2, 2 172)

 $\text{Sr}_{18}\text{H}_2(\text{P}_2\text{O}_7)_{10} + 5\text{H}_2\text{O}$ , and  $+18\text{H}_2\text{O}$  and  $+20\text{H}_2\text{O}$ Insol in  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  or  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  (Pahl, Gm - K 2, 2 171)**Strontium thorium phosphate,**

(Colani, C R 1909, 149 209)

**Strontium uranium metaphosphate,**

(Colani, A ch 1907, (8) 12 141)

**Strontium uranyl phosphate,**

(Blinkoff, Dissert 1900)

 $2\text{SrO}, 5\text{UO}_3, 2\text{P}_2\text{O}_5 + 24\text{H}_2\text{O}$  As Ba comp (Blinkoff)**Strontium phosphate chloride,  $3\text{Sr}_3(\text{PO}_4)_2, \text{SrCl}_2$** *Strontium apatite* Insol in  $\text{H}_2\text{O}$  (Deville and Caron)**Tellurium phosphate (?)**Insol in  $\text{H}_2\text{O}$  (Berzelius)**Thalious metaphosphate,  $\text{TiPO}_3$** 

Two modifications

 $\alpha$  Difficultly sol in  $\text{H}_2\text{O}$  $\beta$  Extremely easily sol in  $\text{H}_2\text{O}$  (Lamy)**Thalious orthophosphate,  $\text{Ti}_3\text{PO}_4$** 1 pt is sol in 201 2 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and 149 $\text{H}_2\text{O}$ , sol in  $\text{HNO}_3 + \text{Aq}$ sol in  $\text{HC H}_3\text{O}_2 + \text{Aq}$  Veryolutions of  $\text{NH}_4$  salts (Car-

l in alcohol (Lamy)

**Thalious hydrogen phosphate,  $\text{Ti}_2\text{HPO}_4$** *Anhydrous* Much less sol in  $\text{H}_2\text{O}$  than the hydrous salt, but easily sol in a solution of the hydrous salt (Lamy) $+ \frac{1}{2}\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol (Lamy)Composition is  $\text{HTi}_2\text{PO}_4, 2\text{H TiPO}_4$  (Rammelsberg, W Ann 16 694)**Thalious dihydrogen phosphate,  $\text{TiH}_2\text{PO}_4$** Very easily sol in  $\text{H}_2\text{O}$  Insol in alcohol (Rammelsberg, B 3 278)**Tri-thalious trihydrogen phosphate,  $\text{Ti}_3\text{HPO}_4, 2\text{TiH}_2\text{PO}_4$** True composition of  $\text{Ti}_3\text{HPO}_4$  of Lamy (Rammelsberg)**Thalious pyrophosphate,  $\text{Ti}_2\text{P}_2\text{O}_7$** Sol in 2 5 pts  $\text{H}_2\text{O}$  with slight decomposition (Lamy) $+ 2\text{H}_2\text{O}$  More sol in  $\text{H}_2\text{O}$  than the above salt, with partial decomp (Lamy)**Thalious hydrogen pyrophosphate,  $\text{H}_2\text{Ti}_2\text{P}_2\text{O}_7, + \text{H}_2\text{O}$** Very sol in  $\text{H}_2\text{O}$  (Lamy)**Thallic phosphate, basic,  $2\text{Ti}_2\text{O}_3, \text{P}_2\text{O}_5 + 5\text{H}_2\text{O}$** Insol in  $\text{H}_2\text{O}$ **Thallic phosphate, basic,  $\text{Ti}_3\text{P}_2\text{O}_7 + 13\text{H}_2\text{O}$** 

(Rammelsberg, W Ann 16 694)

 $\text{Ti}_3\text{P}_4\text{O}_{19} + 12\text{H}_2\text{O}$  (R)**Thallic phosphate,  $\text{TiPO}_3 + 2\text{H}_2\text{O}$** Completely insol in  $\text{H}_2\text{O}$  Sol in conc  $\text{HNO}_3$ , and dil  $\text{HCl} + \text{Aq}$  (Willm)**Thorium metaphosphate,  $\text{Th}(\text{PO}_3)_4$** Insol in  $\text{H}_2\text{O}$  (Troost, C R 101 210)**Thorium metaphosphate,  $\text{ThO}_3, 2\text{P}_2\text{O}_5$** 

Insol in acids (Johnson, B 22 976)

**Thorium orthophosphate,  $\text{Th}_3(\text{PO}_4)_4 + 4\text{H}_2\text{O}$** Insol in  $\text{H}_2\text{O}$  and phosphoric acid (Berzelius), also acetic acid (Cleve)Sol in  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$  (Cleve)**Thorium hydrogen phosphate,  $\text{ThH}_2(\text{PO}_4)_2 + \text{H}_2\text{O}$** 

Precipitate

**Thorium pyrophosphate,  $\text{ThP}_2\text{O}_7 + 2\text{H}_2\text{O}$** Precipitate Insol in  $\text{H}_2\text{O}$  Sol in great excess of pyrophosphoric acid or sodium pyrophosphate +  $\text{Aq}$  (Cleve)**Thorium phosphate bromide**

See Bromophosphate, thorium

**Thorium phosphate chloride**

See Chlorophosphate, thorium

**Tin (stannous) phosphate,  $5\text{SnO}, 4\text{P}_2\text{O}_5 + 4\text{H}_2\text{O}$** Insol in  $\text{H}_2\text{O}$  (I enssen, A 114 113) $\text{Sn}_3(\text{PO}_4)_2$  Insol in  $\text{H}_2\text{O}$  Sol in mineral acids (Kuhn)Insol in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  Sol in  $\text{KOH} + \text{Aq}$ **Tin (stannic) phosphate,  $2\text{SnO}_2, \text{P}_2\text{O}_5 + 10\text{H}_2\text{O}$** Insol in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$  (Ragnoso, J p 54 261)*Anhydrous* Insol in acids (Hautefeuille and Margottet, C R 102 1017)**Tin (stannic) phosphate,  $\text{SnP}_2\text{O}_7$** 

Insol in acids (Hautefeuille und Margottet C R 102 1017)

**Tin (stannous) phosphate chloride,  $3\text{SnO}, \text{P}_2\text{O}_5, \text{SnCl}_2 + \text{H}_2\text{O}$** Not decomp by hot  $\text{H}_2\text{O}$  (I enssen, A 114 113)**Titanium phosphate,  $\text{Ti}_2\text{P}_2\text{O}_7 = 2\text{TiO}_2, \text{P}_2\text{O}_5$** 

Insol in acids (Hautefeuille and Margottet, C R 102 1017)

(Ouvrard, C R 111 177)

 $+ 3\text{H}_2\text{O}$  Ppt Insol in  $\text{H}_2\text{O}$  (Merz)

$\text{TiO}_2, \text{P}_2\text{O}_5$  (Knop) Is  $\text{NaTi}(\text{PO}_4)_3$   
(Wunder, J B 1871 324)  
 $\text{H}_2\text{TiPO}_7$  Sol in  $\text{HCl}, \text{HNO}_3, \text{H}_2\text{SO}_4$   
Sl sol in  $\text{H}_3\text{PO}_4$   
Sol in  $\text{KOH}, \text{NH}_4\text{OH}, (\text{NH}_4)_2\text{CO}_3$  and  
 $(\text{NH}_4)_2\text{HPO}_4 + \text{Aq}$   
Very sl sol in acetic acid (Faber, Z  
anal 1907, 46 288)

#### Uranous metaphosphate, $\text{U}(\text{PO}_3)_4$

Insol in  $\text{HNO}_3, \text{HCl}$ , or  $\text{H}_2\text{SO}_4$ , even  
when hot and conc (Colani, A ch 1907, (8)  
12 105)

#### Uranic metaphosphate, $\text{U}_2(\text{PO}_3)_6$

Insol in  $\text{H}_2\text{O}$  and acids (Hautefeuille and  
Margottet, C R 96 849)

#### Uranous orthophosphate, $\text{U}_3(\text{PO}_4)_4$

More easily attacked by acids than the pyro  
and meta phosphates, especially by  $\text{HNO}_3$   
(Colani, A ch 1907, (8) 12 123)

#### Uranous hydrogen orthophosphate, $\text{UHPO}_4 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Insol in dil, sl sol in  
conc  $\text{HCl} + \text{Aq}$  Decomp by  $\text{KOH} + \text{Aq}$ ,  
not by  $\text{NH}_4\text{OH} + \text{Aq}$  (Rammelsberg, Pogg  
59 1)

#### Uranous pyrophosphate, $\text{UP}_2\text{O}_7$

Insol in  $\text{H}_2\text{O}$   
Sl sol in min acids (Colani)

#### Uranous phosphate, $2\text{UO}_2, \text{P}_2\text{O}_5$

Lasly attacked by boiling  $\text{HNO}_3$   
(Colani)  
 $\text{UO}_2, \text{P}_2\text{O}_5 + 5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{SO}_4$  and  
in  $\text{HCl} + \text{Aq}$  of medium concentration Sol  
in very conc  $\text{HCl} + \text{Aq}$  (Aloy, Dissert  
1901)

#### Uranyl metaphosphate, $\text{UO}(\text{PO}_3)_3$

(Rammelsberg, B A B 1872 447)  
 $\text{UO}_2, 2\text{P}_2\text{O}_5$  Insol in acids (Johnsson,  
B 22 976)

#### Uranyl orthophosphate, $\text{UO}(\text{HPO}_4) + \frac{1}{2}\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$   
+  $3\text{H}_2\text{O}$   
+  $4\text{H}_2\text{O}$   
+  $4\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in 67,000  
pts  $\text{HCl} + \text{Aq}$  50,000 pts  $\text{NH}_4\text{Cl} + \text{H}_2\text{O}_2 +$   
 $\text{Aq}$ , and 300,000 pts of a mixture of the above  
two solutions Sol in  $\text{K}_2\text{CO}_3$  or  $\text{Na}_2\text{CO}_3 +$   
 $\text{Aq}$  (Kitschun, C N 27 199)

#### Uranyl dihydrogen phosphate,

$\text{UO}_2\text{H}_4(\text{PO}_4)_2 + 3\text{H}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{H}_3\text{PO}_4 + \text{Aq}$   
(Werther, J pr 43 322)

#### Uranyl pyrophosphate, $(\text{UO}_2)_2\text{P}_2\text{O}_7 + 5\text{H}_2\text{O}$

Efflorescent Insol in  $\text{H}_2\text{O}$  Sol in  
 $\text{HNO}_3 + \text{Aq}$ , and  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  Insol in  
 $\text{Na}_2\text{HPO}_4 + \text{Aq}$  Insol in alcohol or ether  
(Girard, C R 34 22)  
+  $4\text{H}_2\text{O}$  (Casteing, Bull Soc (2) 34 20)

#### Uranyl tetraphosphate (?), $\text{UO}_2\text{P}_4\text{O}_{11}$

(Johnsson, B 22 978)

#### Uranous orthophosphate chloride, $\text{U}_3(\text{PO}_4)_4, \text{UCl}_4$

Sl sol in  $\text{HCl} + \text{Aq}$  Sol in  $\text{HNO}_3$  and  
 $\text{HNO}_3 + \text{HCl}$  (Colani, A ch 1907, (8) 12  
127)

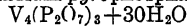
#### Uranous hydrogen orthophosphate chloride, $\text{U}(\text{HPO}_4)_2, \text{UCl}_4$

Very sl sol in  $\text{H}_2\text{O}$  (Aloy, Dissert 1901)

#### Vanadium phosphate, $(\text{VO}_2)_2\text{H}_2\text{PO}_4 + 4\frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$   
See Phosphovanadic acid

#### Vanadium pyrophosphate,



Insol in  $\text{H}_2\text{O}$  (Rosenheim, B 1915, 48  
590)

#### Divanadyl phosphate

Very deliquescent, and sol in  $\text{H}_2\text{O}$  Insol  
in alcohol (Berzelius)

#### Ytterbium metaphosphate, $\text{Yb}(\text{PO}_3)_3$

Insol in  $\text{H}_2\text{O}$  (Cleve, Z anorg 1902, 32  
149)

#### Ytterbium orthophosphate, $\text{YbPO}_4 + 4\frac{1}{2}\text{H}_2\text{O}$

Ppt (Cleve)

#### Ytterbium phosphate, $\text{Yb}_2\text{O}_3, 2\text{P}_2\text{O}_5 + 5\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Cleve)

#### Yttrium metaphosphate, $\text{Y}(\text{PO}_3)_3$

Insol in  $\text{H}_2\text{O}$  or acids (Cleve)

#### Yttrium orthophosphate, $\text{YPO}_4$

Anhydrous Insol in  $\text{H}_2\text{O}$  or acids after  
hydration

Mim *Xenotime* Insol in conc acids Sl  
sol in much conc  $\text{HCl} + \text{Aq}$ , but easily sol  
therein when first heated with a little  $\text{HCl} +$   
 $\text{Aq}$  (Wuth, A 139 237)

#### Yttrium hydrogen orthophosphate, $\text{Y}_2(\text{HPO}_4)_3$

Decomp by boiling with  $\text{H}_2\text{O}$  into insol  
 $\text{YPO}_4$  and sol acid salt

#### Yttrium pyrophosphate, $\text{YHP}_2\text{O}_7 + 3\frac{1}{2}\text{H}_2\text{O}$

Difficultly sol in acids Decomp by  
 $\text{H}_2\text{SO}_4$  Sol in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$  (Cleve)  
 $2\text{Y}_2\text{O}_3, 3\text{P}_2\text{O}_5$  Insol in acids (Johnsson,  
B 22 976)

**Zinc metaphosphate**Sol in H<sub>2</sub>O (Berzelius)**Zinc dimetaphosphate, ZnP<sub>2</sub>O<sub>6</sub>**Sol only in boiling H<sub>2</sub>SO<sub>4</sub> (Fleitmann, Pogg 78 350)Not decomp by boiling Na<sub>2</sub>S or (NH<sub>4</sub>)<sub>2</sub>S + Aq+4H<sub>2</sub>O Insol in H<sub>2</sub>O, but decomp by boiling therewith (Fleitmann, Pogg 78 253)Sol in 4 pts H<sub>2</sub>O Conc H SO<sub>4</sub> decomp it easily, other acids act slightly (Glatzel, Dissert 1880)

Difficultly decomp by boiling acids

**Zinc trimetaphosphate, Zn<sub>3</sub>(PO<sub>3</sub>)<sub>6</sub> + 9H<sub>2</sub>O**1 l H<sub>2</sub>O dissolves 0.1 g at 20° (Lamann, J pr 1892, (2) 45 426)**Zinc tetrametaphosphate, Zn<sub>4</sub>(PO<sub>3</sub>)<sub>4</sub> + 10H<sub>2</sub>O**Sol in 55 pts H<sub>2</sub>O Decomp by acids only on boiling (Glatzel, Dissert 1880)Somewhat sol in HNO<sub>3</sub> + Aq Sol in boiling H<sub>2</sub>SO<sub>4</sub> (Glatzel)**Zinc orthophosphate, Zn<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O**Insol in H<sub>2</sub>O Easily sol in acids, NH<sub>4</sub>OH, (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>, (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, or NH<sub>4</sub>NO<sub>3</sub> + Aq (Heintz, A 143 356)Sol in NH<sub>4</sub>Cl + Aq (Fuchs)

Easily sol in Zn salts + Aq (Rose)

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 930)

Min Hopeite

+6H<sub>2</sub>O (Reynoso)**Zinc hydrogen phosphate, ZnHPO<sub>4</sub> + H<sub>2</sub>O**Insol in H<sub>2</sub>O, sol in H<sub>3</sub>PO<sub>4</sub> + Aq (Graham)**Zinc tetrahydrogen phosphate, ZnH<sub>4</sub>(PO<sub>4</sub>)<sub>2</sub> + 2H<sub>2</sub>O**Nearly insol in H<sub>2</sub>O, but decomp thereby into H<sub>3</sub>PO<sub>4</sub> and 10ZnO, 4P<sub>2</sub>O<sub>5</sub> + 10H<sub>2</sub>O (Demel, B 12 1171)**Zinc phosphate, 10ZnO, 4P<sub>2</sub>O<sub>5</sub> + 10H<sub>2</sub>O**Insol in H<sub>2</sub>O (Demel, B 12 1171)**Zinc pyrophosphate, Zn P O<sub>7</sub> + 3/2 H<sub>2</sub>O**Ppt Sol in H SO<sub>4</sub> + Aq Sol in acids, KOH + Aq, NH<sub>4</sub>OH + Aq (Schwarzenberg, A 65 151)Insol in Na<sub>4</sub>P<sub>2</sub>O<sub>7</sub> + Aq (Gladstone), and in ZnSO<sub>4</sub> + Aq (Rose)

Insol in acetic acid (Knorre, Z anorg 1900, 24 389)

+5H<sub>2</sub>O Insol in H<sub>2</sub>O (Pahl, J B 1873 229)**Zinc hydrogen pyrophosphate**Sol in H<sub>2</sub>O (Pahl, Sv V A F 30, 7 45)**Zinc metaphosphate ammonia**

Ppt (Bette)

**Zinc orthophosphate ammonia, 2ZnO, P<sub>2</sub>O<sub>5</sub>, 3NH<sub>3</sub> + 8H<sub>2</sub>O**

(Rother, A 143 356)

6ZnO, 3P<sub>2</sub>O<sub>5</sub>, 8NH<sub>3</sub> + 4H<sub>2</sub>O (Schweikeit, A 145 517)**Zinc pyrophosphate ammonia, 3Zn<sub>2</sub>P<sub>2</sub>O<sub>7</sub>, 4NH<sub>3</sub> + 9H<sub>2</sub>O**Ppt Insol in H<sub>2</sub>O (Bette)**Zirconium orthophosphate, 5ZrO<sub>2</sub>, 4P<sub>2</sub>O<sub>5</sub> + 8H<sub>2</sub>O**

Somewhat sol in acids (Hermann, J pr 97 321)

Insol in acids (Paykull, Bull Soc (2) 20 65)

2ZrO<sub>2</sub>, 4P<sub>2</sub>O<sub>5</sub> Not attacked by acids (Hautefeuille and Margottet, C R 102 1017)**Zirconium pyrophosphate, Zr<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub>**

(Knop, A 159 36)

**Phosphoricovanadicotungstic acid****Ammonium phosphoricovanadicotungstate,**14(NH<sub>4</sub>)<sub>2</sub>O, 2P<sub>2</sub>O<sub>5</sub>, 7V<sub>2</sub>O<sub>5</sub>, 31WO<sub>3</sub> + 78H<sub>2</sub>OSol in H<sub>2</sub>O Insol in alcohol, ether, CS<sub>2</sub> and benzene (Rogers, J Am Chem Soc 1903, 25 305)**Phosphorimidamide, PN<sub>2</sub>H<sub>3</sub>**

(Joannis, C R 1904, 139 365)

**Phosphorimide, P<sub>2</sub>(NH)<sub>3</sub>**Very sol in ammoniacal solution of NH<sub>4</sub>I (Hugot, C R 1905, 141 1236)**Phosphornitryl, PON**

See Phosphoryl nitride

**Phosphorosomolybdic acid, P<sub>2</sub>O<sub>5</sub>,**24MoO<sub>3</sub> + 63H<sub>2</sub>O

(Rosenheim and Pinsker, Z anorg 1911, 70 77)

**Ammonium phosphorosomolybdate,**2(NH<sub>4</sub>)<sub>2</sub>O, 2H<sub>3</sub>PO<sub>4</sub>, 12MoO<sub>3</sub> + 12 1/2 H<sub>2</sub>OInsol in cold, slightly sol in hot H<sub>2</sub>O (Gibbs, Am Ch J 5 361)**Phosphorosophosphomolybdic acid****Ammonium phosphorosophosphomolybdate,**9(NH<sub>4</sub>)<sub>2</sub>O, 2H<sub>3</sub>PO<sub>4</sub>, 3P<sub>2</sub>O<sub>5</sub>, 72MoO<sub>3</sub> + 38H<sub>2</sub>ONearly insol in H<sub>2</sub>O (Gibbs)

**Phosphorosophosphotungstic acid**

**Potassium phosphorosophosphotungstate**,  
 $5K_2O, 2H_3PO, P_2O_5, 24WO_3 + 13H_2O$   
 Sol in much boiling  $H_2O$  (Gibbs, Am Ch J 7 313)

**Phosphorosotungstic acid**

**Ammonium phosphorosotungstate**,  $6(NH_4)_2O,$   
 $4H_3PO_3, 22WO_3 + 25H_2O$   
 Sl sol in cold  $H_2O$

**Potassium —**,  $5K_2O, 16H_3PO_3, 32WO_3 +$   
 $46H_2O$   
 Sl sol in hot  $H_2O$

**Sodium —**,  $2Na_2O, 8H_3PO_3, 22WO_3 +$   
 $35H_2O$   
 Nearly insol in cold, sl sol in hot  $H_2O$   
 (Gibbs, Am Ch J 7 313)

**Phosphorous anhydride,  $P_2O_3$** 

See Phosphorus trioxide

**Phosphorous acid,  $H_3PO_3$** 

Deliquescent Very sol in  $H_2O$

**Phosphites**

The neutral alkali phosphites are sol in  $H_2O$ , most of the others are sl sol in  $H_2O$ , but sol in  $H_3PO_3 + Aq$  all are insol in alcohol

**Aluminum phosphite, basic**,  $Al(HPO_3)_3$   
 $Al_2(OH)_2$   
 Ppt (Grutzn, Arch Pharm 1897, 235 698)

**Aluminum phosphite**

Precipitate (Rose, Pogg 9 39)  
 Sl sol in  $H_2O$

**Ammonium phosphite**,  $(NH_4)HPO_3 + H_2O$   
 Very deliquescent, and sol in  $H_2O$  (Rose, Pogg 9 28)  
 Sol in 2 pts cold, and less hot  $H_2O$  Insol in alcohol (Berzelius)  
 Insol in acetone (Fudmann, C C 1899, II 1014, N um un, B 1904, 37 4328)

**Ammonium hydrogen phosphite**,  
 $(NH_4)H_2HPO_3$ 

Very deliquescent, and sol in  $H_2O$  1 pt  $H_2O$  dissolves 1.71 pts salt at  $0^\circ$ , 1.9 pts at  $14.5^\circ$ , and 2.60 pts at  $31^\circ$  (Amst, C R 105 809)

**Ammonium hydroxylamine phosphite**,  
 $NH_4(NH_2OH)HPO_3$ 

Sol in  $H_2O$  and abs alcohol (Hofmann, Z anorg 1898, 16 466)

**Ammonium magnesium phosphite**,  
 $(NH_4)_2Mg_3(PO_3)_4 + 16H_2O$ 

Slightly sol in  $H_2O$  (Rammelsberg, Pogg 131 367)

**Antimonyl phosphite**,  $(SbO)_2H_2PO_3$ 

Very sol in  $H_2O$  containing  $HCl$  (Grützner, Arch Pharm 1897, 235 694)

**Barium phosphite**,  $BaHPO_3$ 

100 pts  $H_2O$  dissolve 0.25 pt (Ure)  
 Very slightly sol in  $H_2O$ , and decomp by boiling  $H_2O$  (Dulong)  
 Easily sol in  $H_2O$  containing  $NH_4Cl$  (Wackenroder, A 41 315)  
 Sol in  $H_3PO_3 + Aq$  or  $HCl + Aq$  (Railton)

**Barium hydrogen phosphite**,  $Ba_2H_2(HPO_3)_3 + 8H_2O$ 

Easily sol in  $H_2O$ , but decomp by boiling therewith Insol in alcohol (Rammelsberg, Pogg 132 496)

**Barium dihydrogen phosphite**,  $BaH_2(HPO_3)_2 + \frac{1}{2}H_2O$ 

Easily sol in  $H_2O$  (Rose, Pogg 9 215)  
 $+ H_2O$  Sol in  $H_2O$ , decomp by boiling  $H_2O$  into a neutral insol, and an acid sol salt (Wurtz, A 58 66)  
 $+ 2H_2O$  Easily sol in  $H_2O$  (Rammelsberg, Pogg 132 496)  
 Insol in alcohol (Wurtz)

**Bismuth phosphite**,  $2Bi_2O_3, 3P O_3$ 

Insol in  $H_2O$   
 $Bi_2(HPO_3)_3 + 3H_2O$  Ppt (Grutzn, Arch Pharm 1897, 235 696)  
 Decomp by  $H_2S$  Not decomp by  $KOH$  +  $Aq$  (Vannino, J pr 1906, (2) 74 151)

**Cadmium phosphite**,  $CdHPO_3 + 3H_2O$ 

Ppt (Rose, Pogg 9 41)

**Calcium phosphite**,  $CaHPO_3 + \frac{1}{2}H_2O$ 

Sl sol in  $H_2O$ , the aqueous solution is decomp by boiling  
 $+ H_2O$  Sol in  $NH_4Cl + Aq$  (Wackenroder, A 41 315)  
 Insol in alcohol

**Calcium hydrogen phosphite**,  $CaH(HPO_3) + H_2O$ 

Sol in  $H_2O$  Aqueous solution is decomp by alcohol (Wurtz, A ch (3) 7 212)

**Chromic phosphite**

Precipitate Almost insol in  $H_2O$  (Rose, Pogg 9 40)

**Cobaltous phosphite**,  $CoPHO_3 + 2H_2O$ 

Ppt Sl sol in  $H_2O$  (Rose)



**Cupric phosphite,  $\text{CuHPO}_3 + 2\text{H}_2\text{O}$** 

Ppt Insol in  $\text{H}_2\text{O}$  (Wurtz, A ch (3) 16 213)

**Didymium phosphite,  $\text{D}_{12}(\text{HPO}_3)_3$** 

Precipitate (Frerichs and Smith, A 191 331)

**Glucinum phosphite**

Precipitate Insol in  $\text{H}_2\text{O}$  (Rose, Pogg 9 39)

**Iron (ferrous) phosphite,  $\text{FeHPO}_3 + x\text{H}_2\text{O}$** 

Ppt Nearly insol in  $\text{H}_2\text{O}$  (Rose, Pogg 9 35)

**Iron (ferric) phosphite, basic,  $\text{Fe}_2(\text{HPO}_3)_3, \text{Fe}_2(\text{OH})_6$** 

(Grützner, Arch Pharm 1897, 235 697)  
 $\text{Fe}_2(\text{HPO}_3)_3, \text{Fe}(\text{OH})_3 + 5\text{H}_2\text{O}$  Hydro-  
 scopic (Berger, C R 1904, 138 1500)

**Iron (ferric) phosphite,  $\text{Fe}_2(\text{HPO}_3)_3 + 9\text{H}_2\text{O}$** 

Ppt Sol in iron alum + Aq (Rose)

**Lanthanum phosphite,  $\text{La}_2(\text{HPO}_3)_3$** 

(Smith)

**hosphite, basic,  $4\text{PbO}, \text{P}_2\text{O}_3 + 2\text{H}_2\text{O}$** 

(Rose, Pogg 9 222)

,  $\text{P}_2\text{O}_3 + \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in  
 dil  $\text{H}_3\text{PO}_3$  + Aq, from which it is  
 pptd by  $\text{NH}_4\text{OH}$  + Aq (Wurtz, A ch (3) 16 214)

**Lead phosphite,  $\text{PbHPO}_3$** 

Insol in  $\text{H}_2\text{O}$  Very sl sol in a solution  
 of phosphorous acid, easily sol in cold  $\text{HNO}_3$ ,  
 + Aq (Wurtz)

**Lead hydrogen phosphite,  $\text{PbH}_2(\text{PO}_3)_2$** 

Decomp by  $\text{H}_2\text{O}$  (Amat, C R 110 901)

**Lead pyrophosphite,  $\text{PbH}_2\text{P}_2\text{O}_5$** 

Gradually decomp by  $\text{H}_2\text{O}$  into  $\text{H}_3\text{PO}_3$  and  
 $\text{PbHPO}_3$  (Amat, C R 110 903)

**Lithium hydrogen phosphite,  $\text{LiHPO}_3$** 

Very sol in  $\text{H}_2\text{O}$  (Amat A ch (6) 24 309)

**Lithium pyrophosphite,  $\text{LiH}_2\text{P}_2\text{O}_5$** 

Very sol in  $\text{H}_2\text{O}$  (Amat A ch 1891, (6) 24 352)

**Magnesium phosphite,  $\text{MgHPO}_3 + 3\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  (Rose, Pogg 9 28)  
 Sol in 400 pts  $\text{H}_2\text{O}$  (Berzelius)  
 +  $4\text{H}_2\text{O}$

**Magnesium pyrophosphite,  $\text{Mg}(\text{H}_2\text{P}_2\text{O}_5)$** 

Very sol in  $\text{H}_2\text{O}$  (Amat A ch 1891, (6) 24 313)

**Manganous phosphite,  $\text{MnHPO}_3 + \frac{1}{2}\text{H}_2\text{O}$** 

Difficultly sol in  $\text{H}_2\text{O}$ , easily in  $\text{MnCl}_2$  or  
 $\text{MnSO}_4$  + Aq (Rose, Pogg 9 33)

**Nickel phosphite,  $\text{NiHPO}_3 + 3\frac{1}{2}\text{H}_2\text{O}$** 

Ppt Sl sol in  $\text{H}_2\text{O}$

**Potassium phosphite,  $\text{K}_2\text{HPO}_3$** 

Very deliquescent Very sol in  $\text{H}_2\text{O}$   
 Insol in alcohol (Dulong)

**Potassium hydrogen phosphite,  $(\text{KH})\text{HPO}_3$** 

1 pt  $\text{H}_2\text{O}$  dissolves about 172 pts salt at  
 $20^\circ$  (Amat C R 106 1351)

$\text{K}_2\text{HPO}_3, 2\text{H}_3\text{PO}_3$  Very sol in  $\text{H}_2\text{O}$   
 (Wurtz, A 58 63)

Sol in 3 pts cold, and in less hot  $\text{H}_2\text{O}$   
 (Fourcroy and Vauquelin)

**Potassium pyrophosphite,  $\text{K}_2\text{H}_2\text{P}_2\text{O}_5$** 

Very sol in  $\text{H}_2\text{O}$  (Amat A ch (6) 24 351)

**Sodium phosphite, basic,  $\text{Na}_2\text{HPO}_3, \text{NaOH} (?)$** 

Not obtained in pure state (Zimmerman,  
 B 7 290), =  $\text{Na PO}_3$  (Wislizenus)

Does not exist (Amat)

**Sodium phosphite,  $\text{Na}_2\text{HPO}_3 + 5\text{H}_2\text{O}$** 

Deliquescent, and very sol in  $\text{H}_2\text{O}$  In-  
 sol in alcohol

Correct formula for  $\text{Na}_3\text{PO}_3$  of Rose and  
 Dulong

**Sodium hydrogen phosphite,  $(\text{NaH})\text{HPO}_3 + 2\frac{1}{2}\text{H}_2\text{O}$** 

0.56 pt salt dissolves in 1 pt  $\text{H}_2\text{O}$  at  $0^\circ$ ,  
 0.66 pt at  $10^\circ$  1.93 pts at  $42^\circ$  (Amat,  
 C R 106 1351)

$\text{Na H}_2(\text{HPO}_3)_3 + \text{H}_2\text{O}$  Deliquescent in  
 moist air Sol in 2 pts cold, and about the  
 same amt hot  $\text{H}_2\text{O}$  Sl sol in spirit (Four-  
 croy and Vauquelin)

**Sodium pyrophosphite,  $\text{Na}_2\text{H}_2\text{P}_2\text{O}_5$** 

Very sol in  $\text{H}_2\text{O}$  with gradual decomp into  
 $\text{Na}_2\text{HPO}_3$  (Amat)

**Strontium phosphite,  $\text{SrHPO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$** 

Difficultly sol in  $\text{H}_2\text{O}$  Aqueous solution  
 decomp on heating into a sol acid salt and  
 an insol basic salt

**Strontium hydrogen phosphite,  $\text{SrH}_2(\text{PO}_3)_2$** 

Very sol in  $\text{H}_2\text{O}$  (Amat, A ch (6) 24 312)

**Thallous hydrogen phosphite,  $\text{THPO}_3$** 

Very sol in  $\text{H}_2\text{O}$  (Amat, A ch (6) 24 310)

**Thallous pyrophosphite,  $\text{TH}_2\text{P}_2\text{O}_5$** 

Deliquescent Very sol in  $\text{H}_2\text{O}$  (Amat)

**Tin (stannous) phosphite,  $\text{SnHPO}_3$**

Ppt Sol in  $\text{HCl} + \text{Aq}$  (Rose, Pogg 9 45)

**Tin (stannic) phosphite,  $2\text{SnO}_2, \text{P}_2\text{O}_3$**

Ppt (Rose, Pogg 9 47)

**Titanium phosphite (?)**

Precipitate (Rose, Pogg 9 47)

**Uranyl phosphite,  $(\text{UO})_2\text{H}_2(\text{HPO}_3)_4 + 12\text{H}_2\text{O}$**

Precipitate (Rammelsberg Pogg 132 500)

**Zinc phosphite,  $\text{ZnHPO}_3$**

Sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 132 481)

+  $2\frac{1}{2}\text{H}_2\text{O}$  More easily sol in cold than warm  $\text{H}_2\text{O}$  (Rammelsberg)

**Zinc phosphite, acid,  $\text{Zn}_2\text{H}_3\text{P}_3\text{O}_8$**

Sol in  $\text{H}_2\text{O}$

+  $2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 132 498)

$\text{Zn}_3\text{H}_3\text{P}_3\text{O}_{13}$  Sol in  $\text{H}_2\text{O}$

+  $3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Rammelsberg)

$\text{Zn}_2\text{H}_3\text{P}_3\text{O}_{14}$  Sol in  $\text{H}_2\text{O}$

+  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Zirconium phosphite,  $\text{Zr}(\text{PO}_3)_2 + \text{H}_2\text{O}$**

Ppt Nearly insol in dil mineral acids (Hauser, Z anorg 1913 84 92)

**Phosphorous anhydride,  $\text{P}_2\text{O}_3$**

See Phosphorus trioxide

**Phosphorus, P**

(a) *Ordinary white phosphorus* Insol in  $\text{H}_2\text{O}$ , but slowly decomp thereby (G K), very sl sol in  $\text{H}_2\text{O}$  (Berchius and others)

A pure aqueous solution containing 0.1 g P in 500 cc  $\text{H}_2\text{O}$  can be obtained by dissolving 0.1 g P in  $\text{CS}_2$  mixed with ether and hot alcohol, this solution is poured into 500 cc boiling  $\text{H}_2\text{O}$  free from air, and the boiling continued with stirring until the alcohol, ether and  $\text{CS}_2$  are boiled off (Pokorny, Ch Ztg 1896, 20 1022)

100 g  $\text{H}_2\text{O}$  sat. with P contains 0.0003 g P (Stich, C C 1903, I 1291)

Sol with decomp in hot conc  $\text{HNO}_3 + \text{Aq}$

Decomp by boiling caustic alkalis +  $\text{Aq}$

Easily sol in  $\text{SCL}_2$ , especially if hot (Wohler)

Sol in sulphur phosphides

Largely sol in  $\text{PCl}_3$

Easily sol in  $\text{PCl}_5$

Sol in  $\text{PBr}_3$  Sol in  $\text{PSCL}_3$ , easily on warming, separating on cooling (Serullas, A ch 1829, 42 25)

Sol in liquid  $\text{SO}_2$  (Sestini, Bull Soc 1868, (2) 10 226)

Sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Sol in  $\text{S}_2\text{Cl}_2$  without foaming (Nicolardot, C R 1908, 147 1304)

Sol in  $\text{PS}_2\text{Cl}_3$  (Gladstone, A 1850, 74 91)

Sol in 320 pts cold alcohol of 0.799 sp gr, and in 240 pts of the same when warm

Pptd from alcoholic solution by  $\text{H}_2\text{O}$  (Buchner)

One gram P dissolves in 1 ounce abs alcohol (Schacht)

Sol in 20 pts absolute ether at  $20^\circ$  and 240 pts ordinary ether at  $20^\circ$  (Bucholz)

Sol in 80 pts absolute ether at  $15.5^\circ$ , and 240 pts ordinary ether at  $15.5^\circ$  (Brugnattelli, A ch 24 73)

Solubility of  $\text{P}_4$  in 100 g ether at  $t^\circ$

$t^\circ$	G phosphorus	Sp gr
0	0.4335	
5	0.62	
8	0.79	
10	0.85	
15	0.9	at $13^\circ$ 0.7257
18	1.005	
20	1.04	at $19^\circ$ 0.7187
23	1.121	
25	1.39	0.7283
28	1.601	
30	1.75	
33	1.8	
35	1.9984	

(Christomanos, Z anorg 1905, 45 136)

Solubility of  $\text{P}_4$  in 100 g benzene at  $t^\circ$

$t^\circ$	G phosphorus	Sp gr
0	1.513	
5	1.99	
8	2.31	
10	2.4	
15	2.7	at $13^\circ$ 0.8959
18	3.1	
20	3.21	at $19^\circ$ 0.8912
23	3.3995	at $22^\circ$ 0.8875
25	3.7	0.8861
28	4.35	
30	4.601	
33	5.0	
35	5.17	
40	5.75	
45	6.105	
50	6.8	
55	7.315	
60	7.9	
65	8.4	
70	8.898	
75	9.4	
81	10.027	

(Christomanos)

Sol to about 1% in acetic acid (Vulpius, Arch Pharm 1878, 213 38)  
 100 g 96% acetic acid dissolve 0 105% P (Stich, Pharm Ztg 1903, 48 343)  
 Sol in 0 05 pt CS<sub>2</sub> (Bottger), 0 125 pt (Trommsdorf)  
 Alcohol ppts P from CS<sub>2</sub> solution  
 1 pt CS<sub>2</sub> dissolves 17-18 pts P (Vogel, J B 1868 149)

Solubility in CS<sub>2</sub> at t°  
 (g per 100 g of solution)

t°	G P <sub>4</sub>	t°	G P <sub>4</sub>
-10	31 40	-2 5	75 00
-7 5	35 85	0 0	81 27
-5	41 95	+5 0	86 30
-3 5	66 14	+10 0	89 80
-3 2	71 72		

(Cohen and Inouye, Z phys Ch 1910, 72 418)

Very sol in methylene iodide (Retgers, Z anorg 3 343)

Strong vinegar dissolves P (Beudet)  
 Sol in considerable amount in stearic acid (Vulpius, Arch Pharm (3) 13 38)

Sol in ethyl chloride, benzoyl chloride, stannic chloride, and in liquid cyanogen

Sl sol in ethyl nitrite, and wood-spirit  
 Sl sol in acetone, with gradual decomposition

Insol in nicotine, and conune  
 Sl sol in cold, more sol in hot benzene (Mansfield)

Sol in 14 pts hot, and less in cold petroleum from Amiano (Saussure)

Sl sol in "liquid paraffine" (Crismer, B 17 649)

Sl sol in warm essential oils, as oil of turpentine, and in the fatty oils

Sol in hot oil of copaiba, separating out on cooling

Sol in hot oil of caraway, and mandarin oil (Luca)

Sl sol in cold, more sol in hot caoutchun, depositing on cooling

Readily sol in warm, less in cold styrene  
 Sol in aniline, and quinoline (Hofmann)

Sl sol in cold creosote  
 Somewhat sol in fusel oil

Easily sol in valerianic acid, and amyl valerate

Sol in hexyl alcohol, ethylene chloride, allyl sulphocyanide, mercury methyl, chloroform, bromoform, warm chloral, acetic ether, aldehyde, hot cacodyl sulphide, and in cacodyl oxide

100 g oil of almonds sat with P contain 1 25 g (Stich, C C 1903, I 1291)

100 g oleic acid sat with P contain 1 06 g (Stich)

100 g paraffine sat with P contain 1 g (Stich)

(b) *Amorphous phosphorus* Insol in H<sub>2</sub>O  
 Insol in NH<sub>4</sub>OH+Aq (Fluckiger)

Sol in boiling KOH+Aq

The statement of Burgess and Chapman, (Chem Soc 79 1235) that red P is sol in aqueous alcoholic alkali is incorrect Both ordinary crystalline and amorphous red P are insol in aqueous alcoholic alkali (Michaelis, A 1902, 325 367)

Insol in liquid NH<sub>3</sub> (Hugot, A ch 1900 (7) 21, 31), (Franklin, Am Ch J 1898, 20 828)

Bright red variety is sol in liquid NH<sub>3</sub> at ord temp leaving a black residue (Stoch, Bottcher and Lenger, B 1909, 42 2854)

*Red Amorphous*

Sol in S<sub>2</sub>Cl<sub>2</sub> with foaming (Nicolardot, C R 1908, 147 1304)

Solubility of amorphous bright red P<sub>4</sub> in PBr<sub>3</sub> is diminished by long heating as follows

	172°	185°
Initial concentration	0 555	0 476
Final concentration	0 374	0 397
Length of expt in hours	34	24

	198°	218°
	0 592	0 476
	0 416	0 592
	18	17

(Buck, Dissert 1904)

Ordinary amorphous P<sub>4</sub> is sol in PBr<sub>3</sub>

A sample prepared by heating bright red amorphous P with 94 2% P dissolved by heating in PBr<sub>3</sub> as follows

% P	0 106	0 121	0 178
hours	10	20	42

A finely pulverized commercial product containing 98 0% P

% P	0 92	0 116
hours	10	20

An ordinary commercial product with 98% P

% P	0 056	0 108
hours	10	42

(Buck)

100 g PBr<sub>3</sub> dissolve 0 2601 g bright red phosphorus at 172°, 0 3634 g at 184° (Schenk, B 1902, 35 35;)

Insol in KOH+Aq

Conc H<sub>2</sub>SO<sub>4</sub> does not act upon it in the cold, but dissolves easily when hot

Insol in dil, easily sol in conc HNO<sub>3</sub>+Aq with decomposition

Much more sol in HNO<sub>3</sub>+Aq than ordinary P (Personne, C R 45 115)

Insol in methylene iodide (Retgers)

Appreciably sol in isobutyl alcohol (Svedberg)

Insol in CS<sub>2</sub>, alcohol, ether, naphtha, ligroine, PCl<sub>3</sub>, etc

Sl sol in boiling oil of turpentine and

other high-boiling liquids, with conversion into ordinary phosphorus

Insol in oil of turpentine even at 270° (Colson, A ch 1908, (8) 14 554)

(c) *Crystalline* Insol in, and not attacked by dil  $\text{HNO}_3 + \text{Aq}$

Sol in  $\text{CS}_2$

#### Phosphorus tribromide, $\text{PBr}_3$

Decomposed by  $\text{H}_2\text{O}$ , slowly at 8°, but very rapidly at 25° (Löwig, Pogg 14 485)

Sol in liquid  $\text{H}_2\text{S}$  (Antony and Magri, Gazz ch it 1905, 35 (1) 206)

Sol in  $\text{AlBr}_3$  (Isbekow, Z anorg 1913, 84 27)

Sol in ether, acetone,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$  and  $\text{CS}_2$  (Christomanos, Z anorg 1904, 41 287)

#### Phosphorus pentabromide, $\text{PBr}_5$

Fumes on air, and is violently decomp by  $\text{H}_2\text{O}$

#### Phosphorus tribromide ruthenium bromide, $\text{Ru}_2\text{P}_3\text{Br}_{19}$

Decomp by boiling  $\text{H}_2\text{O}$

Slowly sol in hot alcohol with decomp

Insol in benzene,  $\text{CCl}_4$ , ligroin and cold alcohol (Strecker, B 1909, 42 1775)

#### Phosphorus thiophosphoryl bromide, $\text{PBr}_3$ , $\text{PSBr}_3$

Decomp by  $\text{H}_2\text{O}$  into  $\text{PSBr}_3$  (Michaelis)

#### Phosphorus tribromide ammonia, $3\text{PBr}_3$ , $5\text{NH}_3$

Slowly but completely sol with decomp in  $\text{H}_2\text{O}$  (Storer's Dict)

#### Phosphorus pentabromide ammonia, $\text{PBr}_5$ , $9\text{NH}_3$

(Besson, C R 111 972)

#### Phosphorus monobromotetrachloride, $\text{PBrCl}_4$

Decomp by  $\text{H}_2\text{O}$  (Prinvault, C R 74 868)

#### Phosphorus dibromo/trichloride, $\text{PCl}_3\text{Br}_2$

Very unstable (Michaelis, B 5 9)

#### Phosphorus tetrabromotrichloride, $\text{PCl}_3\text{Br}_4$

Decomp with  $\text{H}_2\text{O}$  (Geuther)

#### Phosphorus heptabromodichloride, $\text{PCl}_2\text{Br}_7$

Very unstable (Prinvault, C R 74 868)

#### Phosphorus octobromotrichloride, $\text{PCl}_3\text{Br}_8$

Very easily decomp (Michaelis, B 5 9)

#### Phosphorus bromofluoride, $\text{PF}_3\text{Br}_2$

Decomp violently with  $\text{H}_2\text{O}$  (Moissan, Bull Soc (2) 43 2)

#### Phosphorus bromonitride

See Nitrogen bromophosphide

#### Phosphorus dichloride, $\text{P}_2\text{Cl}_4$

Decomp by  $\text{H}_2\text{O}$  (Besson, C R 1910, 150 103)

#### Phosphorus trichloride, $\text{PCl}_3$

Gradually decomp by  $\text{H}_2\text{O}$

0.11 g is sol in 100 ccm liquid  $\text{H}_2\text{S}$  (Antony, Gazz ch it 1905, 35 (1) 206)

Acted upon by liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Miscible with  $\text{CS}_2$ ,  $\text{C}_6\text{H}_6$ ,  $\text{CHCl}_3$ , and ether

Decomp with alcohol

#### Phosphorus pentachloride, $\text{PCl}_5$

Very deliquescent, and sol in  $\text{H}_2\text{O}$  with violent decomp and evolution of heat

Sol in liquid  $\text{HCl}$  Acted upon by liquid  $\text{NH}_3$

Somewhat sol without decomp in  $\text{CS}_2$  (Schiff, A 102 118 (Franklin, Am Ch J 1898, 20 828))

Sol without decomp in benzoyl chloride (Gerhardt)

Sol in oil of turpentine with evolution of heat

#### Monophosphorus platinous chloride, $\text{PCl}_3$ , $\text{PtCl}_2$

Deliquescent Sol in  $\text{H}_2\text{O}$  with formation of chloroplatinophosphoric acid

Similarly decomp by alcohol Abundantly sol in hot benzene, toluene, chloroform, or carbon tetrachloride, and crystallizes on cooling (Schutzenberger, Bull Soc (2) 17 482)

#### Diphosphorus platinous chloride, $2\text{PCl}_3$ , $\text{PtCl}_2$

Decomp by  $\text{H}_2\text{O}$  with formation of chloroplatinodiphosphoric acid

Similarly decomp by alcohol Sol without decomp in  $\text{PCl}_3$ ,  $\text{CCl}_4$ ,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$ , or  $\text{C}_7\text{H}_8$  (Schutzenberger)

Sol in propyl alcohol with formation of the propyl ether of platinochlorophosphorous acid and  $\text{HCl}$  (Pomoy, C R 104 364)

#### Phosphorus diphlatinous chloride, $\text{PCl}_3$ , $2\text{PtCl}_2$

Sol in alcohol, with formation of ether ( $\text{PtCl}_2)_2\text{P}(\text{OC}_2\text{H}_5)_3$  (Cochin, C R 86 1402)

#### Phosphorus platonic chloride, $\text{PCl}_3$ , $\text{PtCl}_4$

(Schutzenberger)

#### Phosphorus pentachloride platonic chloride, $\text{PCl}_3$ , $\text{PtCl}_4$ , or $(\text{PCl}_3)_2\text{PtCl}_6$

Decomp at once by  $\text{H}_2\text{O}$  (Baudrimont, A ch (4) 2 47)

**Phosphorus pentachloride selenium tetrachloride**,  $2\text{PCl}_5$ ,  $\text{SeCl}_4$

Sol in  $\text{H}_2\text{O}$  with decomp (Baudrimont, A ch (4) 2 5)

**Phosphorus trichloride ruthenium chloride**,  $\text{Ru}_2\text{P}_2\text{Cl}_{10}$

Slowly decomp by boiling  $\text{H}_2\text{O}$

Sol in benzene and  $\text{CHCl}_3$

Sl sol in  $\text{CCl}_4$  Insol in ligroin (Strecker, B 1909, 42 1774)

**Phosphorus tellurium chloride**,  $\text{PCl}_5$ ,  $2\text{TeCl}_4$

Very deliquescent

Sol in  $\text{H}_2\text{O}$  (Metzner, A ch 1898, (7) 15 203)

**Phosphorus pentachloride stannic chloride**,  $\text{PCl}_5$ ,  $\text{SnCl}_4$

Very deliquescent Sol in much  $\text{H}_2\text{O}$  with evolution of heat, forming  $\text{SnCl}_4$ ,  $\text{HCl}$ , and  $\text{H}_3\text{PO}_4$ , and soon separates out stannic phosphate (Casselmann, A 83 257)

**Phosphorus trichloride titanium chloride**,  $\text{PCl}_3$ ,  $\text{TiCl}_4$

(Bertrand, Bull Soc (2) 33 565)

**Phosphorus pentachloride titanium chloride**,  $\text{P}_2\text{Cl}_{10}$ ,  $\text{TiCl}_4$

Deliquescent Decomp by  $\text{H}_2\text{O}$  and alcohol Sol in ether Sl sol in  $\text{PCl}_3$  (Tuttschew, A 141 111)

Completely sol in dil acids (Weber)

**Phosphorus uranium pentachloride**,  $\text{PCl}_5$ ,  $\text{UCl}_5$

Decomp with  $\text{H}_2\text{O}$

**Phosphorus pentachloride zirconium chloride**,  $\text{PCl}_5$ ,  $\text{ZrCl}_4$

Decomp by  $\text{H}_2\text{O}$  with pptn of Zr phosphate (Paykull)

**Phosphorus trichloride ammonia**,  $\text{PCl}_3$ ,  $5\text{NH}_3$

Insol as such in  $\text{H}_2\text{O}$ , but slowly decomp by boiling  $\text{H}_2\text{O}$  More easily sol with decomp in acids Sol with decomp by boiling with  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$  (Berzelius)

**Phosphorus pentachloride ammonia**,  $\text{PCl}_5$ ,  $5\text{NH}_3$

Properties as  $\text{PCl}_3$ ,  $5\text{NH}_3$  (Berzelius)  
 $\text{PCl}_5$ ,  $8\text{NH}_3$  Sl decomp on air (Besson, C R 111 972)

**Phosphorus pentachloride tungsten trioxide**,  $2\text{PCl}_5$ ,  $\text{WO}_3(?)$

(Persoz and Bloch, C R 28 389)

**Phosphorus chlorobromide**

See Phosphorus bromochloride

**Phosphorus chlorofluoride**,  $\text{PCl}_2\text{F}_3$

Absorbed by  $\text{H}_2\text{O}$  with decomp Absorbed by alcohol or ether (Poulenc, A ch (6) 24 555)

**Phosphorus chloriodide**,  $\text{PCl}_3\text{I}_2$

Decomp by moist air or  $\text{H}_2\text{O}$  Sol in  $\text{CS}_2$  (Most, B 13 2029)

**Phosphorus chloronitride**

See Nitrogen chlorophosphide

**Phosphorus trifluoride**,  $\text{PF}_3$

Decomp slowly by  $\text{H}_2\text{O}$  (Moissan, Bull Soc (2) 43 2)

Rapidly absorbed by  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ , slowly by  $\text{BaO}_2\text{H}_2$ , and  $\text{K}_2\text{CO}_3 + \text{Aq}$  Absorbed by absolute alcohol with decomp (Moissan, C R 99 655)

**Phosphorus pentafluoride**,  $\text{PF}_5$

Fumes on air (Thorpe, A 182 20)

**Phosphorus pentafluoride ammonia**,  $2\text{PF}_5$ ,  $5\text{NH}_3$

(Moissan, C R 101 1490)

**Phosphorus pentafluoride nitrogen peroxide**

Decomp by  $\text{H}_2\text{O}$  (Tassel, C R 110 1264)

**Phosphorus fluobromide**

See Phosphorus bromofluoride

**Phosphorus fluochloride**

See Phosphorus chlorofluoride

**Phosphorus subiodide**,  $\text{P}_4\text{I}$

Sol in dil  $\text{HNO}_3$  and in alkalis +  $\text{Aq}$  (Boulouch, C R 1905, 141 257)

**Phosphorus diiodide**,  $\text{P}_2\text{I}_4$

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{CS}$  (Corenwinder, A ch (3) 30 242)

0.09 g is sol in 100 ccm liquid  $\text{H}_2\text{S}$  (Antony, C C 1905, I 1692)

**Phosphorus triiodide**,  $\text{PI}_3$

Very deliquescent Decomp in moist air and by  $\text{H}_2\text{O}$  (Corenwinder, A ch (3) 30 242)

Very sol in  $\text{CS}_2$

**Phosphorus pentaiodide**,  $\text{PI}_5(?)$

(Hampton, C N 42 180)

**Phosphorus iodosulphide**

See Phosphorus sulphoiodide

**Phosphorus nitride**,  $\text{P}_3\text{N}_5$

Very slightly decomp by long boiling with  $\text{H}_2\text{O}$

Completely insol in any solvent (Stock, B 1903, 36 317)

**Phosphorus suboxide,  $P_4O$** 

Unchanged in dry, gradually oxidized in moist air Insol in  $H_2O$ , alcohol, ether, and oils, not acted on by  $HCl + Aq$ , oxidized by  $HNO_3$  or  $H_2SO_4$  (Marchand, J pr 13 442)

Sl sol in  $H_2O$  (le Verrier, A 27 167)

Forms hydrate  $P_4O, 2H_2O$ , which gives up its  $H_2O$  when dried

Two modifications (a) decomp slowly by  $H_2O$  or alkalies, (b) not decomp by  $H_2O$  or alkalies (Reinitzer and Goldschmidt, B 13 847)

Is oxyphosphuretted hydrogen (?),  $P_4H(OH)$  (Franke, J pr (2) 35 341)

**—  $H_3P_2O$** 

Insol in all solvents Decomp by  $H_2O$  Not attacked by non-oxidizing acids Decomp by dil alkalies (Gautier, C R 76 173)

**—  $P_4HO$** 

Insol in nearly all substances Not attacked by dilute acids, oxidized by ordinary  $HNO_3$ , and conc  $H_2SO_4$  at  $200^\circ$  Attacked by very dil alkaline solutions Perhaps identical with phosphorus suboxide  $P_4O$  (Gautier, C R 76 49)

**Phosphorus oxide,  $P_2O$** 

Decomp by heating with  $H_2O$  at  $100^\circ$  (Besson, C R 1897, 124 764)

**Phosphorus trioxide,  $P_4O_6$  (formerly  $P_2O_3$ )**

Deliquescent, but very slowly dissolved by cold  $H_2O$  to form  $H_3PO_3$  Violently decomp by hot  $H_2O$  or alcohol

Sol without decomp in ether, carbon disulphide, benzene, or chloroform (Thorpe and Tutton, Chem Soc 57 545)

**Phosphorus tetroxide,  $P_2O_4$** 

Very deliquescent Sol with evolution of heat in  $H_2O$  (Thorpe and Fulton, Chem Soc 49 833)

**Phosphorus pentoxide,  $P_2O_5$** 

Very deliquescent Sol in  $H_2O$  with great evolution of heat, forming  $H_3PO_4$

Insol in liquid  $NH_3$  (Franklin, Am Ch J 1898, 20 828)

Insol in acetone (Fidmann, C C 1899, II 1014), (Naumann, B 1904, 37 4329)

**Phosphorus sulphur oxide,  $P_2O_5, 3SO_3 = (PO)_2(SO_4)_3$  (phosphoryl sulphate) (?)**

Decomp by  $H_2O$  Sol in cold, more sol in warm  $SO_3$  (Weber, B 20 86)

**Phosphorus oxy-compounds**

See under Phosphoryl compounds

**Phosphorus oxysulphide**

See Phosphorus sulphoxide

**Phosphorus semiselenide,  $P_4Se$** 

Decomp with  $H_2O$  Insol in cold, decomp by boiling  $KOH + Aq$  Insol in, but apparently decomp by alcohol and ether Easily sol in  $CS_2$  (Hahn, J pr 93 430)

**Phosphorus monoselenide,  $P_2Se$** 

Stable in dry, decomp in moist air and by  $H_2O$  Insol in alcohol and ether Decomp by boiling  $KOH + Aq$   $CS_2$  dissolves out P (Hahn, J pr 93 430)

Sl sol in  $CS_2$  (Gore, Phil Mag (4) 30 414)

**Phosphorous sesquiselenide,  $P_4Se_3$** 

Sol in  $CCl_4$ , sl sol in  $CS_2$  (Meyer, 7 anorg 1902, 30 258)

**Phosphorus triselenide,  $P_2Se_3$** 

Decomp by boiling  $H_2O$  and slowly in moist air Easily sol in cold  $KOH + Aq$ , less easily in  $M_2CO_3 + Aq$  Insol in alcohol, ether, and  $CS_2$  (Hahn, J pr 93 430)

**Phosphorus pentaselenide,  $P_2Se_5$** 

Slowly decomp in moist air or by  $H_2O$ , easily by  $KOH + Aq$  or alcohol Insol in  $CS_2$  Sol in  $CCl_4$  (Hahn, J pr 93 430)

**Phosphorus selenides with  $M_2Se$** 

See M phosphoselenide, under M

**Phosphorus semisulphide,  $P_4S(?)$** 

1 *Liquid* Not decomp by, and insol in boiled  $H_2O$  Insol in alcohol and ether Sl sol in fats and volatile oils, decomp by alkalies Dissolves P on warming, with separation on cooling Sol in  $CS_2$

2 *Red modification* Not attacked at first by  $HNO_3 + Aq$  (sp gr 1.22), but after a time is attacked with the greatest violence Weak acids attack only when hot (Berzelius, A 46 129)

Existence is doubtful (Schulze, B 13 1862, Isambart, C R 96 1628)

**Phosphorus monosulphide,  $PS(?)$** 

1 *Ordinary* Same properties as phosphorus semisulphide, 1

2 *Red modification* Unchanged by air,  $H_2O$ , or alcohol Decomp by conc  $KOH + Aq$ , not by dilute Sl sol in  $NH_4OH + Aq$  (Berzelius, A 46 129)

Existence is doubtful (Schulze, Isambart)

Does not exist (Helff, Z phys Ch 12 206)

**Phosphorus sesquisulphide,  $P_4S_3$** 

Not attacked by cold, slowly by hot  $H_2O$  Cold  $KOH + Aq$  dissolves with decomp

Oxidized by  $\text{HNO}_3$  and aqua regia Sol in alcohol and ether with decomp Sol in  $\text{CS}_2$  (100 pts  $\text{CS}_2$  dissolve 60 pts  $\text{P}_4\text{S}_3$ ),  $\text{PCl}_3$ , and  $\text{PSCl}_3$ , and in  $\text{K}_2\text{S}$  or  $\text{Na}_2\text{S} + \text{Aq}$  (Lemoine, Bull Soc (2) 1 407)

Very sol in  $\text{CS}_2$  (Rebs, A 246 367)

Decomp by dil and conc  $\text{KOH} + \text{Aq}$  1 pt  $\text{P}_4\text{S}_3$  is sol in 9 pts  $\text{CS}_2$  at  $-20^\circ$ , in 37 pts  $\text{CS}_2$  at  $0^\circ$ , in 1 pt  $\text{CS}_2$  at  $17^\circ$ , in 40 pts benzene at  $17^\circ$ , in 9 pts benzene at  $80^\circ$ , in 32 pts toluene at  $17^\circ$ , in 65 pts toluene at  $111^\circ$  (Stock, B 1910, 43 156)

#### Phosphorus trisulphide, $\text{P}_2\text{S}_3$

Decomp by water (Kekulé, A 90 310)

Sol in  $\text{M}_2\text{CO}_3 + \text{Aq}$  with separation of S Easily sol in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  (Berzelius, A 46 129)

Sol in alcohol and ether (Lemoine)

Correct formula is  $\text{P}_4\text{S}_6$  (Isambert, C R 102 1386)

Extremely sl sol in  $\text{CS}_2$  (Rebs, A 246 368)

Existence doubtful (Helff, Z phys Ch 12 210)

#### Phosphorus sulphide, $\text{P}_4\text{S}_7$

Sl sol in  $\text{CS}_2$  (Mai, A 265 192)

Slowly decomp by cold, rapidly by hot  $\text{H}_2\text{O}$

Sol in cold alkalis

1 pt is sol in 3500 pts  $\text{CS}_2$  at  $17^\circ$ , in 20,000 pts at  $0^\circ$  (Stock, B 1910, 43 416)

#### Phosphorus disulphide, $\text{P}_2\text{S}_5$ (formerly $\text{P}_2\text{S}_4$ )

Almost insol in  $\text{CS}_2$  (Helff)

#### Phosphorus pentasulphide, $\text{P}_2\text{S}_5$

Very deliquescent Decomp by  $\text{H}_2\text{O}$  Very sol in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  Sol in  $\text{M}_2\text{CO}_3 + \text{Aq}$  with separation of S at low temp Decomposes alcohol, acetic acid, etc (Kekulé, A 106 331)

Sol in  $\text{CS}_2$  (Isambert, C R 102 1386)

Not very sol in  $\text{CS}_2$  (Rebs, A 246 367)

Mpt,  $290^\circ$ , bpt,  $513-515^\circ$  at 760 mm

Decomp by  $\text{H}_2\text{O}$

Easily sol in warm  $\text{NaOH} + \text{Aq}$

1 pt is sol in 450 pts  $\text{CS}_2$  at room temp, in 550 pts at  $0^\circ$ , in 1200 pts at  $-20^\circ$  (Stock, B 1910, 43 1225)

Ordinary form

Sol in 195 pts boiling  $\text{CS}_2$

New form

Sol in 32 pts  $\text{CS}_2$  (Stock, B 1905, 38 2722)

#### Phosphorus persulphide, $\text{P}_2\text{S}_{12}$ (?)

Decomp by  $\text{H}_2\text{O}$ , alkalis, etc Consists of S, and mechanically united P (Ramme, B 12 941)

#### Phosphorus sulphides with $\text{M}_2\text{S}$

See M Phosphosulphide, under M

#### Phosphorus zinc sulphide, $\text{ZnP}_2\text{S}_2$

Sol in  $\text{HCl} + \text{Aq}$  with separation of  $\text{P}_2\text{S}$  (?) (Berzelius, A 46 150)

#### Phosphorus trisulphide ammonia, $\text{P}_2\text{S}_3, 2\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  (Bineau)

#### Phosphorus pentasulphide ammonia,

$\text{P}_2\text{S}_5, 6\text{NH}_3$

Sol in liquid  $\text{NH}_3$  (Stock, B 1903, 36 314)

$\text{P}_2\text{S}_5, 7\text{NH}_3$  (Stock)

#### Phosphorus sulphobromide

See Thiophosphoryl bromide

#### Phosphorus sulphochloride

See Thiophosphoryl chloride

#### Phosphorus sulphiodide, $\text{P}_2\text{S}_3\text{I}$

Sl attacked by cold, rapidly by hot  $\text{H}_2\text{O}$ , violently decomp by fuming  $\text{HNO}_3$  Easily sol in  $\text{CS}_2$  Sl sol in  $\text{C}_6\text{H}_6$  or  $\text{CHCl}_3$ , and still less in ether or absolute alcohol (Ouvrard, C R 115 1301)

$\text{P}_2\text{S}_3\text{I}_2$  Easily sol in  $\text{CS}_2$  More easily than  $\text{P}_4\text{S}_3\text{I}_2$  and less than  $\text{PI}_3$  (Ouvrard, A ch 1894, (7) 2 224)

$\text{P}_2\text{S}_3\text{I}_4$  Easily decomp (Ouvrard)

$\text{P}_4\text{S}_3\text{I}_2$  Insol in  $\text{H}_2\text{O}$ , sol in warm ether Sl sol in benzene,  $\text{CHCl}_3$ , and glacial acetic acid, sol in toluene and xylene (Wolter, Ch Ztg 1907, 31 640)

Easily sol in  $\text{CS}_2$  Sl sol in benzene, ether, absolute alcohol and  $\text{CHCl}_3$  (Ouvrard, C R 1892, 115 1301)

#### Phosphorus sulphoxide, $\text{P}_4\text{O}_6\text{S}_4$

Deliquescent Easily sol in  $\text{H}_2\text{O}$  with decomp Sol in 2 pts  $\text{CS}_2$  without decomp Sol in benzene with decomp (Thorpe and Tutton, Chem Soc 59 1019)

$\text{P}_2\text{O}_5\text{S}_3$  Slowly decomp by  $\text{H}_2\text{O}$  Violently attacked by fuming  $\text{HNO}_3$  (Besson, C R 1897, 124 152)

$\text{P}_2\text{S}_3\text{O}_4$  Deliquescent, sol in  $\text{H}_2\text{O}$  with decomp, insol in most solvents (Stock, B 1913, 46 1382)

#### Phosphoryl triamide, $\text{PO}(\text{NH}_2)_3$

Insol in boiling  $\text{H}_2\text{O}$ ,  $\text{KOH} + \text{Aq}$ , or dil acids Decomp by long boiling with  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  More easily decomp with aqua regia Easily sol in warm  $\text{H}_2\text{SO}_4$  or nitrosulphuric acid (Schiff, A 101 300)

Does not exist (Gladstone, Mente, A 248 238)

#### Phosphoryl bromide, $\text{POBr}_3$

Not miscible with  $\text{H}_2\text{O}$ , but gradually decomp in contact with it Sol in  $\text{H}_2\text{SO}_4$ , ether, oil of turpentine (Gladstone, Phil Mag (3) 35 345), in  $\text{CHCl}_3$ ,  $\text{CS}_2$  (Baudrimont, Bull Soc 1861 118)

Easily sol in  $\text{AsBr}_3$  (Walden, Z anorg 1902, **29** 374)

Sol in  $\text{CCl}_4$ , and in  $\text{C}_6\text{H}_6$  (Oddo, Chem Soc 1900, **78** (2) 75)

### Phosphoryl bromide sulphide

See Thiophosphoryl bromide

### Phosphoryl bromochloride, $\text{POCl}_2\text{Br}$

Decomp by  $\text{H}_2\text{O}$  (Menschutkin, A **139** 343)

### Phosphoryl dibromochloride, $\text{POClBr}_2$

Decomp by  $\text{H}_2\text{O}$  (Geuther, Jena Zeit **10** 130)

### Phosphoryl chloride, $\text{POCl}$

Very hygroscopic Sol in  $\text{H}_2\text{O}$  with decomp Insol in most solvents Sol in  $\text{PCl}_3$  (Besson, C R 1897, **125** 772)

$\text{POCl}_3$  Decomp by  $\text{H}_2\text{O}$  Not acted on by liquid  $\text{CO}_2$ ,  $\text{P}$ ,  $\text{PH}_3$ ,  $\text{CS}_2$ ,  $\text{I}$ ,  $\text{Br}$ ,  $\text{Cl}$ , etc Sol in  $\text{CCl}_4$ ,  $\text{C}_6\text{H}_6$ ,  $\text{CS}_2$ ,  $\text{CHCl}_3$  and ether (Oddo, Gazz ch it 1899, **29** (2) 318, Chem Soc 1900, **78** (2) 74)

### Phosphoryl boron chloride, $\text{POCl}_3, \text{BCl}_3$

See Boron phosphoryl chloride

### Phosphoryl stannous chloride, $\text{POCl}_3, \text{SnCl}_2$

Deliquescent Decomp by  $\text{H}_2\text{O}$  (Casselmann, A **91** 242)

### Phosphoryl stannic chloride, $\text{POCl}_3, \text{SnCl}_4$

Deliquescent Decomp by  $\text{H}_2\text{O}$  (Casselmann)

### Phosphoryl titanium chloride, $\text{POCl}_3, \text{TiCl}_4$

Deliquescent, and decomp by  $\text{H}_2\text{O}$  (Weber, Pogg **132** 453)

### Pyrophosphoryl chloride, $\text{P}_2\text{O}_5\text{Cl}_4$

Decomp violently with  $\text{H}_2\text{O}$  (Geuther and Mich ulis, B **4** 766)

Very sol in  $\text{H}_2\text{O}$  with decomp, very unstable (Besson, C R 1897, **124** 1100)

### Metaphosphoryl chloride, $\text{PO}_2\text{Cl}$

Decomp by  $\text{H}_2\text{O}$  (Gustafson)

Does not exist (Mich ulis)

### Phosphoryl fluoride, $\text{POF}_3$

Absorbed and decomp at once by  $\text{H}_2\text{O}$  or alcohol (Moissan, C R **102** 1245)

### Phosphoryl imidoamide, $\text{PN}_2\text{H}_3\text{O} =$



Insol in  $\text{H}_2\text{O}$ , gradually decomp by boiling with  $\text{H}_2\text{O}$ , more rapidly in presence of  $\text{KOH}$  Insol in boiling conc  $\text{HCl} + \text{Aq}$  Insol in cold, decomp by hot  $\text{H}_2\text{SO}_4$  Moderately dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  dissolves without evolution

of gas Insol in boiling nitric or nitrosulphuric acid (Gerhardt, A ch (3) **20** 255)

Insol in alcohol, oil of turpentine, etc

### Phosphoryl iodide, $\text{P}_3\text{I}_5\text{O}_8$ (?)

Sol in  $\text{H}_2\text{O}$ , alcohol, and ether (Burton, Am Ch J **3** 280)

$\text{PO}_2\text{I}_2$  (Burton)

### Phosphoryl nitride, $\text{PON}$

Insol in  $\text{H}_2\text{O}$ , acids, or alkalis (Gladstone, Chem Soc **2** 121)

### Phosphoryl chlorosulphide, $\text{P}_2\text{O}_5\text{SCL}_4$

Slowly decomp in contact with  $\text{H}_2\text{O}$  (Besson, C R 1897, **124** 153)

### Phosphoryl thio-compounds

See Thiophosphoryl compounds

### Phosphoselenic acid

See Selenophosphoric acid

### Phosphoselenide, $\text{M}$

See under  $\text{M}$

### Phosphosilicic acid

See Silicophosphoric acid

### Phosphosilicosovanadicotungstic acid

#### Ammonium phosphosilicosovanadicotungstate

Exact formula not known (E F Smith, J Am Chem Soc 1903, **25** 1225)

### Phosphosilicovanadic acid, $3\text{SiO}_2, 2\text{V}_2\text{O}_5, 2\text{P}_2\text{O}_5 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Berzelius)

### Phosphostannosovanadicotungstic acid

#### Ammonium phosphostannosovanadicotungstate

Exact formula not known (E F Smith, J Am Chem Soc 1903, **25** 1226)

### Phosphosulphide, $\text{M}$

See under  $\text{M}$

### Phosphosulphuric anhydride, $\text{P}_2\text{O}_5, 3\text{SO}_3$

Very easily decomp (Weber, B **19** 3190)

### Phosphotelluric acid

#### Ammonium phosphotellurate, $2(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, \text{TeO}_3 + 4\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Weinland, Z anorg 1901, **28** 61)

$4(\text{NH}_4)_2\text{O}, 3\text{P}_2\text{O}_5, 2\text{TeO}_3 + 11\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  without decomp (Weinland)



**Potassium phosphotellurate**,  $15K_2O, P_2O_5,$   
 $TeO_3$

+17.5  $H_2O$  Very sol in  $H_2O$   
 +4.5  $H_2O$  Ppt (Weinland)

**Rubidium phosphotellurate**,  $15Rb_2O, P_2O_5,$   
 $TeO_3 + 4.5H_2O$

Ppt (Weinland)

**Sodium phosphotellurate**,  $2Na_2O, P_2O_5,$   
 $2TeO_3 + 9H_2O$

Difficultly sol in cold  $H_2O$  (Weinland)

### Phosphothorosovanadicotungstic acid

**Ammonium phosphothorosovanadicotungstate**

Exact formula not known (E F Smith,  
 J Am Chem Soc 1903, 25 1226)

### Phosphotitanosovanadicotungstic acid

**Ammonium phosphotitanosovanadicotungstate**

Formula not known (E F Smith, J Am  
 Chem Soc 1903, 25 1226)

**Phosphotungstic acid**,  $P_2O_5, 12WO_3 +$   
 $42H_2O$

Not efflorescent Sol in  $H_2O$ , alcohol, and  
 ether (Péchar, C R 110 754)

$P_2O_5, 16WO_3 + 69H_2O$  Very efflorescent  
 Sol in  $H_2O$ , alcohol, and ether (Péchar,  
 C R 109 301)

+ $xH_2O = H_5PW_8O_{28} + xH_2O$  ( $\alpha$ -phospholuteotungstic acid) Known only in aqueous  
 solution (Kehrmann, B 20 1808)

+ $48H_2O = H_3PW_8O_{28} + 16H_2O$  ( $\alpha$  anhydrophospholuteotungstic acid) Sol in its crystal  
 $H_2O$  by warmth of the hand, sol in less than  
 $1/8$  pt  $H_2O$  (Kehrmann)

Correct composition is represented by  
 $H_3PW_9O_{31} + 9H_2O$  (Kehrmann, Z anorg 1  
 422)

$P_2O_5, 20WO_3 + 8H_2O$  Very efflorescent  
 (Gibbs, B 10 1386)

+ $19H_2O = H_{11}PW_{10}O_{38} + 8H_2O$  Sol in  
 $H_2O$  (Scheibler, B 5 801)

+50, and 62 $H_2O$  Very efflorescent  
 (Péchar, C R 109 301)

$3H_2O, P_2O_5, 21WO_3 + 30H_2O$  Efflorescent  
 Sol in  $H_2O$  in nearly every proportion

$P_2O_5, 22WO_3 + 28H_2O = H_3PW_{11}O_{43} +$   
 $18H_2O$  Efflorescent (Scheibler, B 5 801)  
 Composition is  $6H_2O, 22WO_3, P_2O_5 +$   
 $45H_2O$  (Gibbs)

$H_3PO_4, 12WO_3 + 18H_2O$ , or  $P_2O_5, 24WO_3 +$   
 $39H_2O$  Sol in  $H_2O$ , alcohol and ether  
 (Soboleff, Z anorg 1896, 12 18)

$P_2O_5, 24WO_3 + 40H_2O = 6H_2O, P_2O_5,$   
 $24WO_3 + 34H_2O$  Very efflorescent Sol in  
 $H_2O$  (Gibbs)

+45 $H_2O$

### Solubility in $H_2O$ at $t^\circ$

$t^\circ$	100 ccm $H_2O$ dis solve g of the cryst acid	Sp gr of the solution
0	16 206	1 1890
22	49 718	1 6913
43	53 64	1 8264
92	86 75	2 5813

(Soboleff, Z anorg 1896, 12 31)

### Solubility in ether at $t^\circ$

$t^\circ$	100 ccm ether dissolves g of the cryst acid
0	81 196
7 8	85 327
18 2	96 017
24 2	101 348

(Soboleff)

+53 $H_2O = 6H_2O, P_2O_5, 24WO_3 + 47H_2O$   
 Sol in  $H_2O$  (Gibbs)

Sol in ether If an equal vol of ether is  
 placed above a layer of conc aqueous solution  
 of acid, only drops form between the two  
 layers, which sink to bottom, forming a third  
 layer The sp gr of the latter is 1.525 The  
 crystallized acid dissolved in smallest amt,  
 ether forms an oil of sp gr = 2.083 Ethereal  
 solution is miscible with alcohol, and also  
 with a large quantity of  $H_2O$  (Drechsel, B  
 20 1452)

+61 $H_2O$  Sol in  $H_2O$  (Gibbs, Proc  
 Am Acad 16 116)

**Aluminum ammonium phosphotungstate**

See Aluminicophosphotungstate, ammo-  
 nium

**Ammonium phosphotungstate**,  $3(NH_4)_2O,$   
 $P_2O_5, 7WO_3 + Aq$

Sl sol in cold  $H_2O$  without decomp De-  
 comp by hot  $H_2O$  (Kehrmann, Z anorg  
 1892, 1 438)

$2(NH_4)_2O, P_2O_5, 12WO_3 + 5H_2O$  Insol in  
 cold  $H_2O$  (Péchar, C R 110 754)

$6(NH_4)_2O, P_2O_5, 16WO_3 + 10H_2O$  Easily  
 sol in hot  $H_2O$  (Péchar)

$5(NH_4)_2O, P_2O_5, 16WO_3 + xH_2O =$   
 $(NH_4)_3PW_8O_{28} + xH_2O$  (Ammonium  $\alpha$  phos-  
 pholuteotungstate) Sl sol in  $H_2O$  (Kehrmann)

$3(NH_4)_2O, P_2O_5, 16WO_3 + 16H_2O =$   
 $(NH_4)_3PW_8O_{28} + 8H_2O$  (Ammonium  $\alpha$  an-  
 hydrophospholuteotungstate) Efflorescent  
 Easily sol in  $H_2O$  (Kehrmann)

$5(NH_4)_2O, P_2O_5, 17WO_3 + 16H_2O$  Very  
 sl sol in cold  $H_2O$  (Kehrmann, Z anorg  
 1894, 6 387)

$3(NH_4)_2O, P_2O_5, 18WO_3 + 14H_2O$  (Phos-  
 pholuteotungstate) (Kehrmann, Z anorg  
 1893, 4 140)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $21\text{WO}_3 + x\text{H}_2\text{O}$  Rather sl sol in cold, easily in hot  $\text{H}_2\text{O}$  and alcohol Insol in sat  $\text{NH}_4\text{Cl} + \text{Aq}$  (Kehrmann and Freinkel, B **25** 1972)

$3(\text{NH}_4)_2\text{O}$ ,  $3\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3 + 18\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$  (Gibbs)

$3(\text{NH}_4)_2\text{O}$ ,  $3\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 26\text{H}_2\text{O}$  Very sl sol even in hot  $\text{H}_2\text{O}$  (Gibbs, Proc Am Acad **16** 122)

**Ammonium barium  $\alpha$  anhydropospholutoetungstate**,  $\text{NH}_4\text{BaPW}_3\text{O}_{28} + x\text{H}_2\text{O} = (\text{NH}_4)_x\text{O}$ ,  $2\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $16\text{WO}_3 + x\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Kehrmann)

**Barium phosphotungstate**,  $2\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 15\text{H}_2\text{O}$

Very efflorescent Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Péchar, C R **110** 754)

$3\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $16\text{WO}_3 + x\text{H}_2\text{O} = \text{Ba}_3(\text{PW}_3\text{O}_{28}) + x\text{H}_2\text{O}$  (Barium  $\alpha$ -anhydropospholutoetungstate) Not efflorescent Quite difficultly sol in  $\text{H}_2\text{O}$  (Kehrmann)

$2\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $16\text{WO}_3 + 10\text{H}_2\text{O}$  Efflorescent (Péchar, A ch (6) **22** 240)

$2\text{BaO}$ ,  $6\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3 + 24\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Gibbs, B **10** 1386)

$6\text{BaO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3 + 46\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Gibbs, Proc Am Acad **16** 126)

$7\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3 + 59\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , (Sprenger, J pr (2) **22** 418)

$+53\text{H}_2\text{O}$  (Kehrmann, B **24** 2335)

$4\text{BaO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3 + 39\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  without decomp (Gibbs)

$\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 59\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Sprenger)

$2\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 59\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Sprenger)

$3\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 46\text{H}_2\text{O} = 3\text{BaO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 43\text{H}_2\text{O}$  Easily sol in hot  $\text{H}_2\text{O}$  (Gibbs)

$3\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 48\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Sobokoff, Z anorg **12** 18)

$+58\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Sprenger)

Efflorescent Sl sol in dil  $\text{BaCl} + \text{Aq}$  (Kehrmann, Z anorg **1** 423)

**Barium potassium phosphotungstate**,  $5\text{BaO}$ ,  $2\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3 + 48\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Kehrmann and Freinkel, B **25** 1968)

**Barium silver phosphotungstate**,  $4\text{BaO}$ ,  $3\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3 + 34\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$  (Kehrmann and Freinkel, B **25** 1966)

**Barium sodium phosphotungstate**,  $2\text{BaO}$ ,  $\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3 + 46\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , forming cloudy liquid, which clears up Solution in  $\text{HCl}$  is not cloudy (Brandhorst and Kraut, A **249** 380)

**Calcium phosphotungstate**,  $\text{CaO}$ ,  $5\text{H}_2\text{O}$ ,  $16\text{WO}_3$ ,  $\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$

Readily sol in  $\text{H}_2\text{O}$  (Gibbs, Proc Am Acad **16** 130)

$2\text{CaO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 19\text{H}_2\text{O}$  Efflorescent Insol in alcohol (Péchar, C R **110** 754)

$2\text{CaO}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3 + 22\text{H}_2\text{O}$  Efflorescent (Péchar, A ch (6) **22** 233)

**Cadmium phosphotungstate**,  $2\text{CdO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 13\text{H}_2\text{O}$

Sl efflorescent Very sol in  $\text{H}_2\text{O}$  (Péchar, C R **110** 754)

**Cupric phosphotungstate**,  $3\text{CuO}$ ,  $24\text{WO}_3$ ,  $\text{P}_2\text{O}_5 + 58\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Sprenger, J pr (2) **22** 418)

$2\text{CuO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 11\text{H}_2\text{O}$  Very efflorescent (Péchar, C R **110** 754)

$2\text{CuO}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3 + 13\text{H}_2\text{O}$  Efflorescent (Péchar, A ch (6) **22** 235)

**Lead phosphotungstate**,  $2\text{PbO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 6\text{H}_2\text{O}$

Insol in cold, sol in boiling  $\text{H}_2\text{O}$  (Péchar, C R **110** 754)

$2\text{PbO}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3 + 6\text{H}_2\text{O}$  Sol in boiling  $\text{H}_2\text{O}$  (Péchar, A ch (6) **22** 236)

**Lithium phosphotungstate**,  $\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 21\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Péchar, C R **110** 754)

**Magnesium phosphotungstate**,  $2\text{MgO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3$

Sl efflorescent (Péchar, C R **110** 754)

$2\text{MgO}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3 + 19\text{H}_2\text{O}$  Sl efflorescent (Péchar, A ch (6) **22** 234)

**Mercurous phosphotungstate**

Insol in dil  $\text{HNO}_3 + \text{Aq}$  (Péchar, C R **110** 754)

**Potassium phosphotungstate**,  $\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3 + 9\text{H}_2\text{O}$

Insol in cold, sl sol in hot  $\text{H}_2\text{O}$  (Péchar, C R **110** 754)

$5\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $16\text{WO}_3 + x\text{H}_2\text{O} = \text{K}_5\text{PW}_3\text{O}_{21} + x\text{H}_2\text{O}$  (Potassium phosphotungstate)

Very sl sol in cold  $\text{H}_2\text{O}$  (Gibbs)

Sol in cold dil  $\text{HNO}_3 + \text{Aq}$  (Kehrmann)

$3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $16\text{WO}_3 + 16\text{H}_2\text{O} = \text{K}_3\text{PW}_3\text{O}_{12} + 8\text{H}_2\text{O}$  (Potassium  $\alpha$ -anhydropospholutoetungstate) Efflorescent Easily sol in  $\text{H}_2\text{O}$  (Kehrmann)

$5\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $17\text{WO}_3 + 21$  or  $22\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$  (Kehrmann, Z anorg **1894**, **6** 387)

$3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{WO}_3 + 28\text{H}_2\text{O}$  (Duparc and Pearce, Bull Soc Min **1895**, **18** 42)

$\text{K}_2\text{O}$ ,  $5\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{WO}_3 + 14\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Gibbs)

$6\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{WO}_3 + 30\text{H}_2\text{O}$ , and  $23\text{H}_2\text{O}$

The  $23\text{H}_2\text{O}$  salt is more sol in  $\text{H}_2\text{O}$  than the  $30\text{H}_2\text{O}$  salt (Gibbs)

$7\text{K}_2\text{O}, \text{H}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 27\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Gibbs, B 10 1386)

$\text{K}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 5\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$  (Péchar, A ch (6) 22 231)

$8\text{K}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 18\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Gibbs)

$3\text{K}_2\text{O}, \text{P}_2\text{O}_5, 21\text{WO}_3 + 31\text{H}_2\text{O}$  Easily sol in cold  $\text{H}_2\text{O}$  or alcohol Much less sol in very dil  $\text{HCl} + \text{Aq}$  or  $\text{KCl} + \text{Aq}$  Decomp by boiling  $\text{H}_2\text{O}$  (Kehrmann and Freinkel, B 25 1971)

$2\text{K}_2\text{O}, 4\text{H}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 2\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Gibbs)

$7\text{K}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 31\text{H}_2\text{O}$  Easily sol in cold or hot  $\text{H}_2\text{O}$  Insol in alcohol (Kehrmann, B 25 1966)

$3\text{K}_2\text{O}, 3\text{H}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 8$ , and  $14\text{H}_2\text{O}$  Sol in a large amount of  $\text{H}_2\text{O}$  with partial decomp (Gibbs, Proc Am Acad 16 120)

Practically insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{NH}_4\text{OH}$ , alkalies, or alkali carbonates +  $\text{Aq}$  (Kehrmann, B 24 2329)

$6\text{K}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 18\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Gibbs, Proc Am Acad 15 1)

#### Potassium lead $\alpha$ -phosphotungstate

Sl sol in  $\text{H}_2\text{O}$  (Kehrmann)

Silver phosphotungstate,  $\text{Ag}_2\text{O}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 8\text{H}_2\text{O}$

Ppt Insol in  $\text{H}_2\text{O}$  (Péchar, C R 110 754)

$5\text{Ag}_2\text{O}, \text{P}_2\text{O}_5, 16\text{WO}_3 + x\text{H}_2\text{O} = \text{Ag}_x\text{PW}_8\text{O}_{28} + x\text{H}_2\text{O}$  (Silver  $\alpha$ -phosphotungstate)

Ppt (Kehrmann)

$3\text{Ag}_2\text{O}, \text{P}_2\text{O}_5, 16\text{WO}_3 + 16\text{H}_2\text{O} = \text{Ag}_3\text{PW}_8\text{O}_{28} + 8\text{H}_2\text{O}$  (Silver  $\alpha$ -anhydroposphotungstate)

Easily sol in  $\text{H}_2\text{O}$  (Kehrmann)

$\text{Ag}_2\text{O}, 24\text{WO}_3, \text{P}_2\text{O}_5 + 60\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$

$3\text{Ag}_2\text{O}, 24\text{WO}_3, \text{P}_2\text{O}_5 + 58\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Sprenger, J pr (2) 22 418)

Sodium phosphotungstate,  $3\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 7\text{WO}_3 + \text{Aq}$

Sol in  $\text{H}_2\text{O}$  (Kehrmann, Z anorg 1 437)

$5\text{Na}_2\text{O}, 11\text{H}_2\text{O}, 2\text{P}_2\text{O}_5, 12\text{WO}_3 + 26\text{H}_2\text{O} = \text{Na}_5\text{H}_{11}\text{P}_2\text{W}_6\text{O}_{31} + 13\text{H}_2\text{O}$  (?) (Scheibler, B 5 801)

$2\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 18\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Péchar, C R 110 754)

$5\text{Na}_2\text{O}, 14\text{WO}_3, 2\text{P}_2\text{O}_5 + 42\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Gibbs)

$\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3, 2\text{H}_2\text{O} + 19\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 1895, 17 183)

$\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 23\text{H}_2\text{O} = \text{Na}_2\text{O}, 7\text{H}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 16\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Gibbs)

+  $25\text{H}_2\text{O}$  Sl efflorescent, very sol in  $\text{H}_2\text{O}$ , insol in alcohol (Péchar, A ch (6) 22 227)

$2\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 10\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Péchar)

+  $30\text{H}_2\text{O}$  (P)

$3\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 32\text{H}_2\text{O}$  As above (P)

$2\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 9\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Gibbs)

$3\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 22\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Brandhorst and Kraut, A 249 379)

+  $30\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Soboleff, Z anorg 1896, 12 18)

+  $42\text{H}_2\text{O}$

#### Solubility in $\text{H}_2\text{O}$ at $t^\circ$

$t^\circ$	100 ccm $\text{H}_2\text{O}$ dissolve g of the cryst salt
0	22 04
22	59 65
93	98 184

(Soboleff, Z anorg 1896, 12 31)

$2\text{Na}_2\text{O}, 4\text{H}_2\text{O}, 24\text{WO}_3, \text{P}_2\text{O}_5 + 23\text{H}_2\text{O}$  Readily sol in  $\text{H}_2\text{O}$  (Gibbs, Proc Am Acad 16 118)

Sp gr at  $20^\circ$  of solutions of  $2\text{Na}_2\text{O}, 4\text{H}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 23\text{H}_2\text{O}$  containing

10 22	20 94	31 13% salt,
1 085	1 190	1 316

42 61	52 92	64 11% salt
1 496	1 702	2 001

or, by calculation,  $a = \text{sp gr if } \% \text{ is crystallized salt}$ ,  $b = \text{sp gr if } \% \text{ is anhydrous salt}$

5	10	15	20	25% salt,
a 1 040	1 084	1 131	1 181	1 237
b 1 044	1 092	1 143	1 199	1 262

30	35	40	45	50% salt,
a 1 299	1 370	1 449	1 538	1 640
b 1 333	1 414	1 507	1 613	1 734

55	60	64% salt
a 1 754	1 884	1 998
b 1 872		

(Brandhorst and Kraut, A 249 377)

Strontium phosphotungstate,  $2\text{SrO}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 17\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Péchar, C R 110 754)

Thallium phosphotungstate,  $\text{Tl}_2\text{O}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 4\text{H}_2\text{O}$

Ppt (Péchar, C R 110 754)

Zinc phosphotungstate,  $2\text{ZnO}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 7\text{H}_2\text{O}$

Efflorescent (Péchar, C R 110 754)

#### Monometaphosphotungstic acid

Ammonium monometaphosphotungstate,  $(\text{NH}_4)_2\text{O}, 2\text{NH}_4\text{PO}_3, 18\text{WO}_3 + 11\text{H}_2\text{O}$

Sl sol in cold  $\text{H}_2\text{O}$

**Potassium monometaphosphotungstate,**  
 $3K_2O, 2KPO_3, 24WO_3 + 20H_2O$ 

Very sl sol in  $H_2O$  (Gibbs, Am Ch J 7 319)

**Orthometaphosphotungstic acid****Potassium sodium orthometaphosphotungstate,**  
 $2K_2O, 4Na_2O, 6NaPO_3, 6K_4PO_4, 22WO_3 + 42H_2O$ 

Sl sol in  $H_2O$  (Gibbs, Am Ch J 7 319)

**Pyrophosphotungstic acid****Ammonium manganous sodium pyrophosphotungstate,**  
 $5(NH_4)_2O, 6MnO, 2Na_2O, 2P_2O_5, 28WO_3 + 48H_2O$ 

Very sl in cold and in hot  $H_2O$  (Gibbs, Am Ch J 1895, 17 90)

**Ammonium sodium pyrophosphotungstate,**  
 $6(NH_4)_4P_2O_7, 3Na_4P_2O_7, 2(NH_4)_2O, 22WO_3 + 31H_2O$ 

Nearly insol in cold  $H_2O$  or  $NH_4OH + Aq$   
Sol in a large amount of hot  $H_2O$

**Manganous sodium pyrophosphotungstate,**  
 $6Na_2O, 3MnO, P_2O_5, 14WO_3 + 36H_2O$ 

Efflorescent in dry air Sol in  $H_2O$  and can be recryst therefrom (Gibbs)

**Potassium pyrophosphotungstate,**  
 $9K_4P_2O_7, 22WO_3 + 49H_2O$ 

Very sl sol in cold  $H_2O$   
 $6K_4P_2O_7, 3H_4P_2O_7, 22WO_3, K_2O, H_2O + 42H_2O$  Sl sol in cold Sol in much boiling  $H_2O$  (Gibbs, Am Ch J 7 392)

**Phosphovanadic acid,**  $P_2O_5, V_2O_5, 2H_2O + 9H_2O$ 

Sol in  $H_2O$

Composition is vanadium phosphate  
 $(VO_2)_2H_2PO_4 + 4\frac{1}{2}H_2O$  (Friedheim, B 23 1531)

This is the only "acid" which exists (F)  
 $P_2O_5, V_2O_5 + 14H_2O$  Sol in  $H_2O$ , can be recryst from dil  $H_3PO_4 + Aq$  (Ditte, C R 102 757)

$3P_2O_5, 2V_2O_5 + 9H_2O$  Sol in  $H_2O$  (Ditte)  
 $P_2O_5, 3V_2O_5$  (Berzelius)  
 $3H_2O, 7P_2O_5, 6V_2O_5 + 34H_2O$  Sol in  $H_2O$   
Decomp by much  $H_2O$  into—  
 $6H_2O, P_2O_5, 20V_2O_5 + 53H_2O$  Sol in  $H_2O$  (Gibbs, Am Ch J 7 209)

**Ammonium phosphovanadate,**  $(NH_4)_2O, P_2O_5, V_2O_5 + H_2O$ 

Sl sol in cold  $H_2O$  (Gibbs, Am Ch J 7 209)  
 $+ 3H_2O$  Composition is  $(VO_2)(NH_4)HPO_4 + H_2O$  (Friedheim)  
 $(NH_4)_2O, P_2O_5, 2V_2O_5 + 7H_2O$  Easily sol in  $H_2O$  (Gibbs) Sl sol in  $H_2O$  (Fried-

heim) Composition is  $(NH_4)_2O, V_2O_5, + 2(VO_2)_2H_2PO_4 + 5H_2O$  (Friedheim)  
 $5(NH_4)_2O, 2P_2O_5, 3V_2O_5 + 24H_2O$  Easily sol in  $H_2O$  (Ditte, C R 102 1019) Could not be obtained (Friedheim)

$5(NH_4)_2O, 4P_2O_5, 2V_2O_5 + 24H_2O$  As above (Ditte) Could not be obtained (Friedheim)

$7(NH_4)_2O, P_2O_5, 12V_2O_5 + 26H_2O$  Easily sol in  $H_2O$  Composition is  $2(NH_4)_2HPO_4 + 5(NH_4)_2O, 12V_2O_5 + 25H_2O$  (Friedheim)

**Potassium phosphovanadate,**  $K_2O, P_2O_5, 2V_2O_5 + 7H_2O$ 

Sl sol in  $H_2O$ , decomp thereby to  $7K_2O, 12V_2O_5, P_2O_5 + 26H_2O$

Composition is  $K_2O, V_2O_5 + 2(VO_2)_2H_2PO_4 + 5H_2O$  (Friedheim)

$3K_2O, 4P_2O_5, 6V_2O_5 + 21H_2O$  Sl sol in  $H_2O$  (Gibbs)

$7K_2O, P_2O_5, 12V_2O_5 + 26H_2O$  Easily sol in  $H_2O$  Composition is  $2K_2HPO_4 + 5K_2O, 12V_2O_5 + 25H_2O$  (Friedheim)

$2K_2O, P_2O_5, V_2O_5$   
 $3K_2O, 2P_2O_5, 2V_2O_5 + 5H_2O$   
 $13K_2O, 2P_2O_5, 22V_2O_5 + 58H_2O$   
 $15K_2O, 2P_2O_5, 25V_2O_5 + 76H_2O$  (Friedheim, Z anorg 1894, 5 446)

$16K_2O, 2P_2O_5, 27V_2O_5 + 57H_2O$   
 $6K_2O, P_2O_5, 11V_2O_5 + 33H_2O$   
 $7K_2O, P_2O_5, 13V_2O_5 + 38H_2O$   
 $4K_2O, P_2O_5, 3V_2O_5 + 3H_2O$  (Friedheim, Z anorg 1894, 5 459-465)

**Silver phosphovanadate,**  $2Ag_2O, P_2O_5, V_2O_5 + 5H_2O$ 

Sl sol in cold or hot  $H_2O$  (Gibbs)

**Phosphovanadicotungstic acid****Ammonium phosphovanadicotungstate,**  
 $(NH_4)_2O, P_2O_5, V_2O_5, WO_3 + xH_2O$ 

Ppt (Smith, J Am Chem Soc 1902, 24 577)

$15(NH_4)_2O, 2P_2O_5, 6V_2O_5, 44WO_3 + 106H_2O$  Sol in  $H_2O$  Insol in alcohol, ether or benzene (Rogers, J Am Chem Soc 1903, 25 303)

**Phosphovanadicoxovanadiotungstic acid****Ammonium phosphovanadicoxovanadiotungstate,**  
 $14(NH_4)_2O, 2P_2O_5, 3V_2O_5, 7V_2O, 27WO_3 + 66H_2O$ 

Sparingly sol in cold  $H_2O$  Sol in hot  $H_2O$  (Rogers, J Am Chem Soc 1903, 25 309)

**Phosphovanadicozirconosotungstic acid****Ammonium phosphovanadicozirconosotungstate**

Exact formula not known (E, F Smith, J Am Chem Soc 1903, 25 1226)

The  $23\text{H}_2\text{O}$  salt is more sol in  $\text{H}_2\text{O}$  than the  $30\text{H}_2\text{O}$  salt (Gibbs)

$7\text{K}_2\text{O}, \text{H}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 27\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Gibbs, Proc Am Acad 10 1386)

$\text{K}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 5\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$  (Péchar, A ch (6) 22 231)

$8\text{K}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 18\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Gibbs)

$3\text{K}_2\text{O}, \text{P}_2\text{O}_5, 21\text{WO}_3 + 31\text{H}_2\text{O}$  Easily sol in cold  $\text{H}_2\text{O}$  or alcohol Much less sol in very dil  $\text{HCl} + \text{Aq}$  or  $\text{KCl} + \text{Aq}$  Decomp by boiling  $\text{H}_2\text{O}$  (Kehrmann and Frenkel, B 25 1971)

$2\text{K}_2\text{O}, 4\text{H}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 2\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Gibbs)

$7\text{K}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 31\text{H}_2\text{O}$  Easily sol in cold or hot  $\text{H}_2\text{O}$  Insol in alcohol (Kehrmann, B 25 1966)

$3\text{K}_2\text{O}, 3\text{H}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 8$ , and  $14\text{H}_2\text{O}$  Sol in a large amount of  $\text{H}_2\text{O}$  with partial decomp (Gibbs, Proc Am Acad 16 120)

Practically insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{NH}_4\text{OH}$ , alkalies, or alkali carbonates +  $\text{Aq}$  (Kehrmann, B 24 2329)

$6\text{K}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 18\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Gibbs, Proc Am Acad 15 1)

#### Potassium lead $\alpha$ -phospholutedungstate

sl sol in  $\text{H}_2\text{O}$  (Kehrmann)

r phosphotungstate,  $\text{Ag}_2\text{O}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 8\text{H}_2\text{O}$

Ppt Insol in  $\text{H}_2\text{O}$  (Péchar, C R 110 754)

$5\text{Ag}_2\text{O}, \text{P}_2\text{O}_5, 16\text{WO}_3 + x\text{H}_2\text{O} = \text{Ag}_5\text{PW}_8\text{O}_{29} + x\text{H}_2\text{O}$  (Silver  $\alpha$ -phospholutedungstate) Ppt (Kehrmann)

$3\text{Ag}_2\text{O}, \text{P}_2\text{O}_5, 16\text{WO}_3 + 16\text{H}_2\text{O} = \text{Ag}_3\text{PW}_8\text{O}_{28} + 8\text{H}_2\text{O}$  (Silver  $\alpha$ -anhydropospholutedungstate) Easily sol in  $\text{H}_2\text{O}$  (Kehrmann)

$\text{Ag}_2\text{O}, 24\text{WO}_3, \text{P}_2\text{O}_5 + 60\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$

$3\text{Ag}_2\text{O}, 24\text{WO}_3, \text{P}_2\text{O}_5 + 58\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Sprenger, J pr (2) 22 418)

Sodium phosphotungstate,  $3\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 7\text{WO}_3 + \text{Aq}$

Sol in  $\text{H}_2\text{O}$  (Kehrmann, Z anorg 1 437)

$5\text{Na}_2\text{O}, 11\text{H}_2\text{O}, 2\text{P}_2\text{O}_5, 12\text{WO}_3 + 26\text{H}_2\text{O} = \text{Na}_5\text{H}_{11}\text{P}_2\text{W}_6\text{O}_{31} + 13\text{H}_2\text{O}$  (?) (Scheibler, B 5 801)

$2\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 18\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Péchar, C R 110 754)

$5\text{Na}_2\text{O}, 14\text{WO}_3, 2\text{P}_2\text{O}_5 + 42\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Gibbs)

$\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3, 2\text{H}_2\text{O} + 19\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 1895, 17 183)

$\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 23\text{H}_2\text{O} = \text{Na}_4\text{O}, 7\text{H}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 16\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Gibbs)

+  $25\text{H}_2\text{O}$  Sl efflorescent, very sol in  $\text{H}_2\text{O}$ , insol in alcohol (Péchar, A ch (6) 22 227)

$2\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 10\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Péchar)

+  $30\text{H}_2\text{O}$  (P)

$3\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 32\text{H}_2\text{O}$  As above (P)

$2\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 9\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Gibbs)

$3\text{Na}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 22\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Brandhorst and Kraut, A 249 379)

+  $30\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Soboleff, Z anorg 1896, 12 18)

+  $42\text{H}_2\text{O}$

#### Solubility in $\text{H}_2\text{O}$ at $t^\circ$

$t^\circ$	100 ccm $\text{H}_2\text{O}$ dissolve g of the cryst salt
0	22 04
22	59 65
93	98 184

(Soboleff, Z anorg 1896, 12 31)

$2\text{Na}_2\text{O}, 4\text{H}_2\text{O}, 24\text{WO}_3, \text{P}_2\text{O}_5 + 23\text{H}_2\text{O}$  Readily sol in  $\text{H}_2\text{O}$  (Gibbs, Proc Am Acad 16 118)

Sp gr at  $20^\circ$  of solutions of  $2\text{Na}_2\text{O}, 4\text{H}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 23\text{H}_2\text{O}$  containing

10 22	20 94	31 13% salt,
1 085	1 190	1 316

42 61	52 92	64 11% salt
1 496	1 702	2 001

or, by calculation,  $a = \text{sp gr if } \% \text{ is crystallized salt}$ ,  $b = \text{sp gr if } \% \text{ is anhydrous salt}$

	5	10	15	20	25% salt,
a	1 040	1 084	1 131	1 181	1 237
b	1 044	1 092	1 143	1 199	1 262

	30	35	40	45	50% salt,
a	1 299	1 370	1 449	1 538	1 640
b	1 333	1 414	1 507	1 613	1 734

	55	60	64% salt
a	1 754	1 884	1 998
b	1 872		

(Brandhorst and Kraut, A 249 377)

Strontium phosphotungstate,  $2\text{SrO}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 17\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Péchar, C R 110 754)

Thallium phosphotungstate,  $\text{Tl}_2\text{O}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 4\text{H}_2\text{O}$

Ppt (Péchar, C R 110 754)

Zinc phosphotungstate,  $2\text{ZnO}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 7\text{H}_2\text{O}$

Efflorescent (Péchar, C R 110 754)

#### Monometaphosphotungstic acid

Ammonium monometaphosphotungstate,  $(\text{NH}_4)_2\text{O}, 2\text{NH}_4\text{PO}_3, 18\text{WO}_3 + 11\text{H}_2\text{O}$

Sl sol in cold  $\text{H}_2\text{O}$

**Potassium monometaphosphotungstate,**  
 $3K_2O, 2KPO_3, 24WO_3 + 20H_2O$ Very sl sol in  $H_2O$  (Gibbs, Am Ch J 7 319)**Orthometaphosphotungstic acid****Potassium sodium orthometaphosphotungstate,**  
 $2K_2O, 4Na_2O, 6Na_3PO_3, 6K_3PO_4, 22WO_3 + 42H_2O$ Sl sol in  $H_2O$  (Gibbs, Am Ch J 7 319)**Pyrophosphotungstic acid****Ammonium manganous sodium pyrophosphotungstate,**  
 $5(NH_4)_2O, 6MnO, 2Na_2O, 2P_2O_5, 28WO_3 + 48H_2O$ Very sol in cold and in hot  $H_2O$  (Gibbs, Am Ch J 1895, 17 90)**Ammonium sodium pyrophosphotungstate,**  
 $6(NH_4)_4P_2O_7, 3Na_4P_2O_7, 2(NH_4)_2O, 22WO_3 + 31H_2O$ Nearly insol in cold  $H_2O$  or  $NH_4OH + Aq$   
Sol in a large amount of hot  $H_2O$ **Manganous sodium pyrophosphotungstate,**  
 $6Na_2O, 3MnO, P_2O_5, 14WO_3 + 36H_2O$ Efflorescent in dry air Sol in  $H_2O$  and can be recryst therefrom (Gibbs)**Potassium pyrophosphotungstate,**  
 $9K_4P_2O_7, 22WO_3 + 49H_2O$ Very sl sol in cold  $H_2O$   
 $6K_4P_2O_7, 3H_4P_2O_7, 22WO_3, K_2O, H_2O + 42H_2O$  Sl sol in cold Sol in much boiling  $H_2O$  (Gibbs, Am Ch J 7 392)**Phosphovanadic acid,**  $P_2O_5, V_2O_5, 2H_2O + 9H_2O$ Sol in  $H_2O$   
Composition is vanadium phosphate  $(VO)_2H_2PO_4 + 4\frac{1}{2}H_2O$  (Friedheim, B 23 1531)This is the only "acid" which exists (F)  
 $P_2O_5, V_2O_5 + 14H_2O$  Sol in  $H_2O$ , can be recryst from dil  $H_3PO_4 + Aq$  (Ditte, C R 102 757) $3P_2O_5, 2V_2O_5 + 9H_2O$  Sol in  $H_2O$  (Ditte)  
 $P_2O_5, 3V_2O_5$  (Berzelius)  
 $3H_2O, 7P_2O_5, 6V_2O_5 + 34H_2O$  Sol in  $H_2O$   
Decomp by much  $H_2O$  into—  
 $6H_2O, P_2O_5, 20V_2O_5 + 53H_2O$  Sol in  $H_2O$  (Gibbs, Am Ch J 7 209)**Ammonium phosphovanadate,**  $(NH_4)_2O, P_2O_5, V_2O_5 + H_2O$ Sl sol in cold  $H_2O$  (Gibbs, Am Ch J 7 209)  
 $+ 3H_2O$  Composition is  $(VO_2)(NH_4)HPO_4 + H_2O$  (Friedheim)  
 $(NH_4)_2O, P_2O_5, 2V_2O_5 + 7H_2O$  Easily sol in  $H_2O$  (Gibbs) Sl sol in  $H_2O$  (Fried-heim) Composition is  $(NH_4)_2O, V_2O_5, + 2(VO_2)H_2PO_4 + 5H_2O$  (Friedheim) $5(NH_4)_2O, 2P_2O_5, 3V_2O_5 + 24H_2O$  Easily sol in  $H_2O$  (Ditte, C R 102 1019) Could not be obtained (Friedheim) $5(NH_4)_2O, 4P_2O_5, 2V_2O_5 + 24H_2O$  As above (Ditte) Could not be obtained (Friedheim) $7(NH_4)_2O, P_2O_5, 12V_2O_5 + 26H_2O$  Easily sol in  $H_2O$  Composition is  $2(NH_4)HPO_4 + 5(NH_4)_2O, 12V_2O_5 + 25H_2O$  (Friedheim)**Potassium phosphovanadate,**  $K_2O, P_2O_5, 2V_2O_5 + 7H_2O$ Sl sol in  $H_2O$ , decomp thereby to  $7K_2O, 12V_2O_5, P_2O_5 + 26H_2O$ Composition is  $K_2O, V_2O_5 + 2(VO)_2H_2PO_4 + 5H_2O$  (Friedheim) $3K_2O, 4P_2O_5, 6V_2O_5 + 21H_2O$  Sl sol in  $H_2O$  (Gibbs) $7K_2O, P_2O_5, 12V_2O_5 + 26H_2O$  Easily sol in  $H_2O$  Composition is  $2K_2HPO_4 + 5K_2O, 12V_2O_5 + 25H_2O$  (Friedheim) $2K_2O, P_2O_5, V_2O_5$  $3K_2O, 2P_2O_5, 2V_2O_5 + 5H_2O$  $13K_2O, 2P_2O_5, 22V_2O_5 + 58H_2O$  $15K_2O, 2P_2O_5, 25V_2O_5 + 76H_2O$ 

(Friedheim, Z anorg 1894, 5 446)

 $16K_2O, 2P_2O_5, 27V_2O_5 + 57H_2O$  $6K_2O, P_2O_5, 11V_2O_5 + 33H_2O$  $7K_2O, P_2O_5, 13V_2O_5 + 38H_2O$  $4K_2O, P_2O_5, 3V_2O_5 + 3H_2O$ 

(Friedheim, Z anorg 1894, 5 459-460)

**Silver phosphovanadate,**  $2Ag_2O, P_2O_5, V_2O_5 + 5H_2O$ Sl sol in cold or hot  $H_2O$  (Gibbs)**Phosphovanadicotungstic acid****Ammonium phosphovanadicotungstate,**  
 $(NH_4)_2O, P_2O_5, V_2O_5, WO_3 + xH_2O$ 

Ppt (Smith, J Am Chem Soc 1902, 24 577)

 $15(NH_4)_2O, 2P_2O_5, 6V_2O_5, 44WO_3 + 106H_2O$  Sol in  $H_2O$  Insol in alcohol, ether or benzene (Rogers, J Am Chem Soc 1903, 25 303)**Phosphovanadicovanadiotungstic acid****Ammonium phosphovanadicovanadiotungstate,**  
 $14(NH_4)_2O, 2P_2O_5, 3V_2O_5, 7V_2O_5, 27WO_3 + 66H_2O$ Sparingly sol in cold  $H_2O$  Sol in hot  $H_2O$  (Rogers, J Am Chem Soc 1903, 25 309)**Phosphovanadicozirconosotungstic acid****Ammonium phosphovanadicozirconosotungstate**

Exact formula not known (E. F. Smith, J Am Chem Soc 1903, 25 1226)

**Phosphovanadicovanadic acid****Ammonium phosphovanadicovanadate,**

$7(\text{NH}_4)_2\text{O}, 2\text{P}_2\text{O}_5, \text{VO}_2, 18\text{V}_2\text{O}_5 + 50\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 7 209)  
 $7(\text{NH}_4)_2\text{O}, 14\text{P}_2\text{O}_5, 16\text{V}_2\text{O}_5, 6\text{V}_2\text{O}_5 + 65\text{H}_2\text{O}$   
Decomp by boiling with  $\text{H}_2\text{O}$  into—  
 $5(\text{NH}_4)_2\text{O}, 10\text{P}_2\text{O}_5, 11\text{VO}_2, \text{V}_2\text{O}_5 + 41\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Gibbs)

**Potassium** —,  $5\text{K}_2\text{O}, 12\text{P}_2\text{O}_5, 12\text{VO}_2, 6\text{V}_2\text{O}_5 + 40\text{H}_2\text{O}$

Decomp by hot  $\text{H}_2\text{O}$  into—  
 $7\text{K}_2\text{O}, 12\text{P}_2\text{O}_5, 14\text{VO}_2, 6\text{V}_2\text{O}_5 + 52\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Gibbs)

**Sodium** —,  $4\text{Na}_2\text{O}, 5\text{P}_2\text{O}_5, \text{VO}_2, 4\text{V}_2\text{O}_5 + 37\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Gibbs)

**Phosphovanadiomolybdic acid****Ammonium phosphovanadiomolybdate,**

$7(\text{NH}_4)_2\text{O}, 2\text{P}_2\text{O}_5, \text{V}_2\text{O}_5, 48\text{MoO}_3 + 30\text{H}_2\text{O}$   
Sl sol in cold, somewhat more in hot  $\text{H}_2\text{O}$  with partial decomp (Gibbs, Am Ch J 5 391)  
 $8(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 8\text{V}_2\text{O}_5, 14\text{MoO}_3 + 50\text{H}_2\text{O}$   
Easily sol in hot  $\text{H}_2\text{O}$  without decomp (Gibbs)  
 $5(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 2\frac{1}{2}\text{V}_2\text{O}_5, 21\frac{1}{2}\text{MoO}_3 +$   
 $\text{V}_2\text{O}_5, \text{P}_2\text{O}_5, 5\text{V}_2\text{O}_5, 18\text{MoO}_3 + 45\text{H}_2\text{O}$   
 $\text{V}_2\text{O}_5, \text{P}_2\text{O}_5, 5\frac{1}{2}\text{V}_2\text{O}_5, 16\frac{1}{2}\text{MoO}_3 +$

$4\text{V}_2\text{O}_5, \text{P}_2\text{O}_5, 7\text{V}_2\text{O}_5, 15\text{MoO}_3 + 50\text{H}_2\text{O}$   
All above compounds are sol in  $\text{H}_2\text{O}$  (Blum, J Am Chem Soc 1908, 30 1859)  
 $6(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 7\text{V}_2\text{O}_5, 9\text{MoO}_3 + 28\text{H}_2\text{O},$   
 $+ 33\text{H}_2\text{O}$ , and  $+ 37\text{H}_2\text{O}$

Can be recryst from  $\text{H}_2\text{O}$  (Hinsens, Dissert 1904)

$4(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 4\text{V}_2\text{O}_5, 11\text{MoO}_3 + 37\text{H}_2\text{O}$  (Jacoby, Dissert 1900)  
 $6(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 7\text{V}_2\text{O}_5, 11\text{MoO}_3 + 34\text{H}_2\text{O}$   
and  $+ 43\text{H}_2\text{O}$  (Hinsens, Dissert 1904)  
 $8(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 7\text{V}_2\text{O}_5, 11\text{MoO}_3 + 30\text{H}_2\text{O}$  (Hinsens)

$5(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 4\text{V}_2\text{O}_5, 12\text{MoO}_3 + 39\text{H}_2\text{O}$   
1 cc of solution in  $\text{H}_2\text{O}$  contains 0.2624 g of hydrous salt Sp gr of solution at  $18^\circ = 1.0932$  (Lahrmann, Dissert 1904)

$6(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 4\text{V}_2\text{O}_5, 12\text{MoO}_3 + 24\text{H}_2\text{O}$   
Nearly insol in cold  $\text{H}_2\text{O}$  (Lahrmann)  
 $7(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 6\text{V}_2\text{O}_5, 12\text{MoO}_3 + 33\text{H}_2\text{O}$  (Stamm, Dissert 1905)

$6(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 4\text{V}_2\text{O}_5, 13\text{MoO}_3 + 37\text{H}_2\text{O}$   
1 cc of solution sat at  $18^\circ$  contains 0.1543 g hydrous salt and has sp gr = 1.0900 (Toggenburg, Dissert 1902)

$6(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 5\text{V}_2\text{O}_5, 13\text{MoO}_3 + 29\text{H}_2\text{O}$   
1 cc solution sat at  $18^\circ$  contains 0.2533 g hydrous salt Sp gr = 1.0797 (Stamm, Dissert 1905)

$+ 32\text{H}_2\text{O}$  (Stamm)

$+ 34\text{H}_2\text{O}$  (Stamm)

$6(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 4\text{V}_2\text{O}_5, 14\text{MoO}_3 + 28\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  with decomp (Toggenburg, Dissert 1902)

$8(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 4\text{V}_2\text{O}_5, 14\text{MoO}_3 + 24\text{H}_2\text{O}$   
Decomp by cold  $\text{H}_2\text{O}$  (Lahrmann, Dissert 1904)

$5(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 3\text{V}_2\text{O}_5, 5\text{MoO}_3 + 39\text{H}_2\text{O}$   
1 cc of solution sat at  $18^\circ$  contains 0.2445 g hydrous salt and has sp gr = 1.144 (Jacoby, Dissert 1900)

$6(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 3\text{V}_2\text{O}_5, 15\text{MoO}_3 + 41\text{H}_2\text{O}$   
Extraordinarily easily sol in  $\text{H}_2\text{O}$  (Jacoby)

$7(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 3\text{V}_2\text{O}_5, 18\text{MoO}_3 + 31\text{H}_2\text{O}$  (Schulz, Dissert 1905)

$6(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 3\text{V}_2\text{O}_5, 18\text{MoO}_3 + 40\text{H}_2\text{O}$  (Schulz)

$8(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 5\text{V}_2\text{O}_5, 73\text{MoO}_3 + 26\text{H}_2\text{O} + 33\text{H}_2\text{O}$  (Stamm, Dissert 1905)

**Ammonium barium** —,  $0.5(\text{NH}_4)_2\text{O}, 5\text{BaO}, \text{P}_2\text{O}_5, 6\text{V}_2\text{O}_5, 8\text{MoO}_3 + 38\text{H}_2\text{O}$

(Hinsens, Dissert 1904)

$2(\text{NH}_4)_2\text{O}, 4\text{BaO}, \text{P}_2\text{O}_5, 7\text{V}_2\text{O}_5, 10\text{MoO}_3 + 43\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  Decomp on heating (Toggenburg, Dissert 1902)

$(\text{NH}_4)_2\text{O}, 5\text{BaO}, \text{P}_2\text{O}_5, 6\text{V}_2\text{O}_5, 12\text{MoO}_3 + 49\text{H}_2\text{O}$  Less sol in  $\text{H}_2\text{O}$  than  $\text{NH}_4$  comp (Jacoby, Dissert 1900)

$2(\text{NH}_4)_2\text{O}, 4\text{BaO}, \text{P}_2\text{O}_5, 4\text{V}_2\text{O}_5, 13\text{MoO}_3 + 37\text{H}_2\text{O}$  Sol in much hot  $\text{H}_2\text{O}$  with decomp (Toggenburg, Dissert 1902)

$2(\text{NH}_4)_2\text{O}, 4\text{BaO}, \text{P}_2\text{O}_5, 5\text{V}_2\text{O}_5, 13\text{MoO}_3 + 46\text{H}_2\text{O}$  (Stamm, Dissert 1905)

$3(\text{NH}_4)_2\text{O}, 4\text{BaO}, \text{P}_2\text{O}_5, 5\text{V}_2\text{O}_5, 13\text{MoO}_3 + 40\text{H}_2\text{O}$  (Stamm)

$3(\text{NH}_4)_2\text{O}, 3\text{BaO}, \text{P}_2\text{O}_5, 4\text{V}_2\text{O}_5, 14\text{MoO}_3 + 39\text{H}_2\text{O}$  (Stamm)

$2(\text{NH}_4)_2\text{O}, 4\text{BaO}, \text{P}_2\text{O}_5, 3\text{V}_2\text{O}_5, 17\text{MoO}_3 + 46\text{H}_2\text{O}$  (Schulz, Dissert 1905)

**Ammonium potassium** —,  $(\text{NH}_4)_2\text{O}, 6\text{K}_2\text{O}, \text{P}_2\text{O}_5, 6\text{V}_2\text{O}_5, 10\text{MoO}_3 + 38\text{H}_2\text{O}$

(Jacoby, Dissert 1900)

$(\text{NH}_4)_2\text{O}, 6\text{K}_2\text{O}, \text{P}_2\text{O}_5, 7\text{V}_2\text{O}_5, 11\text{MoO}_3 + 25\text{H}_2\text{O}$  (Jacoby, Dissert 1900)

$(\text{NH}_4)_2\text{O}, 5\text{K}_2\text{O}, \text{P}_2\text{O}_5, 6\text{V}_2\text{O}_5, 12\text{MoO}_3 + 46\text{H}_2\text{O}$  (Jacoby)

$(\text{NH}_4)_2\text{O}, 5\text{K}_2\text{O}, \text{P}_2\text{O}_5, 5\text{V}_2\text{O}_5, 13\text{MoO}_3 + 25\text{H}_2\text{O} + 29\text{H}_2\text{O} + 30\text{H}_2\text{O}$  Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  (Stamm, Dissert 1905)

$5\text{K}_2\text{O}, (\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 4\text{V}_2\text{O}_5, 14\text{MoO}_3 + 31\text{H}_2\text{O}$  (Stamm)

$(\text{NH}_4)_2\text{O}, 4\text{K}_2\text{O}, \text{P}_2\text{O}_5, 3\text{V}_2\text{O}_5, 15\text{MoO}_3 + 36\text{H}_2\text{O}$  (Jacoby, Dissert 1900)

$(\text{NH}_4)_2\text{O}, 6\text{K}_2\text{O}, \text{P}_2\text{O}_5, 3\text{V}_2\text{O}_5, 18\text{MoO}_3 + 43\text{H}_2\text{O}$  (Schulz, Dissert 1905)

$5(\text{NH}_4)_2\text{O}, \text{K}_2\text{O}, \text{P}_2\text{O}_5, 2\text{V}_2\text{O}_5, 20\text{MoO}_3 + 52\text{H}_2\text{O}$  (Schulz)

**Barium potassium** —,  $2\text{BaO}, 2\text{K}_2\text{O}, \text{P}_2\text{O}_5, 2\text{V}_2\text{O}_5, 18\text{MoO}_3 + 47\text{H}_2\text{O}$

(Schulz, Dissert 1905)

**Potassium phosphovanadomolybdate**,  $7K_2O$ ,  $P_2O_5$ ,  $7V_2O_5$ ,  $9MoO_3 + 25H_2O$   
(Hinsen, Dissert 1904)  
 $5K_2O$ ,  $P_2O_5$ ,  $2V_2O_5$ ,  $20MoO_3 + 53H_2O$   
(Schulz, Dissert 1905)

### Phosphovanadotungstic acid

**Ammonium phosphovanadotungstate**,  
 $10(NH_4)_2O$ ,  $3P_2O_5$ ,  $V_2O_5$ ,  $60WO_3 + 60H_2O$

Nearly insol in cold, sl sol in hot  $H_2O$   
Sol in  $(NH_4)_2HPO_4 + Aq$ , and in  $NH_4OH + Aq$

$5(NH_4)_2O$ ,  $P_2O_5$ ,  $3V_2O_5$ ,  $16WO_3 + 37H_2O$   
Easily sol in  $H_2O$  (Gibbs, Am Ch J 5 391)

$13(NH_4)_2O$ ,  $2P_2O_5$ ,  $8V_2O_5$ ,  $34WO_3 + 86H_2O$   
Very sol in cold and hot  $H_2O$

nsol in alcohol, ether,  $CS_2$ , benzene and nitrobenzene (Rogers, J Am Chem Soc 1903, 25 299)

**Barium** —,  $18BaO$ ,  $3P_2O_5$ ,  $2V_2O_5$ ,  $60WO_3 + 144H_2O$

Easily sol in hot  $H_2O$  with decomp (Gibbs, Am Ch J 5 391)

**Potassium** —,  $3K_2O$ ,  $P_2O_5$ ,  $V_2O_5$ ,  $7WO_3 + 11H_2O$

Sol in  $H_2O$   
 $8K_2O$ ,  $3P_2O_5$ ,  $4V_2O_5$ ,  $18WO_3 + 23H_2O$  Sol in hot  $H_2O$  with decomp into preceding salt (Gibbs, Am Ch J 5 391)

**Silver** —,  $13Ag_2O$ ,  $2P_2O_5$ ,  $8V_2O_5$ ,  $33WO_3 + 41H_2O$

Somewhat sol in  $H_2O$   
Completely sol in  $H_2O$  containing a few drops  $HNO_3$  (Rogers, J Am Chem Soc 1903, 25 302)

### Phosphovanadovanadicotungstic acid

**Barium phosphovanadovanadicotungstate**,  
 $18BaO$ ,  $3P_2O_5$ ,  $V_2O_5$ ,  $VO$ ,  $60WO_3 + 150H_2O$

Sl sol in cold, easily sol in hot  $H_2O$  (Gibbs, Am Ch J 5 391)

### Phosphuretted hydrogen

See Hydrogen phosphide

### Platbromonitrous acid

**Potassium platbromonitrite**,  $K_2Pt(NO_2)_4Br_2$

Rather sl sol in  $H_2O$  (Blomstrand, J pr (2) 3 214)

Sol in about 40 pts cold, and 20 pts boiling  $H_2O$  Insol in alcohol Sl sol in  $KBr$  or  $KNO_3 + Aq$  (Vèzes, A ch (6) 29 198)

$K_2Pt(NO_2)_3Br_3$  Sol in about 5 pts warm  $H_2O$  with decomp (Vèzes)

$K_2Pt(NO_2)_2Br_4$  Sol in less than 5 pts  $H_2O$  with decomp (Vèzes)

### Platichloronitrous acid

**Potassium platichloronitrite**,  $K_2Pt(NO_2)_4Cl_2$

Rather sl sol in  $H_2O$  (Blomstrand J pr (2) 3 214)

Sol in 40 pts cold, and 20 pts boiling  $H_2O$  Insol in alcohol Sl sol in  $KCl$  or  $KNO_3 + Aq$  (Vèzes, A ch (6) 29 183)

$K_2Pt(NO_2)_3Cl_3$  Very sol in  $H_2O$  (Vèzes)

$K_2Pt(NO_2)_2Cl_4 + H_2O$  Sol in  $H_2O$  with decomp (Vèzes)

### Platiodonitrous acid

**Potassium platiodonitrite**,  $K_2Pt(NO_2)_2I_4$

Sl sol in cold, more easily in hot  $H_2O$ , decomp by boiling (Vèze, A ch (6) 29 207)

$K_2Pt(NO_2)_2I_6$  As above (Vèzes)

### Platin-

See also Pla mo-, plato-, p at-, and platos-

### Platindramine compounds

See Chloro-, bromo-, hydroxylo-, iodo-, nitrate-, nitrito-, sulphato-, etc, platindramine compounds

### Platindramine carbonate,

$Pt(NH_3)_6(CO_3)_2$

Ppt Sol in  $NaOH + Aq$  (Geddes, J pr (2) 26 257)

— chloride  $Pt(NH_3)_6Cl_4$

Sol in hot  $H_2O$  (Gerdes)

— chloroplatinate,  $Pt(NH_3)_4Cl_4$ ,  $PtCl_4 + 2H_2O$

Very sl sol in  $H_2O$  (Gerdes)

— nitrate,  $Pt(NH_3)_4(NO_3)_4$

Easily sol in  $H_2O$ , sl sol in  $HNO_3 + Aq$  (Gerdes)

— sulphate,  $Pt(NH_3)_4(SO_4)_2 + H_2O$

Nearly insol in  $H_2O$  (Gerdes)

**Tetraplatinamine iodide**,  $Pt_4(NH_3)_8I_{10}$

(Blomstrand, B 16 1469)

**Octoplatinamine iodide**,  $Pt_8(NH_3)_{16}I_{18}$

(Blomstrand)

### Platinic acid

**Barium platinate, basic (?)**,  $3BaO$ ,  $2PtO$

Insol in  $HC H_3O + Aq$ , easily sol in  $HCl + Aq$  (Roussin)



**Barium platinate, BaPtO<sub>3</sub>**

(Rousseau, C R 109 144)  
 +H<sub>2</sub>O Insol in dil HNO<sub>3</sub>+Aq, sol in warm HCl+Aq (Topsoe, B 3 464)  
 +4H<sub>2</sub>O Very sl sol in H<sub>2</sub>O, BaO<sub>3</sub>H<sub>2</sub>, or NaOH+Aq Easily sol in dil acids, except HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, in which it is insol in the cold, but decomp on heating (Topsoe, l c)  
 Composition is 3BaPtO<sub>3</sub>, BaCl<sub>2</sub>, PtCl<sub>2</sub>O+4H<sub>2</sub>O (?) (Johannsen, A 155 204)

**Calcium platinate chloride (?)**, 2Ca<sub>2</sub>Pt<sub>2</sub>O<sub>5</sub>Cl<sub>2</sub>+7H<sub>2</sub>O (?)

"Herschel's precipitate"  
 Easily sol in HCl+Aq, and in HNO<sub>3</sub>+Aq, if freshly pptd (Herschel)  
 Very sol in HNO<sub>3</sub>+Aq (Weiss and Dobereiner, A 14 252)  
 Composition is CaPtO<sub>3</sub>, PtCl<sub>2</sub>O, CaO+7H<sub>2</sub>O (?) (Johannsen, A 155 204)

**Potassium platinate**

Sol in H<sub>2</sub>O (Berzelius)  
 K<sub>2</sub>O, PtO<sub>2</sub>+3H<sub>2</sub>O Very sol in H<sub>2</sub>O (Blondel, A ch 1905, (8) 6 90)  
 K<sub>2</sub>Pt(OH)<sub>6</sub> Sol in H<sub>2</sub>O, insol in alcohol (Bellucci, Z anorg 1905, 44 173)

**Sodium platinate, Na<sub>2</sub>O, 3PtO<sub>2</sub>+6H<sub>2</sub>O**

Dil acids dissolve out Na<sub>2</sub>O and leave PtO<sub>2</sub>  
 Sol in HNO<sub>3</sub>+Aq (Dobereiner, Pogg 28 180)  
 Na<sub>2</sub>O, PtO<sub>2</sub>+3H<sub>2</sub>O Sol in H<sub>2</sub>O (Blondel)

**Metaplatinic acid, 5PtO<sub>2</sub>, 5H<sub>2</sub>O**

Insol, in H<sub>2</sub>O (Blondel, A ch 1905, (8) 6 103)

**Sodium metaplatinate, Na<sub>2</sub>O, 5PtO<sub>2</sub>+9H<sub>2</sub>O**

Insol in H<sub>2</sub>O (Blondel)

**Platinumolybdic acid, 4H<sub>2</sub>O, PtO<sub>2</sub>, 10MoO<sub>3</sub>**  
(Gibbs)

**Ammonium platinumolybdate,**  
 8MoO<sub>3</sub>, 2PtO<sub>2</sub>, 3(NH<sub>4</sub>)<sub>2</sub>O+12H<sub>2</sub>O  
 4MoO<sub>3</sub>, 2PtO<sub>2</sub>, 2(NH<sub>4</sub>)<sub>2</sub>O+19H<sub>2</sub>O  
 Sol in hot H<sub>2</sub>O (Gibbs, Am Ch J 1895, 17 50-52)

**Potassium platinumolybdate,**  
 60MoO<sub>3</sub>, PtO<sub>2</sub>, 10K<sub>2</sub>O+40H<sub>2</sub>O  
 So in hot H<sub>2</sub>O (Gibbs)

**Silver platinumolybdate**

**Sodium platinumolybdate, 4Na<sub>2</sub>O, PtO<sub>2</sub>,**  
 10 MoO<sub>3</sub>+29H<sub>2</sub>O  
 Sol in H<sub>2</sub>O (Gibbs, Sill Am J (3) 14 61)

**Platinungstic acid**

**Ammonium platinungstate, 4(NH<sub>4</sub>)<sub>2</sub>O, PtO<sub>2</sub>,**  
 10WO<sub>3</sub>+12H<sub>2</sub>O  
 Sol in H<sub>2</sub>O (Gibbs, B 10 1384)

**Potassium platinungstate, 4K<sub>2</sub>O, PtO<sub>2</sub>,**  
 10WO<sub>3</sub>+9H<sub>2</sub>O  
 Sol in H<sub>2</sub>O (Gibbs)

**Sodium platinungstate, 4Na<sub>2</sub>O, PtO<sub>2</sub>,**  
10WO<sub>3</sub>+25H<sub>2</sub>O

Sol in H<sub>2</sub>O (Gibbs)  
 5Na<sub>2</sub>O, 7WO<sub>3</sub>, 2PtO<sub>2</sub>+35H<sub>2</sub>O Sol in H<sub>2</sub>O (Gibbs)  
 Is double salt 3Na<sub>2</sub>O, 7WO<sub>3</sub>+2Na<sub>2</sub>PtO<sub>3</sub> (Rosenheim, B 24 2397)  
 10WO<sub>3</sub>, PtO<sub>2</sub>, 4Na<sub>2</sub>O+23H<sub>2</sub>O  
 10WO<sub>3</sub>, PtO<sub>2</sub>, 6Na<sub>2</sub>O+28H<sub>2</sub>O  
 20WO<sub>3</sub>, PtO<sub>2</sub>, 9Na<sub>2</sub>O+58H<sub>2</sub>O  
 30WO<sub>3</sub>, 2PtO<sub>2</sub>, 15Na<sub>2</sub>O+89H<sub>2</sub>O  
 30WO<sub>3</sub>, PtO<sub>2</sub>, 12Na<sub>2</sub>O+72H<sub>2</sub>O  
 All are sol in boiling H<sub>2</sub>O (Gibbs, Am Ch J 1895, 17 74-80)

**Platino-**

See also Plato—

**Platinochlorophosphoric acid**

See Chloroplatinophosphoric acid

**Platinocyanhydric acid, H<sub>2</sub>Pt(CN)<sub>4</sub>**

Deliquescent Very sol in H<sub>2</sub>O, alcohol, and ether

**Ammonium platinocyanide, (NH<sub>4</sub>)<sub>2</sub>Pt(CN)<sub>4</sub>,**  
+3H<sub>2</sub>O.

Very sol in H<sub>2</sub>O  
 +2H<sub>2</sub>O Sol in 1 pt H<sub>2</sub>O, and still more easily in alcohol  
 +H<sub>2</sub>O

**Ammonium hydroxylamine platinocyanide,**  
 NH<sub>4</sub>(NH<sub>4</sub>O)Pt(CN)<sub>4</sub>+3½H<sub>2</sub>O  
 Sol in H<sub>2</sub>O (Scholz, M Ch 1 900)

**Ammonium magnesium platinocyanide,**  
 (NH<sub>4</sub>)<sub>2</sub>Mg[Pt(CN)<sub>4</sub>]<sub>2</sub>+6H<sub>2</sub>O

**Barium platinocyanide, BaPt(CN)<sub>4</sub>+4H<sub>2</sub>O**

Sol in 33 pts H<sub>2</sub>O at 16°, and in much less at 100° Sol in alcohol

**Barium potassium platinocyanide,**  
 BaK<sub>2</sub>[Pt(CN)<sub>4</sub>]<sub>2</sub>  
 Sol in H<sub>2</sub>O

**Barium rubidium platinocyanide,**  
 BaRb<sub>2</sub>[Pt(CN)<sub>4</sub>]<sub>2</sub>  
 Sol in H<sub>2</sub>O

<b>Cadmium platinocyanide</b> , $\text{CdPt}(\text{CN})_4$ Ppt Sol in $\text{NH}_4\text{OH} + \text{Aq}$ (Martius, A 117 376) $\text{CdPt}(\text{CN})_4, 2\text{NH}_3 + \text{H}_2\text{O}$ (M)	<b>Lanthanum platinocyanide</b> , $\text{La}_2[\text{Pt}(\text{CN})_4]_3 + 18\text{H}_2\text{O}$ Easily sol in $\text{H}_2\text{O}$ (Cleve)
<b>Calcium platinocyanide</b> , $\text{CaPt}(\text{CN})_4 + 5\text{H}_2\text{O}$ Very sol in $\text{H}_2\text{O}$	<b>Magnesium platinocyanide</b> , $\text{MgPt}(\text{CN})_4 + 2\text{H}_2\text{O}$ Solubility in $\text{H}_2\text{O}$ 100 g of the sat solution contain at 96 4° 100° 44 33 43 96 g $\text{MgPt}(\text{CN})_4$ (Buxhoevden, Z anorg 1897, 15 325)
<b>Calcium potassium platinocyanide</b> , $\text{CaK}_2[\text{Pt}(\text{CN})_4]_2$ Sol in $\text{H}_2\text{O}$	$+ 4\text{H}_2\text{O}$ Solubility in $\text{H}_2\text{O}$ 100 g of the sat solution contain at 42 2° 46 3° 48 7° 55° 40 21 39 79 40 75 40 02 g $\text{MgPt}(\text{CN})_4$ , 58 1° 69° 77 8° 87 4° 42 01 43 48 44 88 45 52 g $\text{MgPt}(\text{CN})_4$ ,
<b>Cerium platinocyanide</b> , $\text{Ce}_2[\text{Pt}(\text{CN})_4]_3 + 18\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$	90° 93° 45 59 45 04 g $\text{MgPt}(\text{CN})_4$ (Buxhoevden)
<b>Cobaltous platinocyanide ammonia</b> , $\text{CoPt}(\text{CN})_4, 2\text{NH}_3$ Insol in $\text{H}_2\text{O}$ , but sol in hot $\text{NH}_4\text{OH} + \text{Aq}$	$+ 7\text{H}_2\text{O}$ Sol in 3 4 pts $\text{H}_2\text{O}$ at 16° Easily sol in alcohol and ether Solubility in $\text{H}_2\text{O}$ 100 g of the sat solution contain at — 4 12° + 0 5° 5 5° 18 0° 24 9 26 33 28 07 31 23 g $\text{MgPt}(\text{CN})_4$ ,
<b>Cupric platinocyanide</b> , $\text{CuPt}(\text{CN})_4 + x\text{H}_2\text{O}$ Ppt	36 6° 45 0° 46 2° 38 36 41 32 41 96 g $\text{MgPt}(\text{CN})_4$ (Buxhoevden)
<b>Cupric platinocyanide ammonia</b> , $\text{CuPt}(\text{CN})_4, 2\text{NH}_3 + \text{H}_2\text{O}$ $\text{CuPt}(\text{CN})_4, 4\text{NH}_3$ Sol in $\text{H}_2\text{O}$ , alcohol, and ether	<b>Magnesium potassium platinocyanide</b> , $\text{MgK}_2[\text{Pt}(\text{CN})_4]_2 + 7\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$
<b>Didymium platinocyanide</b> , $\text{Dy}_2[\text{Pt}(\text{CN})_4]_3 + 18\text{H}_2\text{O}$ Efflorescent in dry air Sol in $\text{H}_2\text{O}$ (Cleve)	<b>Mercuric platinocyanide</b> , $\text{HgPt}(\text{CN})_4$ Ppt
<b>Dysprosium platinocyanide</b> , $\text{Dy}_2[\text{Pt}(\text{CN})_4]_3 + 21\text{H}_2\text{O}$ Easily sol in $\text{H}_2\text{O}$ (Jantsch, B 1911, 44 1277)	<b>Mercuric platinocyanide nitrate</b> , $5\text{HgPt}(\text{CN})_4, \text{Hg}(\text{NO}_3)_2 + 10\text{H}_2\text{O}$ Ppt
<b>Erbium platinocyanide</b> , $\text{Er}_2[\text{Pt}(\text{CN})_4]_3 + 21\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ (Cleve)	<b>Nickel platinocyanide ammonia</b> , $\text{NiPt}(\text{CN})_4, 2\text{NH}_3 + \text{H}_2\text{O}$
<b>Gadolinium platinocyanide</b> , $2\text{Gd}(\text{CN})_3, 3\text{Pt}(\text{CN})_2 + 18\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ , decomp in the air (Benedicks, Z anorg 1900, 22 405)	<b>Potassium platinocyanide</b> , $\text{K Pt}(\text{CN})_4 + 3\text{H}_2\text{O}$ Extremely efflorescent Sl sol in cold, easily in hot $\text{H}_2\text{O}$ (Willm, B 19 950) Sol in alcohol and ether
<b>Glucinum platinocyanide</b> , $\text{GlPt}(\text{CN})_4$ (Toczynski, Dissert 1871)	<b>Potassium sodium platinocyanide</b> , $\text{K Pt}(\text{CN})_4, \text{Na}_2\text{Pt}(\text{CN})_4 + 6\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ (Willm, B 19 950)
<b>Hydroxylamine platinocyanide</b> , $(\text{NH}_4\text{O})_2\text{Pt}(\text{CN})_4 + 2\text{H}_2\text{O}$ Deliquescent Very sol in $\text{H}_2\text{O}$ (Scholz)	<b>Praseodymium platinocyanide</b> , $2\text{Pr}(\text{CN})_3, 3\text{Pt}(\text{CN})_2$ Sol in $\text{H}_2\text{O}$ (Von Scheele, Z anorg 1898, 18 355)
<b>Hydroxylamine lithium platinocyanide</b> , $(\text{NH}_4\text{O})\text{LiPt}(\text{CN})_4 + 3\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$	
<b>Indium platinocyanide</b> , $\text{In}_2[\text{Pt}(\text{CN})_4]_3 + 2\text{H}_2\text{O}$ Hydroscopic, sol in $\text{H}_2\text{O}$ (Renz, B 1901, 34 2765)	

**Samarium platnocyamide**,  $\text{Sm}_2[\text{Pt}(\text{CN})_4]_3$   
 $+18\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Cleve)

**Scandium platnocyamide**,  $\text{Sc}_2[\text{Pt}(\text{CN})_4]_3$   
 $+21\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  and insol in alcohol, when boiled in alcohol it is dehydrated (Crookes, Phil Trans 1910, 210 A, 368)  
 $+21\text{H}_2\text{O}$  (Orlow, Ch Z 1912, 36 1407)

**Silver platnocyamide**,  $\text{Ag}_2\text{Pt}(\text{CN})_4$   
 Insol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Silver platnocyamide ammonia**,  $\text{Ag}_2\text{Pt}(\text{CN})_4$ ,  
 $2\text{NH}_3$   
 Insol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Silver platnocyamide bromide**  
*See Bromoplatnocyamide, silver*

**Silver platnocyamide chloride**  
*See Chloroplatnocyamide, silver*

**Silver platnocyamide iodide**  
*See Iodoplatnocyamide, silver*

**Sodium platnocyamide**,  $\text{Na}_2\text{Pt}(\text{CN})_4 + 3\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  (Willm, Z anorg 4 298)  
 Sol in alcohol

**Strontium platnocyamide**,  $\text{SrPt}(\text{CN})_4 + 5\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$

**Thallous platnocyamide**,  $\text{Tl}_2\text{Pt}(\text{CN})_4$   
 Nearly insol in cold, sl sol in hot  $\text{H}_2\text{O}$   
 (Friswell, Chem Soc 24 461)

**Thallous platnocyamide carbonate**,  
 $2\text{Tl}_2\text{Pt}(\text{CN})_4$ ,  $\text{Tl}_2\text{CO}_3$   
 Nearly insol in cold  $\text{H}_2\text{O}$  (F)

**Thorium platnocyamide**,  $\text{Th}[\text{Pt}(\text{CN})_4]_2 + 16\text{H}_2\text{O}$   
 Somewhat difficultly sol in cold, easily in hot  $\text{H}_2\text{O}$  (Cleve, Sv V A H Bih 2 No 6)

**Uranyl platnocyamide**,  $(\text{UO}_2)\text{Pt}(\text{CN})_4 + x\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Levy, Chem Soc 1908, 93 1459)

**Ytterbium platnocyamide**,  $2\text{Yb}(\text{CN})_3$ ,  
 $3\text{Pt}(\text{CN})_2 + 18\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  (Cleve, Z anorg 1902, 32 139)

**Yttrium platnocyamide**,  $\text{Y}_2[\text{Pt}(\text{CN})_4]_3 + 21\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  Insol in absolute alcohol (Cleve and Hoglund)

**Zinc platnocyamide ammonia**,  $\text{ZnPt}(\text{CN})_4$ ,  
 $2\text{NH}_3 + \text{H}_2\text{O}$

**Platinonitrous acid**  
*See Platonitrous acid*

**Platinoplatnocyanyhydric acid**,  $\text{HPt}(\text{CN})_4$ ,  
 $+x\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Levy, Chem Soc 1912, 101 1093)

**Platinoselenocyanyhydric acid**

**Potassium platinoselenocyamide**,  
 $\text{K}_2\text{Pt}(\text{SeCN})_6$   
 Sol in  $\text{H}_2\text{O}$  and alcohol (Clarke and Dudley, B 1878, 11 1325)

**Platinoselenostannic acid**  
*See under Selenostannate, platinum*

**Platinososulphocyanyhydric acid**,  
 $\text{H}_2\text{Pt}(\text{SCN})_4$   
 Known only in aqueous solution

**Potassium platinososulphocyamide**,  
 $\text{K}_2\text{Pt}(\text{SCN})_4$   
 Permanent Sol in 25 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and more readily at higher temp Very sol in warm alcohol

**Silver —**,  $\text{Ag}_2\text{Pt}(\text{SCN})_4$   
 Insol in  $\text{H}_2\text{O}$  Sol in  $\text{KSCN} + \text{Aq}$ , and partly sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Platinosulphocyanyhydric acid**,  
 $\text{H}_2\text{Pt}(\text{SCN})_6$   
 Known only in aqueous, and alcoholic solutions

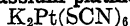
**Ammonium platinosulphocyamide**,  
 $(\text{NH}_4)_2\text{Pt}(\text{SCN})_6$   
 Sol in  $\text{H}_2\text{O}$  and alcohol

**Barium —**,  $\text{BaPt}(\text{SCN})_4$   
 Sol in  $\text{H}_2\text{O}$  and alcohol

**Ferrous —**,  $\text{FePt}(\text{SCN})_6$   
 Insol in  $\text{H}_2\text{O}$  or alcohol Not attacked by dil  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$

**Lead —**,  $\text{PbPt}(\text{SCN})_6$   
 Sl sol in cold, decomp by hot  $\text{H}_2\text{O}$  Sol in alcohol  
 $\text{PbPt}(\text{SCN})_6$ ,  $\text{PbO}$  Insol in  $\text{H}_2\text{O}$  or alcohol Sol in acetic or nitric acids

**Mercurous —**,  $\text{Hg}_2\text{Pt}(\text{SCN})_4$   
 Ppt Insol in  $\text{H}_2\text{O}$

**Potassium platinosulphocyanide,**

Sol in 12 pts  $H_2O$  at  $60^\circ$  Much more easily in boiling  $H_2O$ , and still more easily in hot alcohol

+ $2H_2O$  (Miolati and Bellucci, Gazz Ch it 1900, 30, II 592)

**Silver —,  $Ag_2Pt(SCN)_6$** 

Insol in  $H_2O$  or  $K_2Pt(SCN)_6 + Aq$  Sol in cold  $NH_4OH + Aq$  and in  $KCN + Aq$

**Sodium —,  $Na Pt(SCN)_6$** 

Sol in  $H_2O$  and alcohol

**Platinosulphostannic acid**

See under Sulphostannate, platinum

**Platinosulphurous acid**

See Platinosulphurous acid

**Platinum, Pt**

Not attacked by  $H_2O$ ,  $H_2SO_4$ ,  $HCl$ , or  $HNO_3 + Aq$  Slowly sol in aqua regia, or a mixture of  $HBr$  and  $HNO_3$ , but much less easily than Au

Precipitated Pt is remarkably sol in  $HCl + Aq$  in presence of air (Wilm, B 1881, 14 636)

Pure Pt foil is attacked by fuming  $HCl$  under influence of light, but not in the dark (Berthelot, C R 1904, 138 1297)

Dil  $HCl + Aq$  dissolves 10–15% Pt from active Pt black (Wohler, B 1903, 36 3482)

Conc  $HNO_3$  oxidizes Pt black, Pt sponge, less easily, sheet Pt, slightly (Wohler, Dissert 1901)

Pt in presence of Hg is more or less sol in conc  $HNO_3$  (Tarugi, Gazz ch it 1903, 33, II 171)

Pt vessels are attacked by evaporating  $HNO_3$  therein (Jaunek and Meyer, Z anorg 1913, 83 71)

Sl sol in conc  $H_2SO_4$  containing small amounts of nitrogen oxides (Schueren-Kestner C R 86 1052)

Pt black, pptd by formic acid, is easily sol in boiling  $H_2SO_4$  (Dcville and Stas, Paris, 1878)

Thin sheet Pt is attacked by boiling  $H_2SO_4$  containing  $K_2SO_4$ , 1 sq cm loses 0.01 g in 1 hour and velocity of the reaction is not accelerated by addition of  $HNO_3$  Pt black is completely dissolved under the above conditions in 50 hours (Delépine, C R 1905, 141 1013)

Further data on solubility of Pt in  $H_2SO_4$  are given by Delépine (C R 1906, 142 631)

95%  $H_2SO_4$  dissolves 0.04 g Pt from commercial Pt at  $250$ – $260^\circ$  in 28 hours (Conroy, J Soc Chem Ind 1903, 22 465)

See also Quenessen (Bull Soc 1906, (3) 35 620)

0.0038 g is dissolved by 10 cc of boiling  $H_2SO_4$  (McCoy, Eighth Inter Cong App Chem 1912 2)

$HCl + HNO_3$ , so long as they are sufficiently dil or the temperature is so low that they cannot react on each other, have no action on Pt Addition of Cl does not bring about reaction, but a few drops of  $KNO_3$  or  $N_2O_5 + Aq$  bring about an immediate reaction (Millon) Slowly sol in  $HI + Aq$  (Deville, C R 42 896)

Conc  $H_3PO_4$  attacks Pt when heated in presence of air, but not in its absence (Hüttner, Z anorg 1908, 59 216)

Pt dissolves easily in most acids when they contain  $H_2O_2$  (Fairley, B 1875, 8 1600)

Slowly sol in boiling  $FeCl_3 + Aq$  (Saint-Pierre, C R 54 1077)

$FeCl_3$  in acid solution is without influence on Pt (Marie, C R 1908, 146 476)

Pt is completely insol in  $KCN + Aq$  (Rossler, Z Chem 1866 175)

Pt is attacked by boiling conc  $KCN + Aq$  (Deville and Debray, C R 82 241)

Solubility of Pt in 10%  $KCN + Aq$  is very small at ord temp (1.4 mg in 8 days) but is considerably greater in boiling conc  $KCN + Aq$  (71.5 mg in 5 hours) (Glaser, Z Elektrochem 1903, 9 15)

Pt foil is dissolved in boiling  $KCN + Aq$  (0.030 g for 1 cc in 1 hour) Insol in cold  $KCN + Aq$  (Brochet and Petit, C R 1904, C R 138 1255)

Sol in  $RbCl_4I + Aq$  (Erdmann, Arch Pharm 1894, 232 30)

Insol in liquid  $NH_3$  (Gore, Am Ch J 1898, 20 828)

**Platinum ammonium compounds**

Data published since the first edition of this work have not been included in this edition

See —

Platosamine comps,  $Pt < \begin{smallmatrix} NH_3 R \\ NH_3 R \end{smallmatrix}$

Platocumdiamine comps,  
 $Pt < \begin{smallmatrix} NH_3 NH_3 R \\ R \end{smallmatrix}$

Platomonothamine comps,  
 $Pt < \begin{smallmatrix} NH_3 NH_3 R \\ NH_3 R \end{smallmatrix}$

Platodiamine comps  $Pt < \begin{smallmatrix} NH_3 NH_3 R \\ NH_3 NH_3 R \end{smallmatrix}$

Platosocumamine comps,  $Pt < \begin{smallmatrix} NH_3 R \\ R \end{smallmatrix}$

Diplatodiamine comps,  
 $Pt - NH, NH, R$

$Pt - NH, NH, R$   
Bromoplatinamine comps,  
 $B_{12}Pt < \begin{smallmatrix} NH_3 R \\ NH_3 R \end{smallmatrix}$

Chloroplatinamine comps,  
 $Cl_2Pt < \begin{smallmatrix} NH, R \\ NH_3 R \end{smallmatrix}$

**Chloronitratoplatinamine comps**,  
 $\text{Cl}(\text{NO}_3)\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \end{smallmatrix}$   
**Iodoplatinamine comps**,  $\text{I}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \end{smallmatrix}$   
**Hydroxyloplatinamine comps**,  
 $(\text{OH})_2\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \end{smallmatrix}$   
**Nitratoplatinamine comps**,  
 $(\text{NO}_3)_2\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \end{smallmatrix}$   
**Sulphatoplatinamine comps**,  
 $\text{SO}_4\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \end{smallmatrix}$   
**Bromoplatinsemidiamine comps**,  
 $\text{Br}_2\text{PtNH}_3 \text{ NH}_3 \text{ R}$   
**Bromonitritoplatinsemidiamine comps**,  
 $\text{Br}_2(\text{NO}_2)\text{PtNH}_3 \text{ NH}_3 \text{ R}$   
**Chloroplatinsemidiamine comps**,  
 $\text{Cl}_3\text{PtNH}_3 \text{ NH}_3 \text{ R}$   
**Chlorohydroxylonitritosemidiamine comps**,  
 $\text{Cl}(\text{OH})(\text{NO}_2)\text{PtNH}_3 \text{ NH}_3 \text{ R}$   
**Chloronitritoplatinsemidiamine comps**,  
 $\text{Cl}_2(\text{NO}_2)\text{PtNH}_3 \text{ NH}_3 \text{ R}$   
**Iodoplatinsemidiamine comps**,  
 $\text{I}_3\text{PtNH}_3 \text{ NH}_3 \text{ R}$   
**Hydroxylosemidiamine comps**,  
 $(\text{OH})_3\text{PtNH}_3 \text{ NH}_3 \text{ R}$   
**Bromoplatinmonodiamine comps**,  
 $\text{Br}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \end{smallmatrix}$   
**Bromohydroxyloplatinmonodiamine comps**,  
 $\text{Br}(\text{OH})\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \end{smallmatrix}$   
**Chloroplatinmonodiamine comps**,  
 $\text{Cl}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \end{smallmatrix}$   
**Iodonitratoplatinmonodiamine comps**,  
 $\text{I}(\text{NO}_3)\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \end{smallmatrix}$   
**Hydroxyloplatinmonodiamine comps**,  
 $(\text{OH})_2\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \end{smallmatrix}$   
**Bromoplatinndiamine comps**,  
 $\text{Br}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ NH}_3 \text{ R} \\ \text{NH}_3 \text{ NH}_3 \text{ R} \end{smallmatrix}$   
**Bromocarbonatoplatinndiamine comps**,  
 $\text{CO}_3 > [\text{Pt}(\text{NH}_3)_2\text{R}]_2$   
**Bromochloroplatinndiamine comps**,  
 $\text{BrClPt}(\text{NH}_3)_4\text{R}_2$   
**Bromohydroxyloplatinndiamine comps**,  
 $\text{Br}(\text{OH})\text{Pt}(\text{NH}_3)_4\text{R}_2$   
**Bromonitratoplatinndiamine comps**,  
 $\text{Br}(\text{NO}_3)\text{Pt}(\text{NH}_3)_4\text{R}_2$   
**Bromosulphatoplatinndiamine comps**,  
 $\text{Br}_2(\text{SO}_4)[\text{Pt}(\text{NH}_3)_4\text{R}_2]_2$   
**Carbonatochloroplatinndiamine comps**,  
 $(\text{CO}_3)\text{Cl}_2[\text{Pt}(\text{NH}_3)_4\text{R}_2]_2$   
**Carbonatonitratoplatinndiamine comps**,  
 $(\text{CO}_3)(\text{NO}_3)_2[\text{Pt}(\text{NH}_3)_4\text{R}_2]_2$

**Chloroplatinndiamine comps**,  
 $\text{Cl}_2\text{Pt}(\text{NH}_3)_4\text{R}_2$   
**Chlorohydroxyloplatinndiamine comps**,  
 $\text{Cl}(\text{OH})(\text{NH}_3)_4\text{R}_2$   
**Chloriodoplatinndiamine comps**,  
 $\text{ClIPt}(\text{NH}_3)_4\text{R}_2$   
**Chloronitratoplatinndiamine comps**,  
 $\text{Cl}(\text{NO}_3)\text{Pt}(\text{NH}_3)_4\text{R}_2$   
**Hydroxyloplatinndiamine comps**,  
 $(\text{OH})_2\text{Pt}(\text{NH}_3)_4\text{R}_2$   
**Hydroxylonitratodiamine comps**,  
 $(\text{OH})(\text{NO}_3)\text{Pt}(\text{NH}_3)_4\text{R}_2$   
**Hydroxylosulphatodiamine comps**,  
 $(\text{OH})_2\text{SO}_4[\text{Pt}(\text{NH}_3)_4\text{R}_2]_2$   
**Iodoplatinndiamine comps**,  $\text{I}_2\text{Pt}(\text{NH}_3)_4\text{R}_2$   
**Iodonitritoplatinndiamine comps**,  
 $\text{I}(\text{NO}_2)\text{Pt}(\text{NH}_3)_4\text{R}_2$   
**Nitratoplatinndiamine comps**,  
 $(\text{NO}_3)_2\text{Pt}(\text{NH}_3)_4\text{R}_2$   
**Nitritoplatinndiamine comps**,  
 $(\text{NO}_2)_2\text{Pt}(\text{NH}_3)_4\text{R}_2$   
**Sulphatoplatinndiamine comps**,  
 $(\text{SO}_4)\text{Pt}(\text{NH}_3)_4\text{R}_2$   
**Iododiplatinamine comps**,  
 $\text{I}-\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \\ \text{NH}_3 \text{ R} \end{smallmatrix}$   
**Bromodiplatinndiamine comps**,  
 $\text{Br}-\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ NH}_3 \text{ R} \\ \text{NH}_3 \text{ NH}_3 \text{ R} \\ \text{NH}_3 \text{ NH}_3 \text{ R} \\ \text{NH}_3 \text{ NH}_3 \text{ R} \end{smallmatrix}$   
**Hydroxyloiodiplatinndiamine comps**,  
 $(\text{OH})_2\text{Pt}_2(\text{NH}_3)_8\text{R}_4$   
**Iododiplatinndiamine comps**,  
 $\text{I}_2\text{Pt}_2(\text{NH}_3)_8\text{R}_4$   
**Nitratodiplatinndiamine comps**,  
 $(\text{NO}_3)_2\text{Pt}_2(\text{NH}_3)_8\text{R}_4$   
**Platintriamine comps**,  
 $\text{R}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3 \text{ NH}_3 \text{ NH}_3 \text{ R} \\ \text{NH}_3 \text{ NH}_3 \text{ NH}_3 \text{ R} \end{smallmatrix}$   
*Tetraplatinamine comps*,  $\text{Pt}_4(\text{NH}_3)_{18}\text{R}_{10}$   
*Octoplatinamine comps*,  $\text{Pt}_8(\text{NH}_3)_{16}\text{R}_{18}$

**Platinum antimonide**,  $\text{PtSb}_2$   
 (Christoffe, 1863)

**Platinum arsenide**,  $\text{Pt}_3\text{As}_2$   
 (Tivoli, Gazz ch it 14 487)  
 $\text{PtAs}_2$  Min *Sperrylite* Si attacked by  
 aqua regia (Wells, Sill Am J (3) 37 67)

**Platinum arsenic hydroxide** (?),  $\text{PtAsOH}$

Insol in, and slowly decom by  $\text{H}_2\text{O}$  and  
 alcohol Easily decom by  $\text{HCl} + \text{Aq}$ , not  
 attacked by  $\text{HNO}_3 + \text{Aq}$  Sol in aqua regia,  
 not attacked by cold conc  $\text{H}_2\text{SO}_4$ , but de-  
 comp on heating (Tivoli, Gazz ch it 14  
 487)

**Platinum potassium azoumide**

Ppt Explodes violently even in aq solution (Curtius, J pr 1898, (2) 58 304)

**Platinum boride, Pt<sub>2</sub>B<sub>2</sub>**

Very slowly sol in aqua regia (Martius, A 109 79)

**Platinous bromide, PtBr<sub>2</sub>**

Insol in H<sub>2</sub>O Sol in HBr+Aq Sl sol in KBr+Aq (Topsoe, J B 1868 274)

**Platinic bromide, PtBr<sub>4</sub>**

Not deliquescent, sol in H<sub>2</sub>O (Meyer and Zühln, B 13 404)

Sl sol in H<sub>2</sub>O 100 g PtBr<sub>4</sub>+Aq sat at 20° contain 0.41 g PtBr<sub>4</sub> (Halberstadt, B 17 2962)

Easily sol in HBr+Aq, sl sol in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq Sol in considerable amount in K or NH<sub>4</sub> oxalate+Aq

Very sl sol in alcohol or ether, also in glycerine (Halberstadt)

**Platinic hydrogen bromide**

See Bromoplatinic acid

**Platinous bromide carbonyl**

See Carbonyl platinous bromide

**Platinic bromide with MBr**

See Bromoplatinate, M

**Platinum carbide, PtC<sub>2</sub>**

Hot aqua regia dissolves out nearly all the Pt (Zeise, J pr 20 209)

**Platinum carbon disulphide, PtCS<sub>2</sub>**

See Platinum sulphocarbide

**Platinum monochloride, PtCl+zH<sub>2</sub>O**

Easily sol in HCl, mod sol in hot dil H<sub>2</sub>SO<sub>4</sub> without decomp (Sonstadt, Proc Chem Soc 1898, 14 179)

**Platinous chloride, PtCl<sub>2</sub>**

Insol in H<sub>2</sub>O, conc H<sub>2</sub>SO<sub>4</sub>, or HNO<sub>3</sub> Sol in hot HCl+Aq with exclusion of air (Berzelius)

Insol in alcohol or ether, sol in NH<sub>4</sub>OH+Aq (Raewsky, A ch (3) 22 280) Sol in aqua regia with formation of PtCl<sub>4</sub>

Insol in cold conc KI+Aq, but sol when heated (Lassaigne, A ch (2) 51 117)

Sl sol in liquid NH<sub>3</sub> (Gore, Am Ch J 1898, 20 828)

Insol in acetone (Eidmann, C C 1899, II 1014)

**Platinum trichloride, PtCl<sub>3</sub>**

Sl sol in cold, more sol in hot H<sub>2</sub>O

Partially hydrolyzed by boiling with H<sub>2</sub>O

Insol in cold conc HCl Sol in hot conc HCl with decomp

Sol in KI+Aq (Wöhler, B 1909, 42 3961)

**Platinic chloride, PtCl<sub>4</sub>**

Not deliquescent Very sol in H<sub>2</sub>O (Pulinger, Chem Soc 61 420)

Sp gr of aqueous solution containing  
 5 10 15 20 25 % PtCl<sub>4</sub>,  
 1 046 1 097 1 153 1 214 1 285  
 30 35 40 45 50 % PtCl<sub>4</sub>  
 1 362 1 450 1 546 1 666 1 785

(Precht, Z anal 18 512)

Insol in conc H<sub>2</sub>SO<sub>4</sub> (Dumas)

Sl sol in liquid NH<sub>3</sub> (Gore, Am Ch J 1898, 20 828)

Sol in alcohol and ether, sol in anhydrous acetone (Zeise, A 33 34)

Insol in ether (Willstätter, B 1903, 36 1830)

Sl sol in methyl acetate (Naumann, B 1909, 42 3790)

Sol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4328)

+H<sub>2</sub>O Sol in H<sub>2</sub>O (Gutbier and Heinrich, Z anorg 1913, 81 378)

+4H<sub>2</sub>O Sol in H<sub>2</sub>O (Pigeon, C R 1891, 112 792)

+5H<sub>2</sub>O Not deliquescent Sol in H<sub>2</sub>O or HCl+Aq

Composition is probably H<sub>2</sub>PtCl<sub>4</sub>O+4H<sub>2</sub>O (Norton, J pr 110 469)

+7H<sub>2</sub>O Sol in H<sub>2</sub>O (Pigeon)

+8H<sub>2</sub>O (Blondel, A Ch 1905, (8) 6 98)

**Platinic thallium chloride, Tl<sub>3</sub>Pt<sub>2</sub>Cl<sub>8</sub>H<sub>5</sub>O<sub>4</sub>**

Ppt, insol in H<sub>2</sub>O (Miolati, Z anorg 1900, 22 460)

**Platinous hydrogen chloride**

See Chloroplatinous acid

**Platinic hydrogen chloride**

See Chloroplatinic acid

**Platinous chloride with MCl**

See Chloroplatinite, M

**Platinic chloride with MCl**

See Chloroplatinate, M

**Platinous phosphorus chloride**

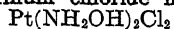
See Phosphorus platinous chloride

**Platinic phosphorus chloride**

See Phosphorus platinic chloride

**Platinous chloride carbonyl**

See Carbonyl platinous chloride

**Platinum chloride hydroxylamine,**

Ppt Sol in alcohol and in ether Decomp in aq solution

$\text{Pt}(\text{NH}_2\text{OH})_2\text{Cl}_2$  Sol in  $\text{H}_2\text{O}$  (Uhlenhuth, A 1900, 311 124)

**Platinum chloride sulphocarbamide,**

Sl sol in  $\text{H}_2\text{O}$ , very sol in hot  $\text{H}_2\text{O}$ , decomp sl on boiling (Kurnakow, J pr 1894, (2) 50 483)

**Platinum chloriodide,  $\text{PtCl}_2\text{I}_2$** 

Very deliquescent (Kammerer, A 148 329)

$\text{PtClI}_2$  Insol in  $\text{H}_2\text{O}$  Sl sol in alcohol Sol in  $\text{KOH} + \text{Aq}$ , from which it is pptd by  $\text{H}_2\text{SO}_4$  (Mather, Sil Am J 27 257)

**Platinum chloronitride,  $\text{PtNCl}$** 

(Alexander, C C 1887 1254)

**Platinous cyanide with MCN**

See Platinocyanide, M

**Platinous fluoride,  $\text{PtF}_2(?)$** 

Insol in  $\text{H}_2\text{O}$  (Moissan, A ch (6) 24 287)

**Platinic fluoride,  $\text{PtF}_4$** 

Deliquescent Sol in  $\text{H}_2\text{O}$  with immediate decomp into  $\text{PtO}_4\text{H}_4$  and  $\text{HF}$  (Moissan, C R 109 807)

**Platinous hydroxide,  $\text{PtO}_2\text{H}_2$** 

Sol in  $\text{HCl}$ ,  $\text{HBr}$ , and  $\text{H}_2\text{SO}_3 + \text{Aq}$ , but not in other oxygen acids Decomp by boiling  $\text{KOH} + \text{Aq}$  (Thomsen, J pr (2) 16 344)

When freshly pptd, is insol in dil  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ , and in  $\text{HC}_2\text{H}_3\text{O}_2$ , sol in conc  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  Very sol in  $\text{H}_2\text{SO}_3$  and  $\text{HCl}$  After drying, is insol in conc  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  (Wohler, Z anorg 1904, 40 424)

**Platinic hydroxide,  $\text{Pt}(\text{OH})_4$** 

Easily sol in dil acids and in  $\text{NaOH} + \text{Aq}$  (Topsoe, J B 1870 386)

Nearly insol in acetic acid (Dobereiner) Insol in all acids except conc  $\text{HCl}$  and aqua regia (Wohler, Z anorg 1904, 40 438)

$+ \text{H}_2\text{O}$  Ppt (Prost, Bull Soc (2) 44 256) Insol in  $2\text{N}-\text{H}_2\text{SO}_4$  and dil  $\text{HNO}_3 + \text{Aq}$ , mod sol in conc  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $2\text{N}-\text{HCl}$  and  $\text{NaOH} + \text{Aq}$  (Wohler)

$+ 2\text{H}_2\text{O}$  Easily sol in dil acids, even acetic acid, and in  $\text{NaOH} + \text{Aq}$  (Topsoe)

Insol in acetic acid, sl sol in  $2\text{N}-\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ , easily sol in  $\text{HCl}$ , and  $\text{NaOH} + \text{Aq}$  (Wohler)

**Platinoplatinic hydroxide,  $\text{Pt}_3\text{O}_4, 9\text{H}_2\text{O}$** 

Ppt (Prost, Bull Soc (2) 46 156)

$\text{Pt}_5\text{O}_{11}, 11\text{H}_2\text{O}$  Ppt (Prost)

**Platinum hydroxylamine comps**

See—

Platodioxamine comps,  $\text{Pt}(\text{NH}_3\text{O})_4\text{R}_2$

Platosoxamine comps,  $\text{Pt}(\text{NH}_3\text{O})_2\text{R}_2$

Platosoxamine-amine comps,

$\text{Pt}(\text{NH}_3\text{O})_2\text{NH}_3\text{R}_2$

**Platinous iodide,  $\text{PtI}_2$** 

Insol in  $\text{H}_2\text{O}$ , acids, or alcohol (Lassaigne, A ch (2) 51 113)

Difficultly sol in  $\text{Na}_2\text{SO}_3 + \text{Aq}$  (Topsoe)

Gradually decomp by hot  $\text{HI} + \text{Aq}$  of 1 038 sp gr, also by hot  $\text{KI} + \text{Aq}$ ,  $\text{PtI}_4$  being dissolved out and  $\text{Pt}$  left behind Not attacked by conc  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ , but gradually decomp by  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$  (Lassaigne)

Insol in acetone (Eidmann, C C 1889, II 1014)

**Platinic iodide,  $\text{PtI}_4$** 

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{NaOH}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$ ,  $\text{H}_2\text{SO}_3$ , or  $\text{Na}_2\text{SO}_3 + \text{Aq}$  Sol in  $\text{HI} + \text{Aq}$  or alkali iodides  $+ \text{Aq}$  Sol in alcohol, with partial decomp Not attacked by acids (Lassaigne, A ch (2) 51 122)

Very sol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 828)

Sol in alcohol (Belluci, C C 1902, I 625)

**Platinic iodide with MI**

See Iodoplatinate, M

**Platinum nitride chloride,  $\text{PtNCl}$** 

See Platinum chloronitride

**Platinous oxide,  $\text{PtO}$** 

Sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  Insol in other acids (Dobereiner, Pogg 28 183)

Sol in conc  $\text{H}_2\text{SO}_4$ , easily in conc  $\text{HCl} + \text{Aq}$  (Storer's Dict.)

Very sl sol in  $\text{HCl} + \text{Aq}$  Sl sol in aqua regia (Wohler, B 1903, 36 3482)

**Platinic oxide,  $\text{PtO}_2$** 

Insol in acids, even aqua regia (Wohler, Dissert, 1901)

**Platinum trioxide,  $\text{PtO}_3$** 

Unattacked by dil  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$  or acetic acid Sol with decomp in dil and conc  $\text{HCl}$ , conc  $\text{H}_2\text{SO}_4$  or conc  $\text{HNO}_3$  (Wohler, B 1909, 42 3329)

**Platinum sesquioxide,  $\text{Pt}_2\text{O}_3 + x\text{H}_2\text{O}$** 

Insol in dil sol in conc  $\text{H}_2\text{SO}_4$  Sl sol in hot dil  $\text{HNO}_3$  Sol in  $\text{HCl}$  Sol in conc alkali hydroxides  $+ \text{Aq}$  (Wohler, B 1909, 42 3964)

+2H<sub>2</sub>O Insol in HNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>  
 Insol in alkalis +Aq, also cold dil HCl+Aq  
 Sol in aqua regia (Dudley, Am Ch J  
 1902, 28 66)  
 +5H<sub>2</sub>O (Delépine, Bull Soc 1910, (4)  
 7 103)

#### Platinoplatic oxide, Pt<sub>2</sub>O<sub>4</sub>

Not attacked by long boiling with HCl,  
 HNO<sub>3</sub>, or aqua regia (Jorgensen, J pr (2)  
 16 344)

Does not exist (Wohler, Z anorg 1904,  
 40 450)

#### Platinum oxychloride, 3PtO, PtCl<sub>2</sub> (?)

Sol in HCl, and in KOH+Aq (Kane,  
 Phil Trans 1842 298)

PtCl<sub>2</sub>(OH)<sub>2</sub>=H<sub>2</sub>PtCl<sub>2</sub>O<sub>2</sub> (Jorgensen, J  
 pr (2) 16 345)

5PtO<sub>2</sub>, 2HCl+9H<sub>2</sub>O Insol in cold H<sub>2</sub>O,  
 decomp on boiling Slowly sol in HCl  
 (Blondel, A ch, 1905, (8) 6 100)

#### Platinum oxysulphide, PtOS

See Platinum sulphhydroxide

#### Platinum phosphide, PtP<sub>2</sub>

Insol in HCl+Aq Sol in aqua regia  
 (Schrotter, W A B 1849 303)

PtP<sub>2</sub>H<sub>2</sub> Insol in H<sub>2</sub>O, and HCl+Aq  
 (Cavazzi, Gazz ch it 13 324)

PtP Insol in aqua regia (Clark and  
 Joslin)

Pt<sub>2</sub>P Sol in aqua regia (Clark and  
 Joslin)

Pt<sub>3</sub>P<sub>5</sub> Partially sol in aqua regia (Clark  
 and Joslin, C N 48 385)

Attacked very slowly by aqua regia  
 Rapidly sol in molten alkalis (Granger,  
 C N 1893, 77 229)

Completely sol in aqua regia if the action  
 sufficiently prolonged, though with difficulty  
 (Granger, C R 1893, 123 1285)

#### Platinum diselenide, PtSe<sub>2</sub>

As PtS<sub>2</sub> (Minozzi, Chem Soc 1909, 96  
 (2) 899)

#### Platinum triselenide, PtSe<sub>3</sub>

Sl attacked by hot conc HNO<sub>3</sub>, not at-  
 tacked by cold conc HCl+Aq, slowly sol  
 in aqua regia and Cl<sub>2</sub>+Aq, insol in CS<sub>2</sub>

#### Platinum silicide, Pt<sub>2</sub>Si

Sol in hot aqua regia (Vigouroux, C R  
 1896, 123 117)

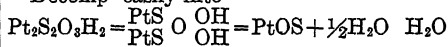
Pt<sub>2</sub>Si<sub>2</sub> (Colson, C R 94 27)

Pt<sub>2</sub>Si<sub>3</sub> Slowly decomp by aqua regia  
 (Guyard, Bull Soc (2) 25 511)

PtSi Insol in HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, HF, and HCl  
 Completely sol in aqua regia (Lebeau and  
 Novitzky, C R 1907, 145 241)

#### Platinum sulphhydroxide, PtOS+H<sub>2</sub>O= PtS(OH)<sub>2</sub>

Decomp easily into—



cannot be removed without decomposing the  
 compound (v Meyer, J pr (2) 15 1)

#### Platinous sulphide, PtS

Not attacked by boiling acids, aqua regia,  
 or KOH+Aq (Böttger, J pr 2 274)

Sol in large excess of (NH<sub>4</sub>)<sub>2</sub>S+Aq

#### Platinoplatic sulphide, Pt<sub>2</sub>S<sub>3</sub>

Not attacked by HCl or HNO<sub>3</sub>+Aq, and  
 only slowly by aqua regia (Schneider, Pogg  
 138 607)

#### Platinic sulphide, PtS<sub>2</sub>

Anhydrous Aqua regia attacks sl, other  
 acids not at all (Davy)

Hydrated Insol in HCl+Aq, sl sol in  
 boiling HNO<sub>3</sub>+Aq Sol n aqua regia  
 (Fresenius) Sol in alkali sulphides, hydrates  
 and carbonates+Aq (Berzelius) Very sl  
 sol in (NH<sub>4</sub>)<sub>2</sub>S+Aq (Claus)

Insol in NH<sub>4</sub>Cl, or NH<sub>4</sub>NO<sub>3</sub>+Aq

1 pt PtCl<sub>4</sub> in 100 pts H<sub>2</sub>O+25 pts HCl is  
 not pptd by H<sub>2</sub>S (Reinsch)

Difficultly sol in alkali sulphhydroxides+  
 Aq, but more easily in presence of SnS,  
 Sb<sub>2</sub>S<sub>3</sub>, As<sub>2</sub>S<sub>3</sub>, or SnS<sub>2</sub> (Ribau, C R 85  
 283)

#### Platinum sulphide, PtS<sub>6</sub>, or Tetraplatinum sulphoplatinate, 4PtS, PtS<sub>2</sub>

Decomp on moist air, but not attacked by  
 acids (Schneider, J pr (2) 7 214)

#### Platinum sulphides with M<sub>2</sub>S

See Sulphoplatinate, M

#### Platinum sulphocarbide, PtC<sub>2</sub>S<sub>2</sub>

Not attacked by hot HCl, HNO<sub>3</sub>+Aq,  
 slightly by aqua regia (Schutzenberger,  
 C R 111 391)

#### Platinum telluride, PtTe

Decomp by fused oxidizing agents, slowly  
 sol in conc HNO<sub>3</sub> (Roessler, Z anorg  
 1897 15 407)

#### Platinum ditelluride, PtTe<sub>2</sub>

Insol in boiling conc KOH+Aq, slowly  
 sol in boiling conc HNO<sub>3</sub>, decomp by fused  
 oxidizing agents (Roessler)

#### Plato-

See also Platino-



**Platoamidosulphonic acid**

**Potassium platoamidosulphonate,**  
 $K_2Pt(NH_2SO_3)_4 + 2H_2O$

Very sl sol in cold  $H_2O$ , sol in 10 pts boiling  $H_2O$  (Ramberg and St Kahlenberg, B 1912, 45 1514)

**Sodium —,**  $Na_2(Pt(NH_2SO_3)_4 + 4H_2O$

Very sol in  $H_2O$  (Ramberg and St Kahlenberg)

**Platodiamine bromide,**  $Pt[(NH_3)_2Br]_2 + 3H_2O$

Easily sol in  $H_2O$  (Cleve)

— **carbonate,**  $Pt(N_2H_5)_2CO_3 + H_2O$

Sol in  $H_2O$  (Peyrone, A 51 14)

$Pt(N_2H_5CO_3H)_2$  Sl sol in, but decomp by boiling with  $H_2O$  into—

— **sesquicarbonate**

More sol than preceding salt (Reiset, C R 11 711)

— **chloride,**  $Pt[(NH_3)_2Cl]_2 + H_2O$

"Reiset's first chloride" Sol in 4 pts  $H_2O$  at 16 5°, and in less hot  $H_2O$  Insol in alcohol or ether (Reiset, A ch (3) 11 419)

As sol in  $NH_4Cl + Aq$  as in  $H_2O$ , insol in absolute alcohol, sl sol in dil alcohol, very sol in dil  $HCl + Aq$  (Peyrone, A ch (3) 12 196)

— **cuprous chloride,**  $Pt(NH_3)_4Cl_2$ ,  $Cu_2Cl_2$

Sol in  $H_2O$ , and pptd from  $H_2O$  solution by alcohol (Buckton)

— **cupric chloride,**  $Pt(NH_3)_4Cl_2$ ,  $CuCl_2$

Sl sol in cold, decomp by hot  $H_2O$  into  $Pt(NH_3)_4Cl_2$ ,  $Cu_2Cl_2$  (Buckton, Chem Soc 5 218)

Nearly insol in  $H_2O$ , easily sol in warm  $HCl + Aq$ , insol in alcohol (Millon and Commaile, C R 57 822)

Millon and Commaile's salt is  $Cu(NH_3)_4Cl_2$ ,  $PtCl_2$ , cuprammonium chloroplatinite

— **lead chloride,**  $Pt(NH_3)_4Cl_2$ ,  $PbCl_2$

Sol in hot, much less in cold  $H_2O$  Insol in  $HCl + Aq$  or alcohol (Buckton, Chem Soc 5 213)

— **mercuric chloride,**  $Pt(NH_3)_4Cl_2$ ,  $HgCl_2$

Easily sol in hot  $H_2O$ , much less in cold Insol in  $HCl + Aq$  (Buckton)

— **zinc chloride,**  $Pt(NH_3)_4Cl_2$ ,  $ZnCl_2$

Easily sol in hot  $H_2O$  Insol in alcohol (Buckton)

**Platodiamine chloroplatinate,**  $Pt(NH_3)_4Cl_2$ ,  $PtCl_4$

Ppt Insol in  $H_2O$  (Cossa, Gazz ch it 17 1)

— **chloroplatinite,**  $Pt(NH_3)_4Cl_2$ ,  $PtCl_2$

(Magnus' green salt) Insol in, and not decomp by  $H_2O$ ,  $HCl + Aq$ , or alcohol (Magnus)

Slowly sol in boiling  $NH_4OH + Aq$  and in conc  $NH_4$  salts +  $Aq$  (Reiset, A ch (3) 11 427)

Almost as sol in  $(NH_4)_2CO_3 + Aq$  as in  $NH_4OH + Aq$  Sol in hot  $PtCl_4 + Aq$  (Reiset)

Not decomp by boiling  $KOH$ , dil  $HCl$ , or  $H_2SO_4 + Aq$ , but easily by  $HNO_3 + Aq$  (Gros, A 27 245)

— **chromate,**  $Pt(NH_3)_4CrO_4$

Scarcely sol in  $H_2O$  (Cleve)

— **dichromate,**  $Pt(NH_3)_4Cr_2O_7$

Sl sol in  $H_2O$  Insol in alcohol Sol in  $KOH + Aq$  (Buckton, Chem Soc 5 213)

— **platinous cyanide,**  $Pt(NH_3)_4(CN)_2$ ,  $Pt(CN)_2$

Sl sol in cold, easily in boiling  $H_2O$ , sol in  $KOH$ ,  $HCl$ , and dil  $H_2SO_4 + Aq$  without decomp, but conc  $H_2SO_4$  decomposes

— **potassium ferrocyanide,**

$Pt(NH_3)_4K_2[Fe(CN)_6]_2 + 3H_2O$

— **hydroxide,**  $Pt[(NH_3)_2OH]_2$

"Reiset's first base" Easily sol in  $H_2O$  Sl sol in alcohol

— **iodide,**  $Pt[(NH_3)_2I]_2$

Sl sol in cold, more easily in hot  $H_2O$ , but slowly decomp on boiling (Reiset)

— **nitrate,**  $Pt[(NH_3)_2NO_3]_2$

Sol in about 10 pts boiling  $H_2O$  Insol or but sl sol in alcohol (Peyrone, A ch (3) 12 203)

— **nitrate sulphate,**  $[Pt(NH_3)_4NO_3]_2SO_4$ ,  $Pt(NH_3)_4SO_4$

Very easily sol in  $H_2O$  (Carlgren, Sv V A F 47 310)

— **nitrite,**  $Pt[(NH_3)_2NO_2]_2 + 2H_2O$

Efflorescent Very sol in hot or cold  $H_2O$  Insol in 90% alcohol (Lang)

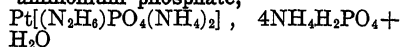
— **platinous nitrite,**  $Pt[(NH_3)_2NO_2]_2$ ,  $Pt(NO_2)_2$

Scarcely sol in cold, somewhat more easily in hot  $H_2O$  Not attacked by cold dil acids More sol in  $NH_4OH + Aq$  than in  $H_2O$  (Lang)

**Platodiamine phosphate**,  $\text{Pt}(\text{N}_2\text{H}_6)_2\text{HPO}_4 + \text{H}_2\text{O}$

Rather difficultly sol in cold, and very easily in hot  $\text{H}_2\text{O}$  (Cleve)

— **ammonium phosphate**,



Very easily sol in  $\text{H}_2\text{O}$  with decomp into—  
 $\text{Pt}(\text{N}_2\text{H}_6\text{H}_2\text{PO}_4)_2, 2\text{NH}_4\text{H}_2\text{PO}_4 + 9\text{H}_2\text{O}$

Much more sol in  $\text{H}_2\text{O}$  than the preceding comp (Cleve)

— **sulphate**,  $\text{Pt}(\text{NH}_3)_4\text{SO}_4$

Sol in 32 pts  $\text{H}_2\text{O}$  at  $16.5^\circ$ , more easily when heated (Reiset)

Sol in 50–60 pts boiling  $\text{H}_2\text{O}$ , less in cold  $\text{H}_2\text{O}$ , insol in alcohol (Cleve)

— **sulphate, acid**,  $\text{Pt}[(\text{NH}_3)_2\text{SO}_4\text{H}]_2 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  or alcohol into neutral salt

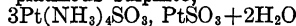
$3\text{Pt}(\text{NH}_3)_4\text{SO}_4, \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Cleve)

— **sulphite**,  $\text{Pt}(\text{NH}_3)_4\text{SO}_3$

Nearly insol in cold  $\text{H}_2\text{O}$  (Birnbaum, A 152 143)

$\text{Pt}[(\text{NH}_3)_2\text{SO}_3\text{H}]_2 + 2\text{H}_2\text{O}$  Ppt Sol in  $\text{HCl} + \text{Aq}$  (Cleve)

— **platinous sulphite**,



Scarcely sol in cold  $\text{H}_2\text{O}$ , sol in 190 pts  $\text{H}_2\text{O}$  at  $100^\circ$  Easily sol in warm  $\text{HCl} + \text{Aq}$  with decomp (Peyrone)

$+ 4\text{H}_2\text{O}$  (Carlgren, Sv V A F 47 308)  
 $2\text{Pt}(\text{NH}_3)_4\text{SO}_3, \text{PtSO}_3, \text{H}_2\text{SO}_3$  Insol in cold  $\text{H}_2\text{O}$  or alcohol Scarcely sol in hot  $\text{H}_2\text{O}$  (Peyrone)

— **sulphocyanide**,  $\text{Pt}(\text{NH}_3)_4(\text{CNS})_2 + \text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Solution is decomp on boiling (Cleve, Sv V A H 10, 9 7)

— **platinous sulphocyanide**,

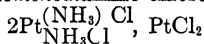


Insol in  $\text{H}_2\text{O}$  and alcohol, sol in dil  $\text{HCl} + \text{Aq}$  (Buckton, Chem Soc 13 122)

**Platomonodiamine chloride**,  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{Cl} \\ \text{NH}_3\text{Cl} \end{smallmatrix}$

Easily sol in  $\text{H}_2\text{O}$  (Cleve)

**Platomonodiamine chloroplatinite**



Moderately sol in cold, but more easily in hot  $\text{H}_2\text{O}$  (Cleve)

— **nitrate**,  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{NO}_3 \\ \text{NH}_3\text{NO}_3 \end{smallmatrix} + \text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Cleve)

**Platomonodiamine sulphate**,  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{SO}_4 \\ \text{NH}_3 \end{smallmatrix}$

Easily sol in cold, but much more in hot  $\text{H}_2\text{O}$

**Platosemdiamine bromide**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{Br} \\ \text{Br} \end{smallmatrix}$

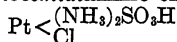
Sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Cleve)

— **chloride**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{Cl} \\ \text{Cl} \end{smallmatrix}$

(Peyrone's chloride) Sol in 387 pts  $\text{H}_2\text{O}$  at  $0^\circ$ , and 26 pts at  $100^\circ$  (Cleve), in 33 pts at  $100^\circ$  (Peyrone)

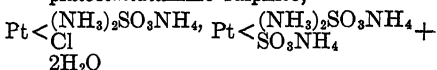
Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , very sl sol in  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , more easily in  $\text{HNO}_3 + \text{Aq}$ , sol in alkali carbonates  $+ \text{Aq}$  (Peyrone, A ch (3) 12 193)

**Platosemdiamine chlorosulphurous acid**,



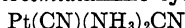
Easily sol in  $\text{H}_2\text{O}$  (Cleve)

**Ammonium platosemdiamine chlorosulphite platosemdiamine sulphite**,



Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol (Cleve)

**Platosemdiamine cyanide**,



Easily sol in  $\text{H}_2\text{O}$  (Cleve) ]

— **platinous cyanide**,  $\text{Pt}(\text{CN})(\text{NH}_3)_2\text{CN}$ ,



Ppt

— **hydroxide**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{OH} \\ \text{OH} \end{smallmatrix}$

Not known

— **iodide**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{I} \\ \text{I} \end{smallmatrix}$

Sl sol in boiling  $\text{H}_2\text{O}$  (Cleve)

— **nitrate**  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{NO}_3 \\ \text{NO} \end{smallmatrix}$

Moderately sol in  $\text{H}_2\text{O}$  (Cleve)

— **nitrite**,  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{NO}_2 \\ \text{NO}_2 \end{smallmatrix}$

Very sl sol in cold, more easily in hot  $\text{H}_2\text{O}$

— **oxalate**,  $\text{Pt}(\text{NH}_3)_2\text{C}_2\text{O}_4$

(Cleve)  
 $+ 2\text{H}_2\text{O}$  (Cleve)

— **sulphate**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2 \\ \text{SO}_4 \end{smallmatrix}$

Very sl sol even in hot  $\text{H}_2\text{O}$  (Cleve)

**Platosemiammine sulphocyanide,**  
 $\text{Pt}(\text{SCN})(\text{NH}_3)_2\text{SCN}$ 

Easily sol in warm  $\text{H}_2\text{O}$ , but solution soon decomposes

**Platosemiammine sulphurous acid****Ammonium platosemiammine sulphite,**  
 $\text{Pt} < (\text{NH}_3)_2\text{SO}_3(\text{NH}_4), (\text{NH}_4)_2\text{SO}_3$ 

Very sol in  $\text{H}_2\text{O}$  (Cleve)

**Barium —,  $\text{Pt}(\text{SO}_3)[(\text{NH}_3)_2\text{SO}_3]\text{Ba}$ ,  $\text{BaSO}_3$**   
Ppt (Cleve)**Silver —,  $\text{Pt}(\text{SO}_3\text{Ag})[(\text{NH}_3)_2\text{SO}_3\text{Ag}]$ ,  
 $\text{Ag}_2\text{SO}_3$**   
Ppt (Cleve)**Diplatodiammine chloride,  $\text{Pt}_2(\text{NH}_3)_4\text{Cl}_2$**   
Insol in  $\text{H}_2\text{O}$ **— hydroxide,  $\text{Pt}_2(\text{NH}_3)_4(\text{OH})_2 + \text{H}_2\text{O}$**   
Insol in  $\text{H}_2\text{O}$ **— nitrate,  $\text{Pt}_2(\text{NH}_3)_4(\text{NO}_3)_2$**   
Insol in  $\text{H}_2\text{O}$  (Cleve)**— sulphate,  $\text{Pt}_2(\text{NH}_3)_4\text{SO}_4$**   
Insol in  $\text{H}_2\text{O}$  (Cleve)**Platobromonitrous acid****Potassium platobromonitrite,  $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{Br} + 2\text{H}_2\text{O}$** 

Sol in about 3 pts cold, and 2 pts boiling  $\text{H}_2\text{O}$  (Vèzes, A ch (6) 29 194)  
 $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{Br}_2 + \text{H}_2\text{O}$  Sol in 1 pt cold, and still less hot  $\text{H}_2\text{O}$  Insol in alcohol (Vèzes)

**Platochloronitrous acid****Potassium chloronitrite,  $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{Cl} + 2\text{H}_2\text{O}$** 

Sol in about 3 pts cold, and 2 pts boiling  $\text{H}_2\text{O}$  (Vèzes, A ch (6) 29 178)  
 $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{Cl}_2$  Sol in about 3 pts cold, and 2 pts boiling  $\text{H}_2\text{O}$  (Vèzes)

**Platochlorosulphurous acid**

See Chloroplatosulphurous acid

**Platiodonitrous acid,  $\text{H}_2\text{Pt}(\text{NO}_2)_2\text{I}_2$** 

Known only in solution (Nilson, J pr (2) 21 172)

**Aluminum platiodonitrite,  $\text{Al}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 27\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$  (Nilson)

**Ammonium —,  $(\text{NH}_4)_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$ , decomp on heating**Barium platiodonitrite,  $\text{BaPt}(\text{NO}_2)_2\text{I}_2 + 4\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$

**Cadmium —,  $\text{CdPt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$**   
Easily sol in  $\text{H}_2\text{O}$ **Cæsium —,  $\text{Cs}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$**   
Easily sol in  $\text{H}_2\text{O}$ **Calcium —,  $\text{CaPt}(\text{NO}_2)_2\text{I}_2 + 6\text{H}_2\text{O}$**   
Very easily sol in  $\text{H}_2\text{O}$ **Cerium —,  $\text{Ce}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 18\text{H}_2\text{O}$**   
Easily sol in  $\text{H}_2\text{O}$ **Cobalt —,  $\text{CoPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$ **Didymium —,  $\text{D}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 24\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$ **Erbium —,  $\text{Er}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 18\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$ **Ferrous —,  $\text{FePt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$ **Ferric —,  $\text{Fe}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 6\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$ **Lanthanum —,  $\text{La}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 24\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$ **Lead —, basic,  $\text{PbPt}(\text{NO}_2)_2\text{I}_2$ ,  $\text{Pb}(\text{OH})_2$**   
Insol in  $\text{H}_2\text{O}$ **Lithium —,  $\text{Li}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 6\text{H}_2\text{O}$**   
Very sol in  $\text{H}_2\text{O}$ **Magnesium —,  $\text{MgPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$ **Manganese —,  $\text{MnPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$ **Mercurous —, basic,  $2\text{Hg}_2\text{Pt}(\text{NO})_2\text{I}_2$ ,  
 $\text{Hg}_2\text{O} + 9\text{H}_2\text{O}$**   
Insol in  $\text{H}_2\text{O}$ **Nickel —,  $\text{NiPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$ **Potassium —,  $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$  in all proportions  
Very sol in alcohol**Rubidium —,  $\text{Rb}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$**   
Sol in  $\text{H}_2\text{O}$

**Silver platiodonitrite**,  $\text{Ag}_2\text{Pt}(\text{NO}_2)_2\text{I}_2$   
Insol in  $\text{H}_2\text{O}$

**Sodium** —,  $\text{Na}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 4\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$

**Strontium** —,  $\text{SrPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$

**Thallium** —,  $\text{Tl}_2\text{Pt}(\text{NO}_2)_2\text{I}_2$   
Insol in  $\text{H}_2\text{O}$

**Yttrium** —,  $\text{Y}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 27\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$

**Zinc** —,  $\text{ZnPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$

**Triplatoctonitrosylic acid**,  $\text{H}_4\text{Pt}_3\text{O}(\text{NO}_2)_8$   
(Nilson, J pr (2) 16 241)

**Potassium triplatoctonitrosylate**  
See under Platonitrite, potassium

**Platonitrous acid**,  $\text{H}_2\text{Pt}(\text{NO}_2)_4$   
Sol in  $\text{H}_2\text{O}$  or alcohol (Lang J pr 83 419)  
Is called "Platotetranitrosylic acid" by Nilson

**Aluminum platonitrite**,  $\text{Al}_2[\text{Pt}(\text{NO}_2)_4]_3 + 14\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$   
 $\text{Al}_2(\text{OH})_2[\text{Pt}(\text{NO}_2)_2]_4\text{O}_2 + 10\text{H}_2\text{O}$  Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  and alcohol (Nilson, B 9 1727)

**Ammonium platonitrite**,  $(\text{NH}_4)_2\text{Pt}(\text{NO}_2)_4 + 2\text{H}_2\text{O}$   
Moderately sol in cold  $\text{H}_2\text{O}$  (Nilson, B 9 1724)

**Barium platonitrite**,  $\text{BaPt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$   
Sl sol in cold, very sol in hot  $\text{H}_2\text{O}$  (Lang)

**Cadmium platonitrite**,  $\text{CdPt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  (Nilson)

**Cæsium platonitrite**,  $\text{Cs}_2\text{Pt}(\text{NO}_2)_4$   
Resembles K salt

**Calcium platonitrite**,  $\text{CaPt}(\text{NO}_2)_4 + 5\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  (Nilson)

**Cerium platonitrite**,  $\text{Ce}[\text{Pt}(\text{NO}_2)_4]_3 + 18\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Nilson)

**Chromium diplatonitrite**,  
 $\text{Cr}_2(\text{OH})_2[\text{Pt}(\text{NO}_2)_2]_4\text{O}_2 + 24\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Nilson)

**Cobalt platonitrite**,  $\text{CoPt}(\text{NO}_2)_4 + 8\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  (Nilson)

**Copper platonitrite**,  $\text{CuPt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Nilson)  
 $3\text{CuPt}(\text{NO}_2)_4$ ,  $\text{CuO} + 18\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Nilson)

**Didymium platonitrite**,  $\text{D}_{12}[\text{Pt}(\text{NO}_2)_4]_3 + 18\text{H}_2\text{O}$   
Deliquescent, sol in  $\text{H}_2\text{O}$

**Erbium platonitrite**,  $\text{Er}_2[\text{Pt}(\text{NO}_2)_4]_3 + 9$ , and  $21\text{H}_2\text{O}$   
Deliquescent, sol in  $\text{H}_2\text{O}$

**Glucinum diplatonitrite**,  $\text{GlPt}(\text{NO}_2)_2]_2\text{O} + 9\text{H}_2\text{O}$   
Sl sol in cold  $\text{H}_2\text{O}$

**Indium diplatonitrite**,  $\text{In}(\text{OH})_2[\text{Pt}(\text{NO}_2)_2]_4\text{O}_2 + 10\text{H}_2\text{O}$   
Sl sol in  $\text{H}_2\text{O}$

**Ferric diplatonitrite**,  $\text{Fe}_2[\text{Pt}(\text{NO}_2)_2]_6\text{O}_3 + 30\text{H}_2\text{O}$   
Sl sol in cold, easily in hot  $\text{H}_2\text{O}$

**Lanthanum platonitrite**,  $\text{La}_2[\text{Pt}(\text{NO}_2)_4]_3 + 18\text{H}_2\text{O}$   
Deliquescent, sol in  $\text{H}_2\text{O}$

**Lead platonitrite**,  $\text{PbPt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$   
Sl sol in  $\text{H}_2\text{O}$  (Nilson)

**Lithium platonitrite**,  $\text{Li}_2\text{Pt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$   
Sl deliquescent, easily sol in  $\text{H}_2\text{O}$

**Magnesium platonitrite**,  $\text{MgPt}(\text{NO}_2)_4 + 5\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$

**Manganese platonitrite**,  $\text{MnPt}(\text{NO}_2)_4 + 8\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$

**Mercurous platonitrite**,  $\text{HgPt}(\text{NO}_2)_4$ ,  $\text{HgO}$   
Nearly insol in  $\text{H}_2\text{O}$  (Lang, J pr 83 415)  
 $+ \text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$  (Nilson)

**Nickel platonitrite**,  $\text{NiPt}(\text{NO}_2)_4 + 8\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  (Nilson)

**Potassium platonitrite**,  $\text{K}_2\text{Pt}(\text{NO}_2)_4$   
Sol in 27 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , more easily sol in warm  $\text{H}_2\text{O}$  (Lang, J pr 83 415)  
 $+ 2\text{H}_2\text{O}$  Efflorescent (Lang)  
 $\text{K}_2\text{H}_4\text{Pt}_3\text{O}(\text{NO}_2)_8 + 3\text{H}_2\text{O}$  Very sl sol in cold (0.01 mol in 1 l at  $16^\circ$ ), but very easily in hot  $\text{H}_2\text{O}$  (Vézes, A ch (6) 29 162)  
 $\text{K}_4\text{Pt}_3\text{O}(\text{NO}_2)_8 + 2\text{H}_2\text{O}$  Sl sol in warm  $\text{H}_2\text{O}$  (Nilson)

**Potassium platonitrite bromide**

See Platibromonitrite and platobromonitrite, potassium

**Potassium platonitrite chloride**

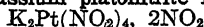
See Plati- and platochloronitrite, potassium

**Potassium platnitrite hydrogen chloride,**

Sol in  $H_2O$  (Miolati, Att Linc Rend 1896, (5) 5, II 358)

**Potassium platonitrite iodide**

See Plati- and platiodonitrite, potassium

**Potassium platonitrite nitrogen dioxide,**

Violently decomp by  $H_2O$  (Miolati, Atti Linc Rend 1896, (5) 5, II, 356)

**Rubidium platonitrite,  $Rb_2(Pt)(NO_2)_4$ , and  $+2H_2O$** 

Very slowly sol in cold, more easily in warm  $H_2O$  (Nilson)

**Silver platonitrite,  $Ag_2Pt(NO_2)_4$** 

Very sl sol in cold, easily in hot  $H_2O$

**Silver dyplatonitrite,  $Ag_2Pt_2(NO_2)_4O$** 

Insol in  $H_2O$  (Nilson)

**Sodium platonitrite,  $Na_2Pt(NO_2)_4$** 

Easily sol in  $H_2O$

**Strontium platonitrite,  $SrPt(NO_2)_4+3H_2O$** 

Somewhat sl sol in cold  $H_2O$ , but easily sol in warm  $H_2O$

**Thallium platonitrite,  $Tl_2Pt(NO_2)_4$** 

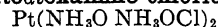
Very sl sol in  $H_2O$  (Nilson)

**Yttrium platonitrite,  $Y_2[Pt(NO_2)_4]_3+9$ , or  $21H_2O$** 

Sol in  $H_2O$

**Zinc platonitrite,  $ZnPt(NO_2)_4+8H_2O$** 

Sol in  $H_2O$

**Platodioxamine chloride,**

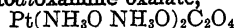
Easily sol in  $H_2O$  (Alexander, A 246 239)

**chloroplatinitre,  $Pt(NH_3O NH_3OCl)_2$ ,  $PtCl_2$** 

Sol in warm  $HCl+AQ$  Insol in cold  $H_2O$  or alcohol, very sl sol in hot  $H_2O$  (Alexander)

**hydroxide,  $Pt(NH_3O NH_3O)_2(OH)_2$** 

Insol in  $H_2O$  or alcohol Easily sol in  $HCl$  or  $HNO_3+AQ$  Difficultly sol in hot dil  $H_2SO_4+AQ$  (Alexander)

**Platodioxamine oxalate,**

Insol in cold  $H_2O$ , alcohol, or organic acids (Alexander)

**phosphate,  $Pt_3(NH_3O NH_3O)_{12}(PO_4)_3+3H_2O$** 

Ppt (Alexander)

**sulphate,  $Pt(NH_3O NH_3O)SO_4+H_2O$** 

Sl sol in  $H_2O$  (Alexander)

**Platosamine bromide,  $Pt(NH_3Br)_2$** 

Sl sol even in hot  $H_2O$  (Cleve)

**chloride,  $Pt(NH_3Cl)_2$** 

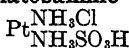
"Reiset's second chloride" Sol in 140 pts  $H_2O$  at  $100^\circ$  (Peyrone, A 61 180)

Sol in 130 pts  $H_2O$  at  $100^\circ$ , and 4472 pts at  $0^\circ$  (Cleve)

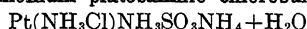
Easily sol in  $NH_4OH+AQ$ ,  $HNO_3$ , or aqua regia, with decomp Sol in  $KCN+AQ$  with evolution of  $NH_3$  (Clevc)

**ammonium chloride,  $Pt(NH_3Cl)_2$ ,  $2NH_4Cl$** 

Sl sol in cold, easily in hot  $H_2O$ , insol in alcohol, sol in  $NH_4OH$  or  $(NH_4)_2CO_3+AQ$  (Grimm, A 99 75)

**Platosamine chlorosulphurous acid,**

Easily sol in  $H_2O$  without decomp (Cleve)

**Ammonium platosamine chlorosulphite,**

Sol in  $H_2O$  (Peyrone, A 61 180)

**Platosamine cyanide,  $Pt(NH_3CN)_2$** 

Quite easily sol in  $H_2O$  or  $NH_4OH+AQ$  (Buckton)

**hydroxide,  $Pt(NH_3OH)_2$** 

"Reiset's second base" Very sol in  $H_2O$  (Odling, B 3 685)

**iodide,  $Pt(NH_3I)_2$** 

Very sl sol in  $H_2O$  Sol in cold  $NH_4OH+AQ$  to form platodiamine iodide (Clevc)

**nitrate,  $Pt(NH_3NO_3)_2$** 

Moderately sol in hot  $H_2O$  Sol in  $NH_4OH+AQ$  with combination (Reiset, A ch (3) 11 26)

**nitrite,  $Pt(NH_3NO_2)_2$** 

Very sl sol in cold, easily in hot  $H_2O$  Insol in alcohol (Lang)

**Platosamine platinous nitrite**,  $\text{Pt}(\text{NH}_3\text{NO}_2)_2$ ,  
 $\text{Pt}(\text{NO}_2)_2$

Slowly and sl sol in cold, more easily sol in hot  $\text{H}_2\text{O}$

Extremely sl sol even in conc acids, more sol in  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Lang)

— **oxide**,  $\text{Pt}(\text{NH}_3)_2\text{O}$

Insol in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  (Reiset)

— **oxalate**,  $\text{Pt}(\text{NH}_3)_2\text{H}_2(\text{C}_2\text{O}_4)_2 + 2\text{H}_2\text{O}$

Ppt (Cleve)

— **sulphate**,  $\text{Pt}(\text{NH}_3)_2\text{SO}_4 + \text{H}_2\text{O}$

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$

— **sulphite**,  $\text{Pt}(\text{NH}_3)_2\text{SO}_3 + \text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Cleve)

— **sulphocyanide**,  $\text{Pt}(\text{NH}_3\text{SCN})_2$

Insol in  $\text{H}_2\text{O}$ , can be cryst from alcohol, not attacked by  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Buckton)

Very sol in hot  $\text{H}_2\text{O}$  (Cleve)

— **silver sulphocyanide**,

$\text{Pt}(\text{NH}_3)_2\text{Ag}_4(\text{SCN})_6$

(Cleve)

**Platosamine sulphurous acid**,

$\text{Pt}(\text{NH}_3\text{SO}_3\text{H})_2$

Exists only in its salts

See **Platosamine sulphite**

**Ammonium platosamine sulphite**,

$\text{Pt}(\text{NH}_3\text{SO}_3\text{NH}_4)_2$

Sol in  $\text{H}_2\text{O}$  Insol in alcohol

**Barium platosamine sulphite**,

$\text{Pt}(\text{NH}_3)(\text{SO}_3)_2\text{Ba} + 3\text{H}_2\text{O}$

Ppt (Cleve)

**Cobalt** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{CO} + 6\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$

**Copper** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{Cu} + 5\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$

**Lead** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{Pb} + \text{H}_2\text{O}$

Ppt

**Manganese** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{Mn} + 4\text{H}_2\text{O}$

Ppt Sl sol in  $\text{H}_2\text{O}$

**Nickel** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{Ni} + 7\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$

**Sodium platosamine sulphite**,

$\text{Pt}(\text{NH}_3\text{SO}_3\text{Na})_2 + 5\frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  100 cem sat solution at  $20^\circ$  contains 5.52 g cryst salt (Haberland and Hanekop, A 245 235)

**Silver** — — —,  $\text{Pt}(\text{NH}_3\text{SO}_3\text{Ag})_2 + \text{H}_2\text{O}$

Ppt

**Uranyl** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{UO}_2 + \text{H}_2\text{O}$

Ppt

**Zinc** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{Zn} + 6\text{H}_2\text{O}$

Ppt Very sl sol in  $\text{H}_2\text{O}$  (Cleve)

**Platososammamine potassium chloride**,

$\text{Pt}\begin{smallmatrix} \text{NH}_3\text{Cl} \\ \text{Cl} \end{smallmatrix}$ ,  $\text{KCl} + \text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$ , insol in alcohol (Cossa, B 23 2507)

**Platosoxamine chloride**,  $\text{Pt}\begin{smallmatrix} \text{NH}_3\text{OCl} \\ \text{NH}_3\text{OCl} \end{smallmatrix}$

Sol in  $\text{H}_2\text{O}$  Much less sol in  $\text{H}_2\text{O}$  than platodioxamine chloride (Alexander, A 246 239)

**Platosoxamine amine chloride**,

$\text{Pt}\begin{smallmatrix} \text{NH}_3\text{O NH}_3\text{Cl} \\ \text{NH}_3 \text{ NH}_3\text{OCl} \end{smallmatrix}$

Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol and conc  $\text{HCl} + \text{Aq}$  (Alexander, A 246 239)

— **chloroplatinite**,  $\text{Pt}\begin{smallmatrix} \text{NH}_3\text{O NH}_3\text{Cl} \\ \text{NH}_3 \text{ NH}_3\text{OCl} \end{smallmatrix}$ ,  $\text{PtCl}_2$

Ppt

**Platosulphurous acid**

**Ammonium platosulphite**,  $(\text{NH}_4)_6\text{Pt}(\text{SO}_3)_4 + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Birnbbaum A 139 170)  
 $(\text{NH}_4)_2\text{Pt}(\text{SO}_3)_2 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Liebig, Pogg 17 108)

**Ammonium platosulphite chloride**,

$(\text{NH}_4)_2\text{Pt}(\text{SO}_3)_2 \cdot 2\text{NH}_4\text{Cl}$

Sol in  $\text{H}_2\text{O}$  (Birnbbaum)  
 $\text{PtCl}_2\text{O}_3\text{H}_2 \cdot 2\text{NH}_4\text{Cl}$  Deliquescent, sol in  $\text{H}_2\text{O}$  (Birnbbaum, A 152 143)

See also **Chloroplatosulphite**, **ammonium**

**Potassium platosulphite**,  $\text{K}_2\text{Pt}(\text{SO}_3)_4 + 4\text{H}_2\text{O}$

Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  Much more sol than the Na salt (Birnbbaum, A 139 168)

$+ 3\text{H}_2\text{O}$  (Lang, J pr 83 415)  
 $6\text{K}_2\text{O}$ ,  $2\text{PtO}$ ,  $10\text{SO}_2$  Sl sol in  $\text{H}_2\text{O}$  (Claus, J B 1847-48 453)

Does not exist (Lang)

$\text{K}_2\text{Pt}(\text{SO}_3)_2$  Sol in  $\text{H}_2\text{O}$

**Silver platotsulphite,  $\text{Ag}_3\text{Pt}(\text{SO}_3)_4$** 

Ppt Very sol in cold  $\text{NH}_4\text{OH} + \text{Aq}$   
(Lang J, pr 83 415)

**Sodium platotsulphite,  $\text{Na}_3\text{Pt}(\text{SO}_3)_4$** 

Very sl sol in cold, somewhat more easily  
in hot  $\text{H}_2\text{O}$  Not decomp by boiling  $\text{KOH}$  or  
 $\text{NaOH} + \text{Aq}$  Gradually sol in  $(\text{NH}_4)_2\text{S}$  or  
 $\text{K}_2\text{S} + \text{Aq}$  Insol in  $\text{NaCl} + \text{Aq}$  or alcohol  
(Litton and Schnedermann, A 42 316)  
+  $1\frac{1}{2}\text{H}_2\text{O}$   
+  $7\text{H}_2\text{O}$   
 $\text{Na}_3\text{Pt}(\text{SO}_3\text{H})_4$  Moderately sol in  $\text{H}_2\text{O}$   
(Litton and Schnedermann)

**Platothiosulphuric acid**

**Sodium platthiosulphate,  $\text{Na}_6\text{Pt}(\text{S}_2\text{O}_3)_4 + 10\text{H}_2\text{O}$**   
Very sol in  $\text{H}_2\text{O}$  (Schottländer, A 140 200)

$\text{PtS}_2\text{O}_3, 4\text{Na}_2\text{S}_2\text{O}_3 + 10\text{H}_2\text{O}$   
 $\text{PtS}_2\text{O}_3, 6\text{Na}_2\text{S}_2\text{O}_3 + 19\text{H}_2\text{O}$   
 $2\text{PtS}_2\text{O}_3, 7\text{Na}_2\text{S}_2\text{O}_3 + 18\text{H}_2\text{O}$  (Jochum,  
C C 1885 642)

**Plumbic acid****Barium plumbate,  $\text{Ba}_2\text{PbO}_4$** 

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  with  
evolution of  $\text{Cl}$  Sol in acids in presence of a  
reducing substance (Kassner, Arch Pharm  
228 109)

**Calcium plumbate**

Insol in  $\text{H}_2\text{O}$   $\text{HNO}_3 + \text{Aq}$  dissolves out  
 $\text{CaO}$  (Crum, A 55 218)  
 $\text{Ca}_2\text{PbO}_4$  Properties as  $\text{Ba}_2\text{PbO}_4$  (Kass-  
ner, Arch Pharm 228 109)  
+  $4\text{H}_2\text{O}$  Easily decomp by  $\text{HNO}_3$ ,  
(Kassner, Arch Pharm 1894, 232 378)

**Calcium hydrogen plumbate,  $\text{H CaPb}_2\text{O}_6$** 

Fairly stable, slowly sol in  $\text{HNO}_3$  in the  
cold (Kassner)

**Calcium lead orthoplumbate,  $\text{CaPbPbO}_4$** 

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl}$   $\text{HNO}_3$ , acetic  
and other acids cause separation of  $\text{PbO}_2$   
(Kassner, Arch Pharm 1903, 241 147)

**Copper metaplumbate,  $\text{CuPbO}_3$** 

Decomp by acids Insol in  $\text{NH}_4\text{OH} + \text{Aq}$   
Acetic acid dissolves  $\text{Cu}$  (Hoehnel, Arch  
Pharm 1896, 234 399)

**Lead metaplumbate,  $\text{PbPbO}_3$** 

Identical with lead sesquioxide (Hoehnel,  
Arch Pharm 1896, 234 399)

**Manganese metaplumbate**

Decomp by acids (Hoehnel, Arch Pharm  
1896, 234 399)

**Potassium plumbate,  $\text{K}_2\text{PbO}_3 + 3\text{H}_2\text{O}$** 

Very deliquescent Decomp by pure  $\text{H}_2\text{O}$   
into  $\text{PbO}_2$  and  $\text{KOH}$  Sol in  $\text{KOH} + \text{Aq}$  with  
out decomp (Fremy, J Pharm (3) 3 32)

**Silver metaplumbate,  $\text{Ag}_2\text{PbO}_3$** 

Ppt (Grutzner, Arch Pharm 1895, 233  
518)

**Sodium plumbate**

Sol in  $\text{H}_2\text{O}$  with decomposition Sl sol in  
alkalies +  $\text{Aq}$  (Fremy, A ch (3) 12 490)

**Sodium metaplumbate,  $\text{Na}_2\text{PbO}_3 + 4\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$ , insol in alcohol (Hoeh-  
nel, Arch Pharm 1894, 232 224)

**Strontium plumbate,  $\text{Sr}_2\text{PbO}_4$** 

Properties as  $\text{Ba}_2\text{PbO}_4$  (Kassner, Arch  
Pharm 228 109)

**Zinc metaplumbate,  $\text{ZnPbO}_3 + 2\text{H}_2\text{O}$** 

Decomp by dil acids, insol in  $\text{H}_2\text{O}$   
(Hoehnel, Arch Pharm 1896, 234 398)

**Plumbous acid****Calcium plumbite**

Sl sol in  $\text{H}_2\text{O}$  (Kirsten, Scher J 5 575)

**Potassium plumbite,  $\text{PbO}, x\text{K}_2\text{O}$** 

Known only in solution

**Silver plumbite,  $\text{Ag PbO}$** 

Insol in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  and  $\text{KOH} +$   
 $\text{Aq}$ , sol in  $\text{HNO}_3$  and acetic acid, and in conc  
 $\text{H}_2\text{SO}_4$ ,  $\text{HI}$ , and  $\text{HI}$  (Bullnheimer, B 1898,  
31 1288)  
+  $2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Decomp on air  
(Kritwig, B 15 264)

**Sodium plumbite**

Known only in solution

**Potassium,  $\text{K}_2$** 

Violently decomposes  $\text{H}_2\text{O}$  or alcohol  
Insol in hydrocarbons Sol with violent  
action in acids

Solubility in fused  $\text{KOH}$  at  $t^\circ$

$t$	$\text{K}_2\text{O}$ sol in 100 g fused $\text{KOH}$
480	7.8–8.9
600	3–4
650	2–2.7
700	0.5–1.3

(Hevesy, Z Elektrochem 1909, 15 534)

Sol in liquid  $\text{NH}_3$  (Seely, C N 23 169),  
(Franklin, Am Ch J 1898, 20 829)  
1 gram atom of  $\text{K}$  dissolves in 4.74 mol

liquid  $\text{NH}_3$  at  $0^\circ$ , in 4.79 mol at  $-50^\circ$ , in 4.82 mol at  $-100^\circ$  (Ruff, B 1906, 39 839)  
 Insol in liquid  $\text{CO}_2$  (Buchner, Z phys Ch 1906, 54 674)

Slowly sol in ethylene diamine Insol in ethyl amine and in secondary and tertiary amines (Kraus, J Am Chem Soc 1907, 29 1561)

**Potassium acetylde,  $\text{K}_2\text{C}_2$**

(Moissan, C R 1898, 127 917)

**Potassium acetylde acetylene,  $\text{K}_2\text{C}_2$ ,  $\text{C}_2\text{H}_2$**

(Moissan, C R 1898, 127 915)

**Potassium amalgams**

$\text{Hg}_2\text{K}$ ,  $\text{Hg}_3\text{K}$ ,  $\text{Hg}_4\text{K}$ ,  $\text{Hg}_{10}\text{K}$ ,  $\text{Hg}_{12}\text{K}$  and  $\text{Hg}_{13}\text{K}$  (Guntz, C R 1900, 131 183)

$\text{Hg}_{14}\text{K}$  Stable up to  $0^\circ$  Can be cryst from Hg without decomp below  $0^\circ$

$\text{Hg}_{12}\text{K}$  Stable from  $0^\circ$  to  $71^\circ$  or  $73^\circ$  Can be cryst from Hg without decomp at any temp between these limits

$\text{Hg}_{10}\text{K}$  Stable from  $71^\circ$  or  $73-75^\circ$  Can be cryst from Hg without decomp at any temp between these limits (Kerp, Z anorg 1900, 25 68)

**Potassium amide,  $\text{KH}_2\text{N}$**

Decomp by water or alcohol Insol in hydrocarbons

**Potassium ammonickelate,  $\text{N}_2\text{N}_3\text{K}_5$ ,  $6\text{NH}_3$**

Decomp by  $\text{H}_2\text{O}$  Sl sol in liquid  $\text{NH}_3$  (Bohart, J phys Chem 1915, 19 559)

**Potassium ammonoargentate,  $\text{AgNHK}$ ,  $\text{NH}_3$  or  $\text{AgNH}_2$ ,  $\text{KNH}_2$**

Ppt, decomp in the air Decomp by  $\text{H}_2\text{O}$  or by liquid  $\text{NH}_3$  solutions of acids (Franklin, J Am Chem Soc 1915, 37 855)

**Potassium ammonobarate,  $\text{BaNK}$ ,  $2\text{NH}_3$**

Hydrolyzed by  $\text{H}_2\text{O}$  Insol in liquid  $\text{NH}_3$  Decomp and dissolved in a solution of  $\text{NH}_4\text{NO}_3$  in liquid  $\text{NH}_3$  (Franklin, J Am Chem Soc 1915, 37 2297)

**Potassium ammonocadmiate,  $\text{Cd}(\text{NHK})_2$ ,  $2\text{NH}_3$**

Ppt (Franklin, Am Ch J 1912, 47 310)  
 $\text{Cd}(\text{NHK})_2$ ,  $2\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$  Insol in liquid  $\text{NH}_3$  (Bohart, J phys Chem 1915, 19 542)

**Potassium ammonocalciate,  $\text{CaNK}$ ,  $2\text{NH}_3$**

Hydrolyzed by  $\text{H}_2\text{O}$  Readily sol in a solution of  $\text{NH}_4\text{NO}_3$  in liquid  $\text{NH}_3$  (Franklin, J Am Chem Soc 1915, 37 2300)

**Potassium ammonocuprite,  $\text{CuNK}_2$ ,  $3\text{NH}_3$**

Very sol in liquid  $\text{NH}_3$   
 $\text{CuNK}_2$ ,  $2\text{NH}_3$

$\text{CuNK}_2$ ,  $\text{NH}_3$  (Franklin, J Am Chem Soc 1912, 34 1503)

$\text{CuNK}_2$ ,  $2\frac{1}{2}\text{NH}_3$  Ppt (Franklin, Am Ch J 1912, 47 311)

**Potassium ammonomagnesate,  $\text{Mg}(\text{NHK})_2$ ,  $2\text{NH}_3$**

Sl sol in liquid  $\text{NH}_3$  Rapidly hydrolyzed by  $\text{H}_2\text{O}$  (Franklin, J Am Chem Soc 1913, 35 1463)

**Potassium ammonoplumbite,  $\text{PbNK}$ ,  $2\frac{1}{2}\text{NH}_3$**

Completely hydrolyzed by action of water vapor Violently decomp by  $\text{H}_2\text{O}$  or dil acids Sol in liquid  $\text{NH}_3$  (Franklin, J phys Chem 1911, 15 519)

**Potassium ammonostannate,  $\text{Sn}(\text{NK})_2$ ,  $4\text{NH}_3$**

Decomp by  $\text{H}_2\text{O}$  Readily sol in  $\text{HCl} + \text{Aq}$  Sl sol in liquid  $\text{NH}_3$  Readily sol in a solution of  $\text{NH}_4\text{I}$  in liquid  $\text{NH}_3$  (Fitzgerald, J Am Chem Soc 1907, 29 1696)

**Potassium ammonostrontiate,  $\text{SrNK}$ ,  $2\text{NH}_3$**

Hydrolyzed vigorously by  $\text{H}_2\text{O}$  Sol in solutions of  $\text{NH}_4\text{NO}_3$  in liquid  $\text{NH}_3$  Insol in liquid  $\text{NH}_3$  (Franklin, J Am Chem Soc 1915, 37 2299)

**Potassium ammonothallate,  $\text{TlNK}_2$ ,  $4\text{NH}_3$**

Sensitive to action of air or moisture Violently decomp by  $\text{H}_2\text{O}$  or dil acids Moderately sol in liquid  $\text{NH}_3$  at  $20^\circ$ , more sol at higher temp and much less sol at lower temp Decomp by liquid  $\text{NH}_3$  solutions of acids (Franklin, J phys Chem 1912, 16 689)

**Potassium ammonotitanate, (N)  $\text{TiNHK}$**

Vigorouslv hydrolyzed by  $\text{H}_2\text{O}$  Insol in liquid  $\text{NH}_3$  solutions of either potassium amide or  $\text{NH}_4\text{Br}$  (Franklin, J Am Chem Soc 1912, 34 1500)

**Potassium ammonozincate,  $\text{Zn}(\text{NHK})_2$ ,  $2\text{NH}_3$**

Decomp by water Sl sol in liquid  $\text{NH}_3$  (Fitzgerald, J Am Chem Soc 1907, 29 663)  
 Decomp by  $\text{H}_2\text{O}$  Sol in dilute acids Sl sol in liquid  $\text{NH}_3$  Sol in solutions of ammonium salts in liquid  $\text{NH}_3$  (Franklin, Z anorg 1907, 55 195)

**Potassium arsenide,  $\text{K}_3\text{As}$**

(Hugot, C R 1899, 129 604)  
 $\text{K}_2\text{As}_4$  (Hugot)

**Potassium arsenide, ammonia,  $\text{AsK}_3$ ,  $\text{NH}_3$**

Nearly insol in liquid  $\text{NH}_3$  (Hugot)  
 $\text{K}_2\text{As}_4$ ,  $\text{NH}_3$  (Hugot)



# POTASSIUM AZOIMIDE

**assium azoimide, KN<sub>3</sub>**

stable in aq solution

16.5 pts are sol in 100 pts H<sub>2</sub>O at 10.5°

18.9 " " " " 100 " H<sub>2</sub>O " 15.5

19.6 " " " " 100 " H<sub>2</sub>O " 17

375 " " " " 100 " abs alcohol at

nsol in pure ether (Curtius, J pr 1898, 58 280)

**assium bromide, KBr**

Solubility of KBr in 100 pts H<sub>2</sub>O at t°

t°	Pts KBr	t°	Pts KBr
0	53.48	60	85.35
20	64.52	80	93.46
40	74.63	100	102.0

(Kremers, Pogg 97 151)

Solubility of KBr in 100 pts H<sub>2</sub>O at t°

t°	Pts KBr	t°	Pts KBr
13.4	46.17	43.15	77.0
6.2	49.57	45.45	77.73
0	53.32	50.5	80.33
-3.4	55.60	54.8	82.78
5.2	56.63	60.15	85.37
12.65	61.03	66.75	88.22
13.0	61.17	71.45	90.69
13.3	61.45	74.85	92.25
18.3	64.11	86.5	97.28
26.05	68.31	97.9	102.9
30.0	70.35	110.0	110.3
37.9	74.46		

Solubility is represented by a straight line the formula  $54.43 + 0.5128t$  (Coppet, A (5) 30 416)

100 pts KBr+Aq sat at 15-16° contain 06 pts KBr (v Hauer, J pr 98 137)

solubility of KBr in 100 pts H<sub>2</sub>O at high temp

t°	Pts KBr
140	120.9
181	145.6

ilden and Shenstone, Phil Trans 1884 23)

Sat solution boils at 112° (Kremers)

Sat KBr+Aq contains at

12° -10° +3° 32° 39°  
1.0 31.5 35.7 41.6 47.7% KBr,

5° 77° 140° 173° 220°  
5.5 48.7 54.1 58.5 61.6% KBr

(Étard, A ch 1894, (7) 2 539)

If solubility S=pts KBr in 100 pts solution,  $S = 34.5 + 0.2420t$  from 0° to 40°, S=

41.5 + 0.1378t from 30° to 120° (Étard, C R 98 1432)

Solubility of KBr in 100 g H<sub>2</sub>O at t°

t°	G KBr	t°	G KBr
10.5	62.1	-11	44.9
10	60.7	-10.5	41.8
3.5	55.5	-10	39.7
0	52.6	-8.5	35.7
-5	50.1	-8	31.2
-8	47.5	-6.5	25.0
-11.5	45.3		

(Meusser, Z anorg 1905, 44 80)

68.74 g KBr are sol in 100 g H<sub>2</sub>O at 25° (Amadori and Pampanini, Rend Ac Linc 1911, V, 20 473)

Sp gr of KBr+Aq at 19°

% KBr	Sp gr	% KBr	Sp gr
5	1.037	30	1.256
10	1.075	35	1.309
15	1.116	40	1.366
20	1.159	45	1.432
25	1.207		

(Gerlach, Z anal 8 285)

Sp gr of KBr+Aq at 15° containing

5 10 20 30 36% KBr  
1.0357 1.074 1.1583 1.2553 1.3198

(Kohlrusch, W Ann 1879 1)

Sp gr of KBr+Aq at t°

G KBr dissolved in 100 g H <sub>2</sub> O	G KBr in 100 g of the solution	t°	Sp gr
4.166	4	14.5	1.0291
11.111	10	15.7	1.0753
25.000	20	16.5	1.1625
42.867	30	16.0	1.2580

(de Lannoy, Z phys Ch 1895, 18 460)

KBr+Aq containing 6.99%KBr has sp gr 20°/20° = 1.0521 (Le Blanc and Rohland, Z phys Ch 1896, 19 278)

Sp gr of KBr+Aq at 20.5°

Normality of KBr+Aq	G KBr in 100 g of solution	Sp gr t°/4°
4.29	37.97	1.3449
3.01	28.83	1.2407
2.00	20.49	1.1629
1.00	11.03	1.0815

(Oppenheimer, Z phys Ch 1898, 27 452)

Solubility of  $\text{KBr} + \text{NH}_4\text{Br}$  at  $25^\circ$ 

% KBr	% $\text{NH}_4\text{Br}$	Sp gr
55 81	0 0	1 3756
55 42	0 64	1 3745
53 65	2 46	1 3733
51 68	5 13	1 3721
44 12	15 29	1 3711
34 73	26 22	1 3715
26 23	34 76	1 3753
26 03	38 14	1 3753
23 22	41 78	1 3766
22 23	43 25	1 3777
17 99	48 08	1 3766
0 0	57 73	1 3763

(Fock, Z Kryst Min 1897, 28 357)

Solubility in  $\text{KNO}_3 + \text{Aq}$ 

1 litre of the solution contains

at $14.5^\circ$		at $25^\circ$	
Mol $\text{KNO}_3$	Mol KBr	Mol $\text{KNO}_3$	Mol KBr
0 0	4 332	0 0	4 761
0 362	4 156	0 131	4 72
0 706	4 093	0 527	4 61
1 235	3 939	0 721	4 54
		1 090	4 475
		1 170	4 44
		1 504	4 375

(Touren, C R 1900, 130 911)

See also under  $\text{KNO}_3$ 

100 pts  $\text{KBr} + \text{KCl} + \text{Aq}$  sat at  $15-16^\circ$  contain 37.55 pts of the two salts, 10.0 pts  $\text{KBr} + \text{KI} + \text{Aq}$  sat at  $15-16^\circ$  contain 57.96 pts of the two salts, 100 pts  $\text{KBr} + \text{KCl} + \text{KI} + \text{Aq}$  sat at  $15-16^\circ$  contain 57.88 pts of the three salts (v Hauer, J pr 98 137)

Solubility of  $\text{KBr} + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $25^\circ$ 

% KBr	% KCl	Sp gr
55 81	0 00	1 3756
53 15	2 34	1 3700
50 36	4 66	1 3648
45 46	8 26	1 3544
37 96	13 66	1 3320
32 48	16 69	1 3119
21 80	21 39	1 2689
14 07	25 09	1 2455
4 75	29 17	1 1977
0 00	31 13	1 1756

(Fock, Z Kryst Min 1897, 28 357)

Solubility of  $\text{KBr} + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Sat solution contains		
	% KCl	% KBr	% total salt
-14	10 7	18 8	29 5
-13 7			29 4
-13 5			29 5
-7	10 7	19 8	30 5
+5 2			34 4
+6	11 3	22 6	33 9
10	11 0	23 7	34 7
21	10 8		35 3
26	11 2	25 5	36 7
30			39 4
32	11 9	26 6	38 5
39			39 8
47	11 0	30 8	41 8
52	11 0	31 2	42 2
55	11 9	29 9	41 8
71	12 0	31 7	43 7
73	11 8	32 9	44 7
102	12 8	35 8	48 6
152	13 2	40 6	53 8
160	12 5	42 3	54 8
168			55 0
225	14 7	45 0	59 7

(Étard, A ch 1894, (7) 3 281)

Solubility of  $\text{KBr} + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $25^\circ$ G per 100 g  $\text{H}_2\text{O}$ 

KBr	KCl
68 47	0 0
62 26	5 43
58 50	8 46
52 45	12 48
45 42	17 17
38 70	21 23
26 62	25 88
12 94	31 02
0 0	36 12

(Amadori and Pampanini, Att Acc Linc 1911, 20, II 475)

Solubility in  $\text{KCl} + \text{Aq}$  at  $25^\circ$ 

1 litre of the solution contains

Mol KCl	Mol KBr
0 0	4 761
0 67	4 22
0 81	4 15
1 35	3 70
1 48	3 54
1 61	3 42
1 70	3 34
2 46	2 50
3 775	0 525

(Touren, C R 1900, 130 1252)

See also under KCl

By repeatedly heating KBr+Aq sat at 15-16° with KI and cooling to 15°, nearly all the KBr can be separated (v Hauer)

100 pts H<sub>2</sub>O sat with KBr at 16° dissolve 13 15 pts KI, but on addition of more KI KBr is pptd (van Melckebeke, C C 1872 586)

### Solubility in KI+Aq at t°

t°	Sat solution contains		
	% KBr	% KI	% total salt
-22	8 3	42 6	50 9
-19	9 5	42 8	52 3
-6	9 3	44 7	54 0
-1 5			55 3
+3	10 3	45 9	56 2
13 6	10 1	46 2	55 9
25	10 8	48 0	58 8
44 2	11 1	50 1	61 2
51	12 1	50 0	62 1
66	10 8	53 1	63 9
70	11 6	51 9	63 5
80	12 3	52 5	64 8
93	13 0	53 7	66 7
116	13 2	54 6	67 8
125	13 7	54 8	68 5
150	15 1	55 1	70 2
175	16 0	57 2	73 2
			72 7
	16 7	56 5	73 2
	17 6	57 0	74 6

(Étard, A ch 1894, (7) 3 279)

### Solubility of KBr+KI in H<sub>2</sub>O at 25°

G per 100 g H <sub>2</sub> O	
KBr	KI
53 21	35 92
42 32	66 63
34 14	95 36
30 08	119 59
29 62	119
22 15	127 10
21 88	127 31
18 54	130 61
0 0	149 26

(Amadori and Pampanini, Att Acc Linc 1911, 20, II 475)

### Solubility of KBr in KOH+Aq

G per 1000 g H <sub>2</sub> O		G per 1000 g H <sub>2</sub> O	
KOH	KBr	KOH	KBr
36 4	558 4	277 6	248 1
113 5	433 6	434 7	137 1
177 2	358 1	579 6	64 8
231 1	281 2	806 9	33 4

(Ditte, C R 1897, 124 30)

Sol in Br<sub>2</sub> at 15° (Walden, Z anorg 1900, 25 220)

Moderately sol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 829)

Sol in liquid NH<sub>3</sub> 45 pts are sol in 100 pts liquid NH<sub>3</sub> at -50° (Joannis, C R 1905, 140 1244)

Attacked by liquid NO<sub>2</sub> with liberation of Br<sub>2</sub> (Frankland, Chem Soc 1901, 79 1361)

Insol in liquid CO<sub>2</sub> (Büchner, Z phys Ch 1906, 54 674)

Sol in SO<sub>3</sub> (Walden, Z anorg 1900, 25 217)

Sol in SO<sub>2</sub>Cl(OH) (Walden, Z anorg 1902, 29 382)

Difficultly sol in AsBr<sub>3</sub> (Walden, Z anorg 1902, 29 374)

Sol in SbCl<sub>3</sub> (Walden, Z anorg 1900, 25 220)

Sol in liquid SO<sub>2</sub> (Walden, Z anorg 1902, 30 160)

Hydrazine dissolves 56 4 pts KBr at 12 5-13° (de Bruyn, R t c 1899, 18 297)

Sl sol in alcohol (Ballard)

Sol in 200 pts cold, and 16 pts boiling 80% alcohol

Sol in 180 pts 90% alcohol (Hager)

Sol in 750 pts abs alcohol at 15° (Eder, Dingl 221 89)

100 pts absolute methyl alcohol dissolve 1 51 pts at 25°, 100 pts absolute ethyl alcohol dissolve 0 13 pt at 25° (de Bruyn, Z phys Ch 10 783)

### Solubility of KBr in methyl alcohol+Aq at 25°

P=% by wt of alcohol in alcohol+Aq  
S=Sp gr of alcohol+Aq sat with KBr  
L=millimols KBr in 100 cem of the solution

P	S 25°/4	L
0	1 3797	471
10 6	1 300	389
30 8	1 159	252
47 1	1 058	162
64 0	0 9801	87
78 1	0 8906	44
98 9	0 8411	23
100	0 8047	14 2

(Herz and Anders, Z anorg 1907, 55 273)

100 g KBr+CH<sub>3</sub>OH contain 0 2 g KBr at the critical temp (Centnerszwer, Z phys Ch 1910, 72 437)

## Solubility of KBr in ethyl alcohol + Aq

Wt % alcohol	Temp = 30°		Temp = 40°	
	G KBr per 100 g		G KBr per 100 g	
	Solution	Solvent	Solution	Solvent
0	41 62	71 30	43 40	76 65
5	38 98	67 25	40 85	72 70
10	36 33	63 40	38 37	69 00
20	31 09	56 40	33 27	62 30
30	25 98	50 15	28 32	56 45
40	21 24	44 95	23 22	50 46
50	16 27	38 85	18 11	44 25
60	11 50	32 50	13 02	37 40
70	6 90	24 70	7 98	28 90
80	3 09	15 95	3 65	18 95
90	0 87	8 80	1 03	10 45

(Taylor, J phys Ch 1896, 1 724)

At room temp, 1 pt KBr by weight is sol in

52 pts methyl alcohol, D<sup>15</sup> 0 7990  
 350 " ethyl " D<sup>15</sup> 0 8100  
 1818 " propyl " D<sup>15</sup> 0 8160

(Rohland, Z anorg 1898, 18 325)

## Solubility of KBr in ethyl alcohol at 0°

Cone of alcohol in mol g per l H <sub>2</sub> O	G KBr in 1 l H <sub>2</sub> O	Mol solubility
—	536 75	4 51
1/4	529 25	4 45
1/2	502 85	4 22
1	491 75	4 13
2	455 25	3 82

(Armstrong and Fyfe, Proc R Soc 1910, [A] 84 127)

100 g methyl alcohol dissolve 2 17 g KBr at 25°

100 g ethyl alcohol dissolve 0 142 g KBr at 25°

100 g propyl alcohol dissolve 0 035 g KBr at 25°

100 g isoamyl alcohol dissolve 0 003 g KBr at 25°

(Turner and Bissett, Chem Soc 1913, 103 1909)

0 055 g is sol in 100 g propyl alcohol (Schlamp, Z phys Ch 1894, 14 276)

Sol in 5000 pts ether (sp gr 0 729 at 15°) (Eder, l c)

Sol in 1700 pts alcohol-ether (1 1) at 15° (Eder, l c)

100 pts acetone dissolve 0 023 pt KBr at 25° (Krug and M'Elroy, J Anal Ch 6 184)

## Solubility of KBr in acetone + Aq at 25°

A = cc acetone in 100 cc acetone + Aq  
 KBr = millimols KBr in 100 cc of the solution

A	KBr	Sp gr
0	481 3	1 3793
20	366 7	1 2688
30	310 5	1 2118
40	259 0	1 1558
50	202 9	1 0918
60	144 9	1 0275
70	95 3	0 9591
80	46 5	0 89415
90	10 1	0 8340

(Herz and Knoch, Z anorg 1905, 45 262)

## Solubility of KBr in glycerine + Aq at 25°

G = g glycerine in 100 g glycerine + Aq  
 KBr = millimols KBr in 100 cc of the solution

G	KBr	Sp gr
0	481 3	1 3793
13 28	444 3	1 3704
25 98	404 0	1 3655
45 36	340 5	1 3594
54 23	310 4	1 3580
83 84	219 25	1 3603
100	172 65	1 3691

(Herz and Knoch, Z anorg 1905, 45 267)

100 g 95% formic acid dissolve 23.2 g KBr at 18 5° (Aschan, Chem Ztg 1913, 37 1117)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3601)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

100 ccm of a sat solution of KBr in furfural at 25° contain 0 139 pts by wt KBr (Wulden, Z phys Ch 1906, 55 713)

Insol in CS<sub>2</sub> (Arcowski, Z anorg 1894, 6 257)

Potassium rhodium bromide  
*See* Bromorhodite, potassium

Potassium ruthenium tribromide  
*See* Bromoruthenite, potassium

Potassium ruthenium tetrabromide  
*See* Bromoruthenate, potassium

Potassium selenium bromide  
*See* Bromoselenate, potassium

**Potassium tellurium bromide***See* Bromotellurate, potassium**Potassium thallic bromide, KBr, TlBr<sub>3</sub>+2H<sub>2</sub>O**Sol in H<sub>2</sub>O  
3KBr, 2TlBr<sub>3</sub>+3H<sub>2</sub>O Sol in H<sub>2</sub>O (Ram-melsberg)**Potassium thorium bromide**Sol in H<sub>2</sub>O (Berzelius)**Potassium tin (stannous) bromide, KBr, SnBr<sub>2</sub>+H<sub>2</sub>O**Sol in H<sub>2</sub>O (Benas, C C 1884 958)  
Can be recryst from HBr or KBr+Ag (Richardson, Am Ch J 14 95)  
2KBr, SnBr<sub>2</sub>+2H<sub>2</sub>O Cannot be recryst from HBr+Ag (Richardson)**Potassium tin (stannic) bromide, 2KBr, SnBr<sub>4</sub>***See* Bromostannate, potassium**Potassium uranous bromide, KUBr<sub>3</sub>**Very sol in H<sub>2</sub>O (Aloy, Bull Soc 1899, (3) 21 264)**Potassium uranyl bromide, 2KBr, UO<sub>2</sub>Br<sub>2</sub>+2H<sub>2</sub>O**Very easily sol in H<sub>2</sub>O (Sendtner)**Potassium zinc bromide, KBr, ZnBr<sub>2</sub>+2H<sub>2</sub>O**

Not hygroscopic (Ephraim, Z anorg 1908, 59 60)

2KBr, ZnBr<sub>2</sub>+2H<sub>2</sub>O Not hygroscopic (Ephraim)**Potassium bromide ammonia, KBr, 4NH<sub>3</sub>**

(Joannis, C R 1905, 140 1244)

**Potassium bromide ruthenium dihydronitrosochloride, (NO)Ru<sub>2</sub>H<sub>2</sub>Cl<sub>3</sub>, 2HCl, 3KBr**Ppt Sl sol in H<sub>2</sub>O (Brizard, A ch 1900, (7) 21 359)**Potassium bromiodide, KBr·I**

Decomp rapidly on air (Wells and Wheeler, Sill Am J 143 475)

**Potassium carbonyl, K<sub>2</sub>C<sub>2</sub>O<sub>2</sub>**Decomp by H<sub>2</sub>O with explosion (Joannis, C R 116 158)**Potassium chloride, KCl**Sol in H<sub>2</sub>O with absorption of heat  
30 pts KCl+100 pts H<sub>2</sub>O at 13 2° lower the temp 12 6° (Rüdorff, B 2 68)100 pts H<sub>2</sub>O dissolve 29 31 pts KCl at 0° (Gay-Lussac), 28 5 pts KCl at 0° (Mulder, Gerardin)

The saturated solution contains 58 5%, and boils at 107 6° (Mulder), contains 59 40%, and boils at 108 3° (Legrand), contains 59 26%, and boils at 109 6° (Gay-Lussac), boils at 110° (Kremers)

Sol in 3 016 pts H<sub>2</sub>O at 15° (Gerlach), in 3 03 pts at 17 5° or 100 pts H<sub>2</sub>O at 17 5° dissolve 33 pts KCl (Schiff)100 pts H<sub>2</sub>O at t dissolve pts KCl

t°	Pts KCl	t°	Pts KCl	t°	Pts KCl
0	29 21	52 39	43 59	109 60	59 26
19 35	34 53	79 58	50 93		

(Gay-Lussac A ch (2) 11 308)

100 pts H<sub>2</sub>O dissolve 34 6 pts KCl at 11 8° 34 9 pts at 13 8° 35 pts at 15 6° (Kopp)100 pts H<sub>2</sub>O at 17 5° dissolve 33 24 pts KCl and sp gr of solution is 1 635 (Karsten)100 pts H<sub>2</sub>O at 12° dissolve 32 pts and at 100° 59 4 pts (Otto Graham)Sol in 3 pts H<sub>2</sub>O at ord temp and 3 pts boiling H<sub>2</sub>O (Bergmann) in 3 33 pts hot or cold H<sub>2</sub>O (Fourcroy) in 3 pts at 15° and 1 68 pts at 110 (M R and P)Sol in 3 5 pts H<sub>2</sub>O at 0° and in less than 1 pt hot H<sub>2</sub>O (Schubarth) 100 pts H<sub>2</sub>O at 17 5° dissolve 30 7 33 0 pts KCl (Ure's Dict)100 pts H<sub>2</sub>O dissolve 35 405 pts KCl at 15° and solution has sp gr = 1 1809 (Michel and Krafft A ch (3) 41 478)100 pts H<sub>2</sub>O dissolve at

18° 30° 40° 57°

33 6 37 8 40 1 45 0 pts KCl

(Gerardin, A ch (4) 5 139)

100 pts H<sub>2</sub>O dissolve 33 06-32 08 pts KCl at 15 6° and sp gr of solution = 1 171 (Page and Keightley, Chem Soc (2) 10 566)Solubility in 100 pts H<sub>2</sub>O at t°

t°	Pts KCl	t°	Pts KCl	t°	Pts KCl
0	28 5	17	33 9	34	38 5
1	28 7	18	34 2	35	38 7
2	29 0	19	34 4	36	39 0
3	29 3	20	34 7	37	39 3
4	29 5	21	35 0	38	39 6
5	30 0	22	35 3	39	39 9
6	30 5	23	35 5	40	40 1
7	31 0	24	35 8	41	40 3
8	31 5	25	36 1	42	40 6
9	31 7	26	36 4	43	40 9
10	32 0	27	36 6	44	41 2
11	32 3	28	36 9	45	41 5
12	32 5	29	37 2	46	41 7
13	32 8	30	37 4	47	42 0
14	33 1	31	37 7	48	42 3
15	33 4	32	38 0	49	42 5
16	33 6	33	38 2	50	42 8

Solubility in 100 pts, etc—*Continued*

t°	Pts KCl	t°	Pts KCl	t°	Pts KCl
51	43 1	71	48 5	91	54 1
52	43 4	72	48 8	92	54 4
53	43 6	73	49 1	93	54 6
54	43 9	74	49 4	94	54 9
55	44 2	75	49 6	95	55 2
56	44 4	76	49 9	96	55 5
57	44 7	77	50 2	97	55 7
58	44 9	78	50 5	98	56 0
59	45 2	79	50 8	99	56 3
60	45 5	80	51 0	100	56 6
61	45 8	81	51 3	101	56 9
62	46 1	82	51 5	102	57 2
63	46 3	83	51 8	103	57 4
64	46 6	84	52 1	104	57 7
65	46 9	85	52 4	105	58 0
66	47 2	86	52 6	106	58 2
67	47 5	87	52 9	107	58 5
68	47 7	88	53 2	107 65	58 5
69	48 0	89	53 5		
70	48 3	90	53 8		

(Mulder, calculated from his own and other observations, Scheik Verhandel 1864 41)

Solubility in 100 pts H<sub>2</sub>O at t°

t°	Pts KCl	t°	Pts KCl	t°	Pts KCl
-11°	24 46	25 7	36 10	64 95	47 17
-6 4	25 78	29 25	37 31	71 65	48 76
0	27 9	38 0	39 71	74 25	49 27
+3 9	29 37	41 45	40 67	80 75	51 24
9 4	30 84	46 15	42 34	86 6	52 53
11 4	32 19	48 8	42 86	91 4	53 49
14 95	32 66	55 1	44 51		
19 0	34 32	60 55	45 90		

(Coppet, A ch (5) 30 414)

Solubility is represented by a straight line, of which the formula is  $28.51 + 0.2837t$  (Coppet)

100 pts H<sub>2</sub>O dissolve 29.33 pts KCl at 4°, 45.5 pts at 60° (Andreu, J pr (2) 29 456)

100 pts H<sub>2</sub>O dissolve at

0° 100° 130° 180°

29.2 56.5 66 78 pts KCl

(Tilden and Shenstone, Lond, R Soc Proc 35 345)

Solubility of KCl in 100 pts H<sub>2</sub>O at high temp

t	Pts KCl	t	Pts KCl	t	Pts KCl
125	59 6	147	70 8	180	77 5
133	69 3	175	75 2		

(Tilden and Shenstone, Phil Trans 1884 23)

If solubility S=pts KCl in 100 pts solution,  $S=20.5+0.1445t$  from -90° to 110° (Étard, C R 98 1432)

Sat KCl+Aq contains at

142° 150° 175° 180°  
38.6 38.8 41.2 41.8% KCl

190° 200° 242° 732° (mpt)  
43.2 42.9 47.6 100% KCl

(Étard, A ch 1894, (7) 2 256)

100 g H<sub>2</sub>O dissolve 0.488 gram-equivalent KCl at 25° (van't Hoff and Meyerhoffer, Z phys Ch 1904, 49 315)

Solubility of KCl in H<sub>2</sub>O at t°

G KCl per 100 G H<sub>2</sub>O

t°	KCl	Sp gr
0 70	28 29	1 1540
19 55	34 37	1 1738
32 80	38 32	1 1839
59 85	45 84	1 1980
74 80	49 58	1 2032
89 45	53 38	1 2069
108 0*	58 11	1 2118

\* Bpt of sat solution

(Berkeley, Phil Trans Roy Soc 1904, 203, A 189)

Solubility of KCl in 100 g H<sub>2</sub>O at t°

t	g KCl	t	g KCl
+18 5	33 3	-4 5	25 9
11 5	31 2	-9	23 9
10	30 8	-8 5	21 5
7 5	29 8	-8	20 0
2 5	28 4	-7	17 5
0	27 5	-6	15 7
-1	27 2	-5 5	14 3

(Meusser, Z anorg 1905, 44 80)

Sat KCl+Aq at 25° contains 26.46% KCl (Foot, Am Ch J 1906, 35 238)

28.01 g KCl are contained in 100 g solution sat at 30° (de Waal, Dissert 1910)

36.12 g KCl are sol in 100 g H<sub>2</sub>O at 25° (Amadori and Pampalini, Rend Acc Line 1911, V 20 473)

4.272 g mol are contained in 1 l solution sat at 25° (Hitz Z anorg 1911, 73 274)

Solubility of KBr at 6°=23.06%, 28.4°=26.91%, 62.6°=31.57° (Suss, Z Krist 1912, 51 262)

Solubility at 22°=25.68% (Bronstedt, Z phys Ch 1912, 80 208)

100 mol H<sub>2</sub>O dissolve at

19.3° 29.7° 40.1° 54.5°  
8.2 8.99 9.75 10.39 mol KCl

(Sudhaus, Miner Jahrb Beil-Bd 1914, 37 18)

KCl+Aq sat at 16° has sp gr = 1.077  
(Stolba, J pr 97 503)

Sp gr of KCl+Aq at 17.5°

% KCl	Sp gr	% KCl	Sp gr	% KCl	Sp gr
1	1.0062	9	1.0586	17	1.1152
2	1.0125	10	1.0655	18	1.1225
3	1.0189	11	1.0725	19	1.1298
4	1.0254	12	1.0795	20	1.1372
5	1.0319	13	1.0866	21	1.1446
6	1.0385	14	1.0937	22	1.1521
7	1.0451	15	1.1008	23	1.1596
8	1.0518	16	1.1080	24	1.1673

(Schiff, A 110 76)

Sp gr of KCl+Aq at 19.5°

% KCl	Sp gr	% KCl	Sp gr
5.98	1.0382	21.31	1.1436
11.27	1.0733	25.133	1.1720
16.27	1.1075		

(Kremers, Pogg 95 119)

Sp gr of KCl+Aq at 15°

% KCl	Sp gr	% KCl	Sp gr	% KCl	Sp gr
1	1.00650	10	1.06580	19	1.12894
2	1.01300	11	1.07271	20	1.13608
3	1.01950	12	1.07962	21	1.14348
4	1.02600	13	1.08654	22	1.15088
5	1.03250	14	1.09345	23	1.15828
6	1.03916	15	1.10036	24	1.16568
7	1.04582	16	1.10750	24.9*	1.17234
8	1.05248	17	1.11465		
9	1.05914	18	1.12179		

\* Mother liquor

(Gerlach, Z anal 8 281)

Sp gr of KCl+Aq at 20°, containing mols  
KCl to 100 mols H<sub>2</sub>O

Mols KCl	Sp gr	Mols KCl	Sp gr
0.5	1.01310	4.0	1.09415
1.0	1.02568	5.0	1.11445
2.0	1.04959		

(Nicol, Phil Mag (5) 16 122)

Sp gr of KCl+Aq at 18°

% KCl	Sp gr	% KCl	Sp gr	% KCl	Sp gr
5	1.0308	15	1.0978	25	1.1408
10	1.0638	20	1.1335		

(Kohlrausch, W Ann 1879 1)

Sp gr of KCl+Aq at 0° S = pts salt in 100  
pts of solution, S<sub>1</sub> = mols salt in 100  
mols solution

S	S <sub>1</sub>	Sp gr
20.7840	5.954	1.1489
17.7214	4.940	1.1258
14.4707	3.922	1.1018
11.0757	2.918	1.0769
7.5440	1.931	1.0521
4.4968	1.123	1.0308

(Charpy, A ch (6) 29 23)

Sp gr of KCl+Aq at 25°

Concentration of KCl+Aq	Sp gr
1-normal	1.0466
1/2- "	1.0235
1/4- "	1.0117
1/8- "	1.0059

(Wagner, Z phys Ch 1890, 5 36)

KCl+Aq containing 5.05% KCl has sp gr  
20°/20° = 1.0327

KCl+Aq containing 20.55% KCl has sp  
gr 20°/20° = 1.1393

(Le Blanc and Rohland, Z phys Ch 1896,  
19 272)

Sp gr of KCl+Aq

g KCl in 1000 g of solution	Sp gr 16°/16°
0	1.000000
0.7140	1.000464
1.5042	1.000975
3.0724	1.001991
8.3165	1.005391

(Dyken, Z phys Ch 1897, 24 109)

Sp gr of KCl+Aq at 20.1°, when p = per  
cent strength of solution, d = observed  
density, and w = volume conc in g per  
cc  $\left(\frac{pd}{100}\right) = w$

p	d	w
36.43	1.853	0.43171
31.12	1.1554	0.35954
24.79	1.1215	0.27887
18.06	1.0866	0.19610
13.17	1.0617	0.13980
8.412	1.0386	0.08736
6.610	1.0297	0.06806
4.419	1.0193	0.04505
3.456	1.0148	0.03507
1.197	1.0040	0.01202

(Barnes, J phys Ch 1898, 2 544)

Sp gr of KCl+Aq at t°

t°	Normality of KCl+Aq	g KCl in 100 g of solution	Sp gr t°/4°
20 5	3 74	23 93	1 1617
"	2 65	17 66	1 1166
"	1 87	12 82	1 0829
"	0 93	6 64	1 0424

(Oppenheimer, Z phys Ch 1898, 27 450)

Sp gr of KCl+Aq at 18°/4°

g KCl in 100 g of solution	Sp gr
0 24963	1 0003
0 12459	0 9995
0 08342	0 99929
0 062343	0 99912

(Jahn, Z phys Ch 1900, 33 559)

KCl+Aq containing 1 pt KCl in 58 923 pts H<sub>2</sub>O at 17° has sp gr = 1 0096 (Hittorf, Z phys Ch 1902, 39 628)

Sp gr 20°/4° of a normal solution of KCl = 1 04443 (Haigh, J Am Chem Soc 1912, 34 1151)

Sp gr of sat KCl+Aq at t°

t°	g KCl sol in 100 g H <sub>2</sub> O	Sp gr
-10°	24 98	1 139
0	28 50	1 156
10	31 23	1 168
20	34 11	1 177
30	37 28	1 183
40	40 12	1 190
50	42 86	1 195
60	45 48	1 199
70	48 30	1 203

(Tschernaj, J Russ phys Chem Soc 1912, 44 1565)

Sp gr of dil KCl+Aq at 20 004°

Conc = g equiv KCl per l at 20 004°  
Sp gr compared with H<sub>2</sub>O at 20 004° = 1

Conc	Sp gr
0 0000	1 000,000,0
0 0001	1 000,004,8
0 0002	1 000,009,7
0 0005	1 000,024,2
0 0010	1 000,048,5
0 0026	1 000,097,1
0 0050	1 000,242,6
0 0100	1 000,483,6

(Lamb and Lee, J Am Chem Soc, 1913, 35 1687)

KCl+Aq containing 10% KCl boils at 101 1°, containing 20% at 103 4° (Gerlach)  
Sat KCl+Aq containing 52 7 pts KCl to 100 pts H<sub>2</sub>O forms a crust at 107 7°, highest temp observed, 108 5° (Gerlach, Z anal 26 426)

B-pt of KCl+Aq containing pts KCl to 100 pts H<sub>2</sub>O G=according to Gerlach (Z anal 26 438), L=according to Legrand (A ch (2) 59 420)

B pt	G	L	B pt	G	L
100 5°	4 9	4 7	105°	36 2	37 8
101 0	9 2	9 0	105 5	39 3	41 0
101 5	13 1	13 2	106	42 4	44 2
102	16 7	17 1	106 5	45 5	47 4
102 5	20 1	20 9	107	48 4	50 5
103	23 4	24 5	107 5	51 5	53 7
103 5	26 7	28 0	108	54 5	56 9
104	29 9	31 4	108 3		59 4
104 5	33 1	34 6	108 5	57 4	

Precipitated from aqueous solution by HCl +Aq Much less sol in very dil HCl+Aq than in H<sub>2</sub>O (Fresenius)

Nearly insol in conc HCl+Aq  
100 cc sat HCl+Aq dissolve 1 9 g KCl at 17° (Ditte, A ch 1881, (5) 24 226)

Solubility of KCl in HCl+Aq at 0°

G per 100 cc of solution	
HCl	KCl
0 0	25 73
1 42	22 69
2 41	20 84
2 59	20 51
4 05	17 71
8 39	11 93
12 40	7 46
14 95	5 60
23 88	1 49
54 20	1 52

(Engel, A ch 1888, (6) 33 377)

Solubility of KCl in HCl+Aq

t	Concentration of HCl g mol per 1000 g H <sub>2</sub> O	Wt KCl per 1000 g H <sub>2</sub> O	Mol solubility
0	0	283 55	3 81
"	1/4	267 25	3 59
"	1/2	250 00	3 36
"	1	214 25	2 88
25	0	359 25	4 82
"	1/4	341 55	4 59
"	1/2	324 30	4 35
"	1	289 60	3 89

(Armstrong and Eyre, Proc R Soc 1910 (A) 84 127)



100 g sat HCl+Aq dissolve 19 g KCl at 20° (Stoltzenberg, B 1912, 45 2248)

### Solubility in HCl+Aq at 25°

Millimols HCl in 10 ccm	Millimols KCl in 10 ccm
	42 72
5 66	37 49
10 20	33 79
15 90	28 68
20 94	24 74
32 52	17 39

(Herz, Z anorg 1912, 73 275)

### Solubility of KCl in HBr+Aq at 25°

Millimols HBr in 10 ccm	Millimols KCl in 10 ccm
	42 72
6 61	37 80
34 15	19 57

(Herz, Z anorg 1912, 73 275)

Sol in sat  $\text{NH}_4\text{Cl}$ +Aq with pptn of  $\text{NH}_4\text{Cl}$  When action has ceased, the solution at 18 75° contains 31 6% of the mixed salt, or 100 pts  $\text{H}_2\text{O}$  dissolve 46 1 pts of the mixed salt, viz, 16 27 pts KCl and 29 83 pts  $\text{NH}_4\text{Cl}$  (Karsten)

### Solubility of KCl in $\text{NH}_4\text{Cl}$ +Aq at 25°

Dissolved in 1000 mols $\text{H}_2\text{O}$	
Mols KCl	Mol $\text{NH}_4\text{Cl}$
74 2	23 8
67 9	32 5
61 4	52 2
55 5	65 9
50 2	74 4
43 0	96 3
37 6	110 0
37 0	107 5
37 5	109 4
22 6	118 2

(Biltz, Z anorg 1911, 71 174)

See also  $\text{NH}_4\text{Cl}$

Sol in sat  $\text{BaCl}_2$ +Aq with pptn of  $\text{BaCl}_2$  until a state of equilibrium is reached, when 100 pts  $\text{H}_2\text{O}$  at 16 8° dissolve 45 9 pts mixed salts, viz 18 2 pts  $\text{BaCl}_2$  and 27 7 pts KCl

See also  $\text{BaCl}_2$

### Solubility of KCl in $\text{MgCl}_2$ +Aq of given percentage composition

t°	30%	21 2%	15%	11%
10	1 9%	5 3%	9 9%	14 3%
20	2 6	6 5	11 3	15 9
30	3 4	7 6	12 7	17 5
40	4 2	8 8	14 2	19 0
50	5 0	10 0	15 6	20 5
60	5 8	11 2	17 0	21 9
70	6 5	12 4	18 3	23 2
80	7 3	13 6	19 5	24 5
90	8 1	14 7	20 8	25 8
100	8 9	15 9	22 1	27 1

(Precht and Wittgen, B 14 1667)

### Solubility of KCl+NaCl in 20% $\text{MgCl}_2$ +Aq

t°	% KCl	% NaCl	t°	% KCl	% NaCl
10	4 2	5 7	60	8 9	6 3
20	5 1	5 8	70	9 9	6 4
30	6 0	5 9	80	10 9	6 6
40	6 9	6 0	90	11 9	6 7
50	7 9	6 1	100	13 0	6 9

(P and W)

### Sol in sat $\text{KNO}_3$ +Aq with pptn of $\text{KNO}_3$

1 litre of the solution contains

at 14 5°		at 25 2	
Mol KCl	Mol $\text{KNO}_3$	Mol KCl	Mol $\text{KNO}_3$
3 865	0 0	4 18	0 0
3 810	0 204	4 11	0 136
3 782	0 318	4 07	0 318
3 710	0 615	3 93	0 902
3 667	0 818	3 85	1 212
3 629	0 910	3 81	1 397
3 597	1 176	3 70	1 805
3 582	1 220		

(Touren, C R 1900, 130 909)

### Solubility of KCl in $\text{KNO}_3$ +Aq

t°	Concentration of $\text{KNO}_3$ in g mol per 1000 g $\text{H}_2\text{O}$	Wt KCl in 1000 g $\text{H}_2\text{O}$	Mol solubility
0	0	283 55	3 81
"	$\frac{1}{4}$	284 25	3 81
"	$\frac{1}{2}$	283 60	3 81
"	1	287 60	3 86
25	0	364 15	4 89
"	$\frac{1}{4}$	355 00	4 90
"	$\frac{1}{2}$	361 65	4 86
"	1	358 80	4 81
"	$1\frac{1}{2}$	355 20	4 77

(Armstrong and Eyre, Proc R Soc 1910 [A], 84 127)

See also  $\text{KNO}_3$

Sol in sat  $\text{NaNO}_3 + \text{Aq}$  without causing pptn (See  $\text{NaNO}_3$ )

Sol in sat  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  without causing pptn

### Solubility in $\text{KBr} + \text{Aq}$ at $25^\circ$

1 litre of the solution contains

Mol KBr	Mol KCl
0 0	4 18
0 49	3 85
0 85	3 58
1 31	3 19
1 78	2 91
2 25	2 58
2 69	2 33

(Touren, C R 1900, 130 1252)

See also KBr

100 pts  $\text{H}_2\text{O}$  dissolve 133.2 pts KI and 10.4 pts KCl at  $21.5^\circ$ , no matter how prepared (Rudorff, B 6 484)

100 pts  $\text{KCl} + \text{Aq}$  sat at  $15-16^\circ$  contain 25.26-25.37 pts KCl 100 pts  $\text{KCl} + \text{KI} + \text{Aq}$  sat at  $15-16^\circ$  contain 57.80 pts of the two salts KCl is pptd by KI (v Hauer, J pr 98 137)

### Solubility in $\text{KI} + \text{Aq}$ at $t^\circ$

$t^\circ$	Sat solution contains		
	% KCl	% KI	% total salt
0	4.8	50.8	56.6
8	5.1	51.1	56.2
18			57.9
30	4.2	54.6	58.8
41	4.7	55.0	59.7
49	5.7	56.0	61.7
60			62.5
75	4.4	59.5	63.9
82	5.0	59.6	64.6
96			66.2
102			66.8
140		63.3	
155	7.6	64.8	72.4
182	8.7	65.4	74.1
190	8.6	66.0	74.6
245	10.0	66.5	76.5

(Étard, A ch 1894, (7) 3 231)

### Solubility of $\text{KCl} + \text{KI}$ in $\text{H}_2\text{O}$ at $25^\circ$

(C per 100 g  $\text{H}_2\text{O}$ )

KCl	KI	KCl	KI
0	149.26	19.64	68.22
4.06	144.03	23.75	43.89
7.63	137.79	29.56	23.83
11.36	132.60	31.38	14.83
11.74	133.90	33.68	7.00
15.10	105.91	36.12	0.00

(Amadori and Pampanini, Att Acc Linc 1911, 20, II 475)

### Solubility of KCl in $\text{KOH} + \text{Aq}$ at $0^\circ$

G per 100 cc solution

KCl	KOH
26.83	0.0
23.44	1.33
21.39	2.64
17.39	5.56
13.89	8.46
10.91	11.23
8.64	13.83
6.78	16.43
4.74	19.72

(Engel, Bull Soc 1891, (3) 6 16)

### Solubility in $\text{KOH} + \text{Aq}$ at $20^\circ$

G KOH in 1 litre	G KCl in 1 litre	Sp gr	Degrees Baumé
10	293	1.185	22.5
20	285	1.185	22.5
30	276	1.190	23.0
40	265	1.192	23.0
50	255	1.195	23.5
60	245	1.200	24.0
70	236	1.200	24.0
80	226	1.205	24.5
90	219	1.205	24.5
100	211	1.210	25.0
110	205	1.210	25.0
120	199	1.215	25.5
130	192	1.215	25.5
140	185	1.220	26.0
150	178	1.225	26.5
160	171	1.225	26.5
170	165	1.230	27.0
180	159	1.235	27.5
190	153	1.240	28.0
200	148	1.245	28.5
210	142	1.250	29.0
220	137	1.255	29.5
230	133	1.260	30.0
240	128	1.265	30.5
250	124	1.270	30.8
260	120	1.275	31.3
270	115	1.280	31.7
280	112	1.285	32.0
290	108	1.290	32.5
300	104	1.295	33.0
310	100	1.300	33.5
320	96	1.305	34.0
330	93	1.310	34.2
340	89	1.315	34.6
350	85	1.320	35.0
360	81	1.325	35.5
370	78	1.330	36.0
380	74	1.335	36.3
390	71	1.340	36.7
400	68	1.345	37.1
410	64	1.350	37.5

## Solubility in KOH+Aq at 20°—Continued

G KOH in 1 litre	G KCl in 1 litre	Sp gr	Degrees Baumé
420	61	1 355	38 0
430	58	1 360	38 5
440	55	1 365	38 9
450	53	1 370	39 2
460	50	1 375	39 5
470	47	1 380	40 0
480	44	1 385	40 2
490	42	1 390	40 6
500	40	1 397	41 0
510	38	1 405	41 5
520	35	1 410	42 0
530	33	1 415	42 3
540	31	1 420	42 6
550	29	1 425	43 0
560	27	1 430	43 5
570	25	1 435	43 7
580	24	1 440	44 0
590	23	1 445	44 3
600	22	1 450	44 6
610	21	1 455	45 0
620	20	1 460	45 5
630	18	1 465	45 9
640	17	1 470	46 2
650	16	1 475	46 5
660	15	1 480	46 8
670	15	1 485	47 0
680	15	1 490	47 5
690	15	1 495	47 9
700	14	1 500	48 2
710	14	1 505	48 5
720	13	1 510	48 8
730	13	1 515	49 1
740	13	1 520	49 5
750	13	1 525	49 7
760	12	1 530	50 0
770	12	1 535	50 3
780	12	1 540	50 6
790	11	1 545	51 0
800	11	1 550	51 3
810	10	1 560	51 5
820	10	1 565	51 8
830	9	1 570	52 2
840	9	1 575	52 6
850	9	1 580	53 0

(Winteler, Z Elektrochem, 1900, 7 360)

## KCl+NaCl

100 pts KCl+NaCl+Aq sat at 13–16° contain 30 18 pts of the two salts (v Hauer)

100 pts H<sub>2</sub>O dissolve 13 92 pts KCl and 30 65 pts NaCl at 15 6°, and solution has sp gr = 1 233 (Page and Keightley)

100 pts H<sub>2</sub>O dissolve 10 11 pts KCl, 32 15 pts NaCl, and 4 69 pts K<sub>2</sub>SO<sub>4</sub>, and solution has sp gr = 1 250 (P and K)

100 pts H<sub>2</sub>O dissolve 29 9 pts NaCl and 15 7 pts KCl at 18 8° (Rudorff)

Solubility of KCl+NaCl in H<sub>2</sub>O at t° 100 pts H<sub>2</sub>O dissolve pts KCl and pts NaCl

t°	Pts KCl	Pts NaCl	t°	Pts KCl	Pts NaCl
10	12 5	29 7	60	24 6	27 2
20	14 7	29 2	70	27 3	26 8
30	17 2	28 7	80	30 0	26 4
40	19 5	28 2	90	32 9	26 1
50	22 0	27 7	100	34 7	25 8

(Precht and Wittgen, B 14 1667)

100 pts H<sub>2</sub>O dissolve 13 99 pts KCl+30 54 pts NaCl=44 53 pts mixed salts at 20° (Nicol, Phil Mag (5) 31 385)

## Solubility of KCl in NaCl+Aq at 20°

G per 100 g H <sub>2</sub> O	
NaCl	KCl
0 0	34 52
6 5	29 37
13 0	4 71
19 5	0 42

(Nicol, Phil Mag 1891, 31 369)

## Solubility of KCl+NaCl at t°

t°	G per 100 g H <sub>2</sub> O	
	KCl	NaCl
25	15 8	14 5
"	29 0	31 3
80	30 0	25 2
"	26 4	34 0

(Soch, J phys Ch 1898, 2 46)

## Solubility of KCl+NaCl at °

G salts in 100 g H <sub>2</sub> O		
NaCl	KCl	Solid phase
9 89	28 34	KCl
18 35	22 75	"
29 88	16 28	KCl+NaCl
31 57	10 91	NaCl
33 17	5 65	"

(Uyeda, Mem Col Sc Kyoto, 1910, 2 245)

100 g H<sub>2</sub>O sat with NaCl dissolve 0 216 gram-equivalent KCl at 25°

100 g H<sub>2</sub>O sat with K<sub>2</sub>SO<sub>4</sub> dissolve 0 466 gram-equivalent KCl at 25° (Euler, Z phys Ch 1904, 49 315)

Solubility in NaCl+Aq at 20°, 30°, 40° and 91° Tables given in the original show that each salt diminishes the solubility of the other (Leather, Chem Soc 1915, 108 (2) 13)

Solubility of KCl+NaCl in HCl+Aq at 25°

% HCl	% NaCl	% KCl
0	19 95	10 90
8 61	10 65	7 58
17 16	3 56	3 80
20 65	2 03	2 86
32 73	0 18	1 27

(Hicks, J Am Chem Soc 1915, 37 846)

See also under NaCl

KCl+SrCl<sub>2</sub>

100 pts H<sub>2</sub>O dissolve 11 2 pts KCl and 48 6 pts SrCl<sub>2</sub> at 14 5° (v Hauer)

If SrCl<sub>2</sub>+Aq sat at 14 5 is sat with KCl at same temp, 100 pts H<sub>2</sub>O dissolve

KCl	33 2	11 2	50 7
SrCl <sub>2</sub>		48 6	
		59 8	

(Mulder, Scheik Verhandel 1864)

KCl+(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>

Sat solution of KCl+(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> at b-pt when cooled to 14° has different composition from sat solution of (NH<sub>4</sub>)Cl and K<sub>2</sub>SO<sub>4</sub>, and its composition is changed by warming it with either KCl or (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> (Rudorff)

KCl+K<sub>2</sub>SO<sub>4</sub>

100 pts H<sub>2</sub>O contain the following amounts salt at 18 75° (1) sat with KCl alone, (2) sat first with KCl then with K<sub>2</sub>SO<sub>4</sub>, (3) sat with K<sub>2</sub>SO<sub>4</sub> and KCl together, (4) sat first with K SO<sub>4</sub> then with KCl, (5) sat with K<sub>2</sub>SO<sub>4</sub> alone

	1	2	3	4	5
KCl	34 5	32 96	33 12	33 12	10 9
K <sub>2</sub> SO <sub>4</sub>		1 79	1 75	1 83	

(Karsten)

100 pts H<sub>2</sub>O sat with both K<sub>2</sub>SO<sub>4</sub> and KCl contain the following amounts

	At 14 8		
KCl	33 5	28 2	10 3
K <sub>2</sub> SO <sub>4</sub>		2 0	

	At 14 8		
KCl	33 6	27 9	10 4
K SO <sub>4</sub>		2 3	

	At 16 1		
KCl	33 6	27 1	10 4
K <sub>2</sub> SO <sub>4</sub>		3 3	

(Kopp, A 34 264)

Sat K<sub>2</sub>SO<sub>4</sub>+Aq dissolves KCl only with pptn of K<sub>2</sub>SO<sub>4</sub>, but sat KCl+Aq dissolves some K<sub>2</sub>SO<sub>4</sub> without any separation (Karsten)

Solubility of KCl+K<sub>2</sub>SO<sub>4</sub> 100 pts H<sub>2</sub>O dissolve at t°

t	Pts KCl	Pts K <sub>2</sub> SO <sub>4</sub>	t°	Pts KCl	Pts K <sub>2</sub> SO <sub>4</sub>
10	30 9	1 32	60	43 8	1 94
20	33 4	1 43	70	46 5	2 06
30	36 1	1 57	80	49 2	2 21
40	38 7	1 68	90	52 0	2 38
50	41 3	1 82	100	54 5	2 53

(Precht and Wittgen)

100 g H<sub>2</sub>O dissolve 34 76 g KCl+2 93 g K<sub>2</sub>SO<sub>4</sub> at 25° (Van't Hoff and Meyerhoffer, Z phys Ch 1898, 27 75)

Sol in 20% KC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq (Stromeyer) Quickly attacked by liquid NO<sub>2</sub> in the presence of traces of moisture, with evolution of Cl<sub>2</sub> (Frankland, Chem Soc 1901, 79 1361)

Sl sol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 829)

Easily sol in liquid HF (Franklin, Z anorg 1905, 46 2)

100 g hydrazine dissolves 8 5 pts KCl at 12 5-13° (de Bruyn, R t c 1899, 18 297)

100 g anhyd hydroxylamine dissolve 12 3 g KCl at 17-18° (de Bruyn, Z phys Ch 1892, 10 782)

100 pts alcohol of 0 900 sp gr dissolve 4 62 pts 0 872 1 66 pts 0 834 0 38 pt 0 817 0 00 pt KCl (Kirwan)

Sol in 48 pts boiling alcohol (Wenzel)

Insol in absolute alcohol containing LiCl (Mitscherlich)

At 15°, 100 pts alcohol of p percentage by volume (S=sp gr) dissolve pts KCl as follows

p	10	20	30	40
S	0 984	0 972	0 958	0 940
KCl	19 8	14 7	10 7	7 7

p	50	60	80
S	0 918	0 896	0 848
KCl	5 0	2 8	0 45

(Schiff, A 118 365)

100 pts of a mixture of 40% alcohol with 60% H<sub>2</sub>O dissolve 9 2 pts KCl at 15° (Schiff)

Insol in absolute alcohol or in 96% alcohol at 15° or below At 20°, 100 pts of the latter dissolve 0 04 pt, at 25°, 0 06 pt, at 30°, 0 20 pt KCl Dilute alcohol dissolves less KCl than the contained H<sub>2</sub>O would dissolve by itself

Solubility in dil alcohol D = sp gr of alcohol, S = solubility in 100 pts alcohol at t°

D = 0.9904		D = 0.9848		D = 0.9793		D = 0.9726	
t°	S	t	S	t°	S	t°	S
0	23.2	4	20.9	4	16.4	3	12.2
4	24.8	20	25.5	21	20.3	5	12.7
22	29.4	27	26.6	28	22.0	16	15.4
25	30.2	30	27.5	43	25.6	20	16.1
34	32.8	37	29.0			25	17.3
52	37.5	60	35.2			34	19.0

D = 0.9573		D = 0.9390		D = 0.8967		D = 0.8244	
t°	S	t°	S	t°	S	t°	S
10	8.8	2	4.2	12	2.87	4	0.00
11	9.0	7	5.1	31	4.35	15	0.00
17	10.3	16	6.4	47	4.88	20	0.04
30	12.5	30	8.5	65	5.65	25	0.06
40	13.9	38	9.6			32	0.20
60	16.7	57	11.3				

(Gerardin, A ch (4) 5 140)

Solubility of KCl in dil alcohol at 14.5°

Sp gr	100 ccm contain		
	Alcohol	Water	KCl
1.1720		88.10	29.10
1.1542		85.78	26.85
1.1365	2.79	84.00	24.67
1.1075	4.98	79.63	20.56
1.1085	10.56	75.24	17.24
1.0545	15.57	70.52	14.27
1.0455	20.66	67.05	13.25
0.9695	24.25	50.18	6.35
0.9315	40.42	40.60	3.82
0.8448	48.73	15.55	0.30

(Bodlander, Z phys Ch 7 316)

Solubility of KCl in ethyl alcohol

(G KCl per 100 g alcohol + Aq)

Wt % alcohol	at 30°		Wt % alcohol	at 30°	
	at 30°	at 40°		at 30°	at 40°
0	38.9	41.8	43.1	11.1	13.1
5.28	33.9	35.9	55.9	6.8	8.2
9.43	30.2	33.3	65.9	3.6	4.1
16.9	24.9	27.6	78.1	1.3	1.6
25.1	19.2	21.8	86.2	0.4	0.5
34.1	15.6	17.2			

(Bathrick, J phys Ch 1896, 1 160)

Solubility of KCl in ethyl alcohol at 0°

Concentration of alcohol Mol g alcohol per 1000 g H <sub>2</sub> O	Solubility in 1000 g H <sub>2</sub> O	Molecular solubility
0.25	285.15	3.80
0.50	277.95	3.73
1.00	271.10	3.64
3.00	265.50	3.45
	208.80	2.81

(Armstrong and Eyre, Proc Roy Soc 1910, (A) 84 127)

Solubility of KCl in ethyl alcohol + Aq at 25°

Wt % alcohol	G KCl per 100 cc sat solution	Wt % alcohol	G KCl per 100 cc sat solution
0	31.18	60	4.18
10	23.93	70	2.27
20	17.89	80	0.93
30	13.27	90	0.31
40	9.40	100	0.08
50	6.26		

(McIntosh, J phys Ch 1903, 7 350)

100 pts absolute methyl alcohol dissolve 0.5 pt at 18.5°, 100 pts absolute ethyl alcohol dissolve 0.034 pt at 18.5° (de Bruyn, Z phys Ch 10 783)  
100 pts 40% wood alcohol dissolve 9.2 pts KCl (Scheff)

Solubility of KCl in methyl alcohol + Aq at 25°

P = % by wt of alcohol in alcohol + Aq  
S = Sp gr alcohol + Aq sat with KCl  
L = millimols KCl in 100 ccm of the solution

P	S 25°/4	L
0	1.1782	417.4
10.6	1.125	329
30.8	1.033	183
47.1	0.9679	102
64.0	0.9064	46.1
78.1	0.8607	20.6
98.9	0.8242	9.9
100	0.7937	5.7

(Herz and Anders, Z anorg 1907, 55 273)

## Solubility of KCl in methyl alcohol

t°	Concentration of alcohol Mol % per 1000 g H <sub>2</sub> O	Solubility 1 in 1000 g H <sub>2</sub> O	Molecular solubility
0		283 55	3 81
"	0 25	280 00	3 76
"	0 50	276 35	3 71
"	1 00	267 85	3 60
"	3 00	238 10	3 18
25		364 15	4 89
"	0 25	361 90	4 86
"	0 50	357 10	4 79
"	1 00	348 70	4 67
"	3 00	324 15	4 35

(Armstrong and Eyre, Proc Roy Soc 1910  
(A) 84 127)

At room temp 1 pt by weight is sol in  
200 pts methyl alcohol, D<sup>15</sup> 0 7990

750 " ethyl " D<sup>15</sup> 0 8035

Insol in propyl alcohol (Rohland, Z  
anorg 1899, 18 325)

100 g methyl alcohol dissolve 0 53 g KCl  
at 25°

100 g ethyl alcohol dissolve 0 022 g KCl  
at 25°

100 g propyl alcohol dissolve 0 004 g KCl  
at 25°

100 g isoamyl alcohol dissolve 0 0008 g  
KCl at 25°

(Turner and Bissett, Chem Soc 1913, 103  
1909)

Insol in propyl alcohol (Schlamp, Z  
phys Ch 1894, 14 276)

## Solubility of KCl in propyl alcohol

t	Concentration of alcohol Mol % per 1000 g H <sub>2</sub> O	Solubility in 1000 g H <sub>2</sub> O	Molecular solubility
0		283 55	3 81
"	0 25	274 10	3 68
"	0 50	265 45	3 56
"	1 00	248 0	3 33
25		365 10	4 90
"	0 25	355 40	4 77
"	0 50	347 70	4 67
"	1 00	331 50	4 45

(Armstrong and Eyre, Proc Roy Soc 1910,  
(A) 84 127)

Insol in fusel-oil (Gooch, Am Ch J 9  
53)

Very sl sol in mixture of equal pts ab-  
solute alcohol and ether (Berzelius)

500 mg KCl treated with 10 g of above  
mixture yield only 0 3 mg to the liquid  
(Lawrence Smith, Am J Sci 16 56)

Insol in acetone (Krug and M'Elroy, J  
Anal Ch 6 184, Eidmann, C C 1899, II  
1014)

## Solubility of KCl in acetone+Aq at t°

t°	% acetone	100 g of the solution contain		
		G H <sub>2</sub> O	G acetone	G KCl
30	0	72 73	0 00	27 27
	5	71 15	3 74	25 11
	9 09	69 62	6 96	23 42
	20	64 88	16 22	18 90
	30	59 49	25 45	15 06
	40	53 17	35 52	11 31
	50	45 98	45 98	8 04
	60	37 97	56 91	5 12
	70	29 22	68 18	2 60
	80	19 82	79 43	0 76
	90	9 98	89 88	0 13
	100	0 00	100 00	0 00
40	0	71 31	0 00	28 69
	5	69 62	3 67	26 72
	9 09	67 88	6 79	25 33
	15	65 15	11 51	32 34
	20	62 97	15 75	21 28
	30	59 49	25 45	15 06
	40	53 17	35 52	11 31
	50	45 98	45 98	8 04
	60	37 97	56 91	5 12
	70	29 22	68 18	2 60
	80	19 82	79 43	0 76
	90	9 98	89 88	0 13
	100	0 00	100 00	0 00

Since there is but one liquid phase here,  
these figures represent the solubility of KCl in  
acetone+Aq at 30° and 40°

(Snell, J phys Chem 1898, 2 484)

The addition of KCl to mixtures of acetone  
and H<sub>2</sub>O will cause a division into  
two layers. The following table gives  
the temp at which sat solutions of KCl  
in acetone+Aq of varying concentra-  
tions separate into two layers and also  
the compositions of the sat solutions of  
KCl in acetone+Aq

% acetone	Temp of division	100 g of solution contain		
		G H <sub>2</sub> O	G acetone	G KCl
26	46 5°			
30	40 0	59 36	25 44	15 20
40	34 2	53 21	35 47	11 32
50	32 6	45 97	45 97	8 06
60	33 3	37 86	56 80	5 34
70	35 5	29 09	68 25	2 66
75	39 0			
80	45 6	19 80	79 20	1 00

(Snell)

The following table gives the compositions of the solutions of KCl in acetone+Aq at the points at which the solution just divides into two layers Temp = 40°

100 g of the solution contain		
G H <sub>2</sub> O	G acetone	G KCl
56 68	28 63	14 68
53 05	35 67	11 29
50 34	39 82	9 83
47 60	43 83	8 58
44 35	48 36	7 29
42 68	50 75	6 57
38 53	56 26	5 21
36 59	58 84	4 57
32 37	64 18	3 45
30 62	66 43	2 95
28 12	69 45	2 44

(Snell)

The addition of KCl to aqueous acetone causes the separation of the liquid into two layers The following table gives the composition of these layers at 40°

Upper layer contains per 100 g of solution		
G H <sub>2</sub> O	G acetone	G KCl
55 20	31 82	12 99
54 27	36 69	12 03
53 27	35 44	11 29
51 69	37 76	10 55
51 23	48 50	10 27
50 34	39 88	9 77
49 08	41 67	9 26
48 02	43 18	8 79
47 62	43 73	8 64
46 49	45 34	8 17
45 65	46 52	7 83
45 64	46 57	7 79
58 99	25 24	15 77

Lower layer contains per 100 g of solution

G H <sub>2</sub> O	G acetone	G KCl
28 14	69 42	2 44
29 45	67 83	2 72
30 96	65 97	3 07
31 83	64 83	3 33
32 64	63 79	3 56
34 07	62 01	3 92
35 27	60 49	4 24
37 44	57 67	4 89
38 00	56 96	5 04
38 68	56 17	5 25
39 98	54 36	5 66
40 41	53 78	5 81
23 66	74 91	1 43

(Snell)

Solubility in acetone+Aq at 20°  
A = ccm acetone in 100 ccm acetone+Aq  
KCl = millimols KCl in 100 ccm of the solution

A	KCl
0	410 5
10	351 7
20	286 6
30	223 7
40	166 5
50	115 4
60	71 2
70	38 5
80	12 9
90	2 0
100	

(Herz and Knoch, Z anorg 1904, 41 317)

Solubility of KCl in glycerine+Aq at 25°

G = g glycerine in 100 g glycerine+Aq  
KCl = millimols KCl in 100 cc of the solution

G	KCl	Sp gr
0	424 5	1 1800
13 28	383 4	1 1848
25 98	339 3	1 1935
45 36	271 4	1 2106
54 23	238 5	1 2189
83 84	149 0	1 2590
100	110 6	1 2860

(Herz and Knoch, Z anorg 1905, 45 267)

Insol in CS<sub>2</sub> (Baeyer, Arctowski, Z anorg 1894, 6 257)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Solubility of KCl in organic compounds +Aq at 25°

Compound	G comp per l H <sub>2</sub> O	C KCl per 100 g sat solution
Water		26 89
Acetaldehyde	11 01	27 05
Paraldehyde	11 07	26 42
Glycerol	13 01	25 58
Glycol	15 51	26 43
"	62 05	25 26
Mannitol	45 53	24 86
"	136 59	24 46

(Armstrong and Eyre, Proc Roy Soc 1913, A, 88 234)

Solubility in pyridine+Aq at 10°

Solvent		100 g of the solution contain g KCl
H <sub>2</sub> O	Pyridine	
100	0	23 79
90	10	19 76
80	20	16 37
70	30	13 19
60	40	10 05
50	50	6 34
40	60	3 335
30	70	1 245
20	80	0 24
10	90	0 039
0	100	

(Schroeder, J pr 1908, (2) 77 268)

Insol in anhydrous pyridine and in 97% pyridine+Aq

Very sl sol in 95% pyridine+Aq  
Sl sol in 93% pyridine+Aq (Kahlenberg, J Am Chem Soc 1908, 30 1107)

100 ccm of a sat solution of KCl in furfural at 25° contain 0 085 pts by wt KCl (Walden, Z phys Ch 1906, 55 713)

100 g H<sub>2</sub>O dissolve 246 5 g sugar+44 8 g KCl at 31 25°, 100 g sat solution contain 62 28 g sugar+11 33 g KCl (Kohler, Z Ver Zuckerind, 1897, 47 447)

Solubility in glucose+Aq at 25°

Concentration of glucose in 9 mol per 1000 g H <sub>2</sub> O	Solubility in 1000 g H <sub>2</sub> O	Molecular solubility
	362 70	4 86
0 25	366 10	4 91
0 50	369 85	4 96
1 0	376 25	5 04
3 0	402 25	5 39

(Armstrong and Eyre, Proc Roy Soc 1910, 84 127)

Potassium manganic chloride, K<sub>2</sub>MnCl<sub>5</sub>

Sol in H<sub>2</sub>O, less sol in NH<sub>4</sub>Cl+Aq, un stable (Neuman, M 1894, 15 492)

Potassium rhodium chloride

See Chlororhodite, potassium

Potassium ruthenium sesquichloride

See Chlororuthenite, potassium

Potassium ruthenium trichloride

See Chlororuthenate, potassium

Potassium tellurium chloride

See Chlorotellurate, potassium

Potassium thallic chloride, 3KCl, 11Cl<sub>3</sub>+2H<sub>2</sub>O

Sol in H<sub>2</sub>O Not decomp by boiling H<sub>2</sub>O (Rammelsberg)

Potassium thorium chloride, KCl, 2ThCl<sub>4</sub>+18H<sub>2</sub>O

Deliquescent, sol in H<sub>2</sub>O and alcohol (Berzelius)

Potassium tin (stannous) chloride (Potassium chlorostannite), KCl, SnCl<sub>2</sub>+H<sub>2</sub>O

Decomp by H<sub>2</sub>O, sol in hot HCl or KCl+Aq (Remsen and Richardson, Am Ch J 14 90)

2KCl, SnCl<sub>2</sub>+H<sub>2</sub>O Partially decomp by dissolving in H<sub>2</sub>O (Rammelsberg, Pogg 94 507)

+2H<sub>2</sub>O Very sol in hot, and but slightly in cold HCl+Aq or KCl+Aq (Remsen and Richardson)

4KCl, SnCl<sub>2</sub>+3H<sub>2</sub>O (Poggiale, C R 20 1182)

Does not exist (Remsen and Richardson)

Potassium tin (stannic) chloride, 2KCl, SnCl<sub>4</sub>

See Chlorostannate, potassium

Potassium tungsten chloride, K<sub>2</sub>(OH)WCl<sub>5</sub>

Decomp by moisture Insol in organic solvents (Olsson, B 1913, 46 581)

K<sub>3</sub>W<sub>2</sub>Cl<sub>7</sub> Sol in H<sub>2</sub>O Nearly insol in most organic solvents (Olsson)

Potassium uranium chloride, UCl<sub>4</sub>, 2KCl

Very hygroscopic, sol in H<sub>2</sub>O with decomp, sol in acetic acid Decomp by alcohol Nearly insol in ether (Aloy, Bull Soc 1899, (3) 21 264)

Potassium uranyl chloride, K<sub>2</sub>(UO<sub>2</sub>)Cl<sub>4</sub>

Very sol in H<sub>2</sub>O Moderately sol in dil alcohol (Aloy, Dissert 1901)

+2H<sub>2</sub>O Very sol in H<sub>2</sub>O and alcohol (Arfvedson)

Sol in H<sub>2</sub>O, with decomp and separation of KCl, unless H<sub>2</sub>O is acidulated with HCl (Peligot, A ch (3) 5 37)

Solubility in H<sub>2</sub>O at t°

t°	100 pts of the solution contain			Solid phase
	Its UO <sub>2</sub>	Pts Cl	Pts K	
0 8	38 57	13 59	3 86	UO <sub>2</sub> Cl <sub>2</sub> 2KCl 2H <sub>2</sub> O +KCl
14 9	33 71	13 51		
17 5	37 36	14 50	5 27	
25 0	35 01	15 26		
41 5	35 27	15 92	7 39	
50 0	34 18	16 56		
60 0	34 19	17 25	9 14	UO <sub>2</sub> Cl <sub>2</sub> 2KCl 2H <sub>2</sub> O
71 5	33 55	17 44	9 28	
78 5	35 26	18 24	9 95	

(Rimbach, B 1904, 37 463)



Potassium uranyl chloride is decomp by  $H_2O$  at temp below  $60^\circ$ . Above  $60^\circ$ , it is sol in  $H_2O$  without decomp

**Potassium vanadium chloride,  $VK_2Cl_5 + H_2O$**

Difficultly sol in  $H_2O$  and alcohol (Stahler, B 1904, 37 4412)

**Potassium yttrium chloride**

Sol in  $H_2O$  with evolution of heat

**Potassium zinc chloride,  $2KCl, ZnCl_2$**

Very deliquescent Sol in 1 pt cold, and in all proportions of hot  $H_2O$  (Pierre, A ch (3) 16 248)

+ $H_2O$  Not very deliquescent Can be recryst (Ephraim, Z anorg 1908, 59 58)

$KCl, ZnCl_2 + 2H_2O$  Not deliquescent Cannot be recryst without decomp (Ephraim)

**Potassium chloriodide,  $KCl_2I$**

Very unstable (Wells and Wheeler, Sill Am J 143 475)

$KCl_2I$  Sol in  $H_2O$  with decomp Ether dissolves out  $ICl_3$  (Filhol, J Pharm 25 433)

**Potassium fluoride,  $KF$  or  $K_2F_2$**

Very deliquescent Very sol in  $H_2O$  Sl sol in  $HF + Aq$  Easily sol in conc  $KC_2H_3O_2 + Aq$  Insol in alcohol (Berzelius) Sol in dilute alcohol (Stromeyer, A 100 83)

Sp gr of aqueous solution of  $KF$  at  $18^\circ$  containing—

	5	10	20	30	40% $KF$
	1.041	1.084	1.117	1.272	1.378

(Kohlrausch, W Ann 1879 1)

Solubility in  $HF + Aq$  at  $21^\circ$

(G per 100 g  $H_2O$ )

HF	KF	HF	KF
0 0	96 3	13 95	31 4
1 21	72 0	15 98	33 4
1 61	61 0	17 69	35 6
3 73	40 4	20 68	38 4
4 03	32 5	28 60	46 9
6 05	30 4	41 98	61 8
9 25	29 9	53 71	74 8
11 36	29 6	74 20	105 0
12 50	30 5	119 20	169 5

(Ditte, C R 1896, 123 1282)

Easily sol in liquid  $HF$  (Franklin, Z anorg 1905, 46 2)

Very sl sol in liquid  $NH_3$  (Gore, Am Ch J 1898, 20 829)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

$KF$  will "salt out" acetone from aqueous solution The table shows the composition of the solutions at the points at which inhomogeneous solutions of  $KF$ , acetone and  $H_2O$  just become homogeneous at  $20^\circ$

100 g of the solution contain

G $KF$	G $H_2O$	G acetone	G $KF$	G $H_2O$	G acetone
5 75	58 91	35 34	0 61	31 95	67 44
5 00	56 28	38 72	0 50	29 92	69 58
3 84	52 25	43 91	28 42	69 76	1 82
3 06	49 05	47 89	25 74	71 24	3 02
2 61	46 84	50 55	22 35	72 99	4 66
2 22	44 79	52 99	20 28	73 80	5 90
14 95	73 66	11 39	18 71	74 10	7 19
11 46	70 77	17 77	16 31	73 97	9 72
9 17	67 30	23 53	12 40	72 01	15 59
7 72	64 01	28 27	33 86	65 73	0 397
7 07	62 03	30 90	29 97	68 54	1 50
6 43	60 50	33 07	22 05	73 41	4 54
1 38	40 55	58 06	17 82	74 01	8 16
0 979	36 42	62 60	14 34	73 29	12 37
0 693	32 69	66 61	44 24	55 52	0 240
0 57	31 50	67 93	33 34	65 66	1 00
0 89	35 74	63 36	29 86	68 54	1 60
0 75	33 84	65 41	24 38	72 16	3 45

At the first quadruple point where the hydrate, acetone, water and vapor are in equilibrium the upper layer contains 98% acetone, while the lower layer contains in 100 g, 46 3 g  $KF$  A sat solution of  $KF$  will thus dehydrate acetone to the extent of 98%

(Frankforter and Cohen, J Am Chem Soc 1914, 36 1115)

Similar data are given for  $KF$  in ethyl and propyl alcohol by Frankforter and Frary (J phys Ch 1913, 17 402)

+ $2H_2O$  Very deliquescent (Guntz, A ch (6) 3 20)

Sat aq solution at  $18^\circ$  contains 45 3%  $KF$  (de Forcrand, C R 1911, 152 1210)

Sp gr of solution sat at  $18^\circ = 1.502$ , and contains 48%  $KF$  (Mylus and Funk, B 1897, 30 1718)

+ $4H_2O$  Not deliquescent (de Forcrand, C R 1911, 152 1075)

Sat aq solution at  $18^\circ$  contains 35 96%  $KF$  (de Forcrand, C R 1911, 152 1210)

**Potassium hydrogen fluoride,  $KF, HF = KHF_2$**

Easily sol in  $H_2O$  Sl sol in  $H_2O$  containing  $HF$  Easily sol in conc  $KC_2H_3O_2 + Aq$  Sol in dil alcohol, but insol in absolute alcohol

$KF, 2HF$  Deliquescent Decomp by  $H_2O$  with absorption of heat (Moissan, C R 106 547)

$KF, 3HF$  As above (Moissan)

**Potassium manganic fluoride***See Fluomanganate, potassium***Potassium scandium fluoride,  $K_3ScF_6$** Sol in  $H_2O$  Decomp by acids (R J Meyer, Z anorg 1914, 86 275)**Potassium silicon fluoride***See Fluosilicate, potassium***Potassium tantalum fluoride***See Fluotantalate, potassium***Potassium tellurium fluoride,  $KF, TeF_4$** Decomp by  $H_2O$  (Hogbom, Bull Soc (2) 35 60)**Potassium thallic fluoride,  $2TlF_3, KF$** 

Decomp by moisture Insol in HF (Gewecke, A 1909, 366 226)

**Potassium thorium fluoride,  $2KF, ThF_4 + 4H_2O$** Nearly insol in  $H_2O$  Sol in HF + Aq  
 $KF, ThF_4$  Precipitate (Chydenius)**Potassium tin (stannous) fluoride,  $2KF, 3SnF_2 + H_2O$** Sol in  $H_2O$  (Wagner, B 19 896)**Potassium tin (stannic) fluoride***See Fluostannate, potassium***Potassium titanium tetrafluoride***See Fluotitanate, potassium***Potassium titanium sesquifluoride,  $4KF, 11F_6$** Precipitate Very sl sol in  $H_2O$  Sol in dil acids (Piccini, C R 97 1064)*See also Fluosessquititanate, potassium***Potassium titanyl fluoride***See Fluoxypertitanate, potassium***Potassium tungstyl fluoride***See Fluoxytungstate, potassium***Potassium uranium fluoride,  $KF, UFl_4$** Insol in  $H_2O$  and dil acids Difficultly sol in conc HCl + Aq Sol in conc  $H_2SO_4$  (Bolton, J B 1866 212)**Potassium uranyl fluoride***See Fluoxyuranate, potassium***Potassium vanadium sesquifluoride***See Fluovanadate, potassium***Potassium vanadium tetrafluoride (?)**Easily sol in  $H_2O$  Insol in alcohol (Berzelius)**Potassium zinc fluoride,  $KF, ZnF$** Sol in  $H_2O$  (R Wagner) $2KF, ZnF_2$  Sol in  $H_2O$  (Berzelius)**Potassium zirconium fluoride***See Fluozirconate, potassium***Potassium fluoride hydrogen peroxide,  $KF, H_2O_2$** Not hygroscopic Very sol in  $H_2O$  Is not decomp at  $70^\circ$  and only partially so at  $110^\circ$  (Tanatar, Z anorg 1901, 28 255)**Potassium fluoride vanadic acid***See Fluoxyvanadate, potassium***Potassium hydride,  $KH$** Decomp by  $H_2O$  Insol in oil of turpentine, benzene, ether and  $CS_2$  (Moissan, C R 1902, 134 18)**Potassium hydrosulphide,  $KSH$** Very deliquescent, and sol in  $H_2O$  with gradual decomp Crystallizes with  $\frac{1}{2}H_2O$  Sol in alcohol**Potassium hydroxide,  $KOH$** Very deliquescent, and sol in  $H_2O$  with evolution of much heat 100 pts  $KOH$ , exposed over  $H_2O$  at  $16-20^\circ$  take up 460 pts  $H_2O$  in 56 days (Mulder)1 pt  $KOH$  dissolves in 0.5 pt cold  $H_2O$  (Lowitz) in 0.47 pt cold  $H_2O$  (Bineau C R 41 509) in 1 pt  $H_2O$  (Abl)Solubility of  $KOH$  in  $H_2O$  at  $t^\circ$ 

$t^\circ$	G $KOH$ per 100 g		Solid phase
	$H_2O$	solution	
—22	3 7	3 6	Ice
—20 7	22 5	18 4	
—65 2	44 5	30 8	
—36 2	36 2	26 6	$KOH 4H_2O$
—32 7	77 94	43 8	
—33	80	44 4	
—23 2	85	45 9	$KOH 4H_2O + KOH 2H_2O$
0	97	49 2	
10	103	50 7	
15	107	51 7	$KOH 2H_2O + KOH H_2O$
20	112	52 8	
30	126	55 76	
32 5	135	57 44	$KOH H_2O$
50	140	58 33	
100	178	64 03	
125	213	68 06	
143	311 7	75 73	

(Pickering, Chem Soc 1893, 63 908)

100 pts  $KOH$  are sol in 93.4 pts  $H_2O$  at  $15^\circ$  or 100 pts  $H_2O$  dissolve 107 pts  $KOH$  at  $15^\circ$  Sp gr = 1.5355 at  $15^\circ$

All higher values found in solubility tables are incorrect (Ferchland, Z anorg 1902, 30 133)

100 g sat aq solution at 15° contain 50.48 g KOH (de Forcrand, C R 1909, 149 719)

Sat KOH+Aq boils at 157.7° (Griffiths), 340° (Gerlach)

B-pt of KOH+Aq containing pts KOH to 100 pts H<sub>2</sub>O

B-pt	Pts KOH	B pt	Pts KOH
105°	20 5	215°	210 5
110	34 5	220	219 8
115	46 25	225	230 0
120	57 5	230	240 9
125	67 5	235	251 9
130	76 8	240	263 1
135	85 0	245	274 4
140	92 5	250	285 7
145	99 8	255	298 5
150	106 5	260	312 5
155	114 05	265	328 0
160	121 7	270	343 5
165	129 35	275	359 0
170	137 0	280	375 0
175	144 8	285	391 0
180	152 6	290	408 2
185	160 4	295	425 5
190	168 2	300	444 4
195	176 5	310	484 0
200	185 0	320	526 3
205	193 5	330	571 5
210	202 0	340	623 6

(Gerlach, Z anal 26 464)

Sp gr and b-pt of KOH+Aq according to Dalton

% K <sub>2</sub> O	Sp gr	B pt	% K <sub>2</sub> O	Sp gr	B pt
4 7	1 06	100 56°	36 8	1 44	123 89°
9 5	1 11	101 11	39 6	1 47	129 44
13 0	1 15	101 66	42 9	1 52	135 56
16 2	1 19	103 33	46 7	1 60	143 33
19 5	1 23	104 44	51 2	1 68	160 00
23 4	1 28	106 66	56 8	1 78	188 22
26 3	1 33	109 44	63 6	1 88	215 56
29 4	1 36	112 22	72 4	2 00	315 56
32 4	1 39	115 56	84 0	2 2	red heat
34 4	1 42	118 89	100	2 4	

Sp gr of KOH+Aq at 15

% K <sub>2</sub> O	Sp gr	% K <sub>2</sub> O	Sp gr	% K <sub>2</sub> O	Sp gr
0 568	1 0050	10 750	1 1059	20 935	1 2268
1 697	1 0153	11 882	1 1182	21 500	1 2342
2 829	1 0369	13 013	1 1308	22 632	1 2493
3 961	1 0589	14 145	1 1437	23 764	1 2648
5 002	1 0478	15 277	1 1568	24 895	1 2805
6 224	1 0589	16 408	1 1702	26 027	1 2966
7 355	1 0703	17 540	1 1839	27 158	1 3131
8 487	1 0819	18 671	1 1979	28 290	1 3300
9 619	1 0938	19 803	1 2122		

(Zimmerman N J Pharm 18 2 5

Sp gr of KOH+Aq

% K <sub>2</sub> O	Sp gr	% K <sub>2</sub> O	Sp gr	% K <sub>2</sub> O	Sp gr
2 44	1 02	23 14	1 22	37 97	1 42
4 77	1 04	24 77	1 24	40 17	1 44
7 02	1 06	26 34	1 26	42 31	1 46
9 20	1 08	27 86	1 28	44 40	1 48
11 28	1 10	29 34	1 30	46 45	1 50
13 30	1 12	30 74	1 32	48 46	1 52
15 38	1 14	32 14	1 34	50 09	1 54
17 40	1 16	33 46	1 36	51 58	1 56
19 34	1 18	34 74	1 38	53 06	1 58
21 25	1 20	36 99	1 40		

(Richter)

Sp gr of KOH+Aq at 15° a=sp gr if % is K<sub>2</sub>O, b=sp gr if % is KOH

%	a	b	%	a	b
1	1 010	1 009	31	1 370	1 300
2	1 020	1 017	32	1 385	1 311
3	1 030	1 025	33	1 403	1 324
4	1 039	1 033	34	1 418	1 336
5	1 048	1 041	35	1 431	1 349
6	1 058	1 049	36	1 445	1 361
7	1 068	1 058	37	1 460	1 374
8	1 078	1 065	38	1 475	1 387
9	1 089	1 074	39	1 490	1 400
10	1 099	1 083	40	1 504	1 411
11	1 110	1 092	41	1 522	1 425
12	1 121	1 110	42	1 539	1 438
13	1 132	1 111	43	1 564	1 450
14	1 143	1 119	44	1 570	1 462
15	1 154	1 128	45	1 584	1 472
16	1 166	1 137	46	1 600	1 488
17	1 178	1 146	47	1 615	1 499
18	1 190	1 155	48	1 630	1 511
19	1 202	1 166	49	1 645	1 527
20	1 215	1 177	50	1 660	1 539
21	1 230	1 188	51	1 676	1 552
22	1 242	1 198	52	1 690	1 565
23	1 256	1 209	53	1 705	1 578
24	1 270	1 220	54	1 720	1 590
25	1 285	1 230	55	1 733	1 604
26	1 300	1 241	56	1 746	1 618
27	1 312	1 252	57	1 762	1 630
28	1 326	1 264	58	1 780	1 641
29	1 340	1 278	59	1 795	1 655
30	1 355	1 288	60	1 810	1 667

(Calculated by Gerlach, Z anal 8 279, after Zimmermann, N J Pharm 18, 2 5, and Schiff, A 107 300)

Sp gr of KOH+Aq at 15°

% KOH	Sp gr	% KOH	Sp gr
4 2	1 0382	21 0	1 2008
8 4	1 0776	25 2	1 2439
12 6	1 1177	29 4	1 2880
16 8	1 1588		

(Kohlrausch, W Ann 1879 1)

## Sp gr of KOH+Aq at 15°

% KOH	Sp gr	% KOH	Sp gr
10	1 077	50	1 539
20	1 175	60	1 667
30	1 288	70	1 790
40	1 411		

(Gerlach, Z anal 27 275, calculated from Schiff, A 107 300)

Sp gr of K<sub>2</sub>O+Aq at 15°

% K <sub>2</sub> O	Sp gr	% K <sub>2</sub> O	Sp gr
5	1 054	30	1 358
10	1 111	35	1 428
15	1 171	40	1 500
20	1 231	45	1 576
25	1 294		

(Hager, Adjumenta varia, Leipsic, 1876)

Sp gr of KOH+Aq at 20° containing 2 mols KOH to 100 mols H<sub>2</sub>O=1 05325 (Nicol, Phil Mag (5) 16 122)

## Sp gr of KOH+Aq at 15°

% KOH	Sp gr	% KOH	Sp gr	% KOH	Sp gr
52	1 53822	34	1 33313	16	1 14925
51	1 52622	33	1 32236	15	1 13955
50	1 51430	32	1 31166	14	1 12991
49	1 50245	31	1 30102	13	1 12031
48	1 49067	30	1 29046	12	1 11076
47	1 47896	29	1 27997	11	1 10127
46	1 46733	28	1 26954	10	1 09183
45	1 45577	27	1 25918	9	1 08240
44	1 44429	26	1 24888	8	1 07302
43	1 43289	25	1 23866	7	1 06371
42	1 42150	24	1 22849	6	1 05443
41	1 41025	23	1 21838	5	1 04517
40	1 39906	22	1 20834	4	1 03593
39	1 38793	21	1 19837	3	1 02671
38	1 37686	20	1 18839	2	1 01752
37	1 36586	19	1 17855	1	1 00834
36	1 35485	18	1 16875	0	0 99918
35	1 34396	17	1 15898		

(Pickering, Phil Mag 1894, (5) 37 375)

Sp gr of N solution at 18°/4°=1 0481 (Loomis, W Ann 1896, 60 55)

## Sp gr of KOH+Aq

% KOH	6 87	12 10
Sp gr 20°/20°	1 0601	1 1025

(Le Blanc and Rohland, Z phys Ch 1896, 19 272)

KOH+Aq containing equal pts of KOH and H<sub>2</sub>O freezes at -54° (Guyton-Morveau, Gm-K 2, 1 18)

KOH is completely miscible with NaOH and with RbOH in both the liquid and the solid states (Hevesy, Z phys Ch 1910, 73 667)

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 828)

Abundantly sol in strong alcohol or wood-spirit

See below under KOH+2H<sub>2</sub>O

Readily sol in glycerine

Sol in not less than 25 pts of ether (Boullay) Sol in much more than 25 pts of ether (Connell)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3601)

Insol in acetone Readily sol in fusel oil

Insol in acetone and in methylal (Eidmann, C C 1899, II 1014)

Sol in aqueous solution of mannite (Favre, A ch (3) 11 76)

The composition of the hydrates formed by KOH at different dilutions is calculated from determinations of the lowering of the fr-pt produced by KOH and of the conductivity and sp gr of KOH+Aq (Jones, Am Ch J 1905, 34 337)

+H<sub>2</sub>O

+2H<sub>2</sub>O Very deliquescent, and sol in H<sub>2</sub>O with absorption of much heat

100 g sat solution in H<sub>2</sub>O at 30° contain 55 75 g anhyd KOH (de Waal, Dissert 1910)

Solubility of KOH+2H<sub>2</sub>O in alcohol+Aq at 30°

% KOH	% alcohol	% H <sub>2</sub> O
55 75	0	44 25
54 81	0 43	44 76
		*
31 0	57 50	11 50
25 99	65 07	5 94
27 67	69 92	2 41
27 20	73 01	negative
26 25	81 98	"

\*Separates into two layers

(de Waal, Dissert, 1910)

+4H<sub>2</sub>O

**Potassium hydrogen titanium diimide,**  
 $Ti(NH)NK$

Decomp by  $H_2O$  and alcohol Insol in all ord indifferent organic solvents (Ruff, B 1912, 45 1371)

**Potassium iodide, KI**

Deliquescent only in very moist air Very sol in  $H_2O$  with absorption of heat

The temp of  $H_2O$  can be lowered  $24^\circ$  by dissolving KI (Baup)

140 pts KI dissolved in 100 pts  $H_2O$  at  $10.8^\circ$  lower the temp  $22.5^\circ$  (Rudorff, Pogg 136 276)

100 pts  $H_2O$  dissolve 126.6 pts KI at  $0^\circ$  (Kremers), 127.8 pts KI at  $0^\circ$  (Mulder), 127.9 pts KI at  $0^\circ$  (Gerardin)

By boiling, 100 pts  $H_2O$  dissolve 221 pts KI at  $120^\circ$  (Baup), 222.2 pts KI at  $120^\circ$  (Gay-Lussac), 222.6 pts KI at  $118.4^\circ$  (Mulder), 223.58 pts KI at  $117^\circ$  (Legrand), 223.6 pts KI at  $117^\circ$  (Gerardin)

Between these temps the solubility increases proportional to temp

Sol in 0.735 pt  $H_2O$  at  $12.5^\circ$  in 0.709 pt  $H_2O$  at  $16^\circ$  in 0.7 pt  $H_2O$  at  $18^\circ$  in 0.45 pt  $H_2O$  at  $120^\circ$  (Graham Otto)

100 pts KI + Aq sat at  $15.16^\circ$  contain 58.07 pts KI (v Hauer J pr 98, 137)

100 pts  $H_2O$  at  $12.5^\circ$  dissolve 136 pts KI at  $16^\circ$  141 pts KI (Baup)

100 pts  $H_2O$  at  $18^\circ$  dissolve 143 pts KI at  $120^\circ$  271 pts (Gay Lussac)

Sol in 0.79 pt  $H_2O$  at  $0^\circ$  in 0.70 pt  $H_2O$  at  $20^\circ$  in 0.63 pt  $H_2O$  at  $48^\circ$  in 0.57 pt  $H_2O$  at  $60^\circ$  in 0.53 pt  $H_2O$  at  $80^\circ$  in 0.51 pt  $H_2O$  at  $100^\circ$  (Kremers Pogg 97 15)

Sol in 0.71 pt  $H_2O$  at  $15^\circ$  (Eder, Dingl 221 89)

**Solubility of KI in 100 pts  $H_2O$  at  $t^\circ$**

$t^\circ$	Pts KI	$t^\circ$	Pts KI	t	Pts KI
0	127.9	19	143.4	38	159
1	128.7	20	144.2	39	160
2	129.6	21	145.1	40	160
3	130.4	22	145.9	41	161
4	131.2	23	146.7	42	162
5	132.1	24	147.5	43	163
6	132.9	25	148.3	44	164
7	133.7	26	149.1	45	164
8	134.5	27	149.9	46	165
9	135.3	28	150.7	47	166
10	136.1	29	151.5	48	167
11	137.0	30	152.3	49	168
12	137.8	31	153	50	168
13	138.6	32	154	51	169
14	139.4	33	155	52	170
15	140.2	34	156	53	171
16	141.0	35	156	54	172
17	141.8	36	157	55	172
18	142.6	37	158	56	173

**Solubility of KI in 100 pts, etc—Continued**

$t^\circ$	Pts KI	$t^\circ$	Pts KI	$t^\circ$	Pts KI
57	174	78	191	99	208
58	175	79	192	100	209
59	175	80	192	101	210
60	176	81	193	102	211
61	177	82	194	103	212
62	178	83	195	104	213
63	179	84	196	105	213
64	180	85	197	106	214
65	180	86	197	107	215
66	181	87	198	108	216
67	182	88	199	109	217
68	183	89	200	110	218
69	184	90	201	111	219
70	184	91	202	112	220
71	185	92	202	113	220
72	186	93	203	114	221
73	187	94	204	115	222
74	188	95	205	116	223
75	188	96	206	117	223.6
76	189	97	207		
77	190	98	208		

(Mulder, calculated from his own and other observations, Scheik Verhandel 1864 63)

**Solubility of KI in 100 pts  $H_2O$  at  $t^\circ$**

$t^\circ$	Pts KI	t	Pts KI	$t^\circ$	Pts KI
-22.65	107.2	21.05	143.3	71.1	183.5
-22.35	106.6	25.6	146.6	74.75	185.6
-16.8	111.1	29.1	149.6	81.6	192.0
-11.35	116.3	37.3	156.7	86.35	194.6
-5.9	120.4	42.3	160.3	93.5	200.3
0	126.1	45.75	163.6	100.7	205.6
+3.25	130.1	51.8	167.6	110.2	216.1
9.55	134.0	55.05	169.1	113.7	218.8
12.75	137.1	60.55	173.4		
12.9	137.9	65.0	178.3		

(Coppet, A ch (5) 30 417)

Solubility is represented by a straight line of the formula  $126.23 + 0.8088t$  (Coppet)

**Solubility of KI in 100 pts  $H_2O$  at high temp**

$t^\circ$	Pts KI	t	Pts KI
124	233.9	144	264.6
133	249.3	175	310.4

(Tilden and Shenstone, Phil Trans 1884 23)

If solubility  $S$  = pts KI in 100 pts solution,  
 $S = 55.8 + 0.122t$  from  $0^\circ$  to  $165^\circ$  (Étard, C R 98 1432)

## Sat KI+Aq contains % KI at t°

t°	% KI	t°	% KI
-21	50.7	78	64.8
-21	51.0	96	66.9
-21	51.2	150	70.6
-19	52.2	151	70.9
-15	53.2	175	71.6
-9	54.5	176	72.7
0	56.9	190	73.8
+21	59.3	193	74.5
44	60.8	213	75.7
72	64.3		

(Étard, A ch 1894, (7) 2, 542)

Solubility of KI in 100 g H<sub>2</sub>O at t°

t°	g KI	t	g KI
-1	122.2	-11.5	64.7
-5	119.8	-9.5	51.5
-4	117.4	-7	42.6
-10	115.1	-6	34.4
-14	75.8	-5	25.7

(Meusser, Z anorg 1905, 44 80)

102.70 pts by weight are contained in 100 cc KI+Aq sat at 25°, or 59.54 pts in 100 g of solution, sp gr = 1.7254

94.05 pts by weight are contained in 100 cc KI+Aq sat at 0°, or 56.34 pts in 100 g of solution, sp gr = 1.6699 (Walden, Z phys Ch 1906, 55 715)

Solubility of KI in H<sub>2</sub>O at low temperatures

t	% KI	Solid phase	t	% KI	Solid phase
-12.5	38	Ice	-22	52.1	KI
-15	41.2	"	-20	52.6	"
-17	54.6	"	-15	53.5	"
-20	48	"	-10	54.5	"
-22	55.1	"	-5	55.4	"
-23	51.9	" + KI	0	56.4	"

(Kremann and Kershbaum, Z anorg 1907, 56 218)

149.26 g KI dissolve in 100 g H<sub>2</sub>O at 25° (Amadori and Pampunni, Rend Acc Line 1911, V, 20 473)

60.39 g in 100 g KI+Aq sat at 25° (Parsons and Whittemore, J Am Chem Soc 1911, 33 1934)

56.1 g in 100 g KI+Aq sat at 0°, 60.35 g in 100 g KI+Aq sat at 30° (Van Dam and Donk, Chem Weekbl 1911, 8 848)

## Sp gr of KI+Aq at 21°

% KI	Sp gr	% KI	Sp gr	% KI	Sp gr
1	1.0075	21	1.1807	41	1.4224
2	1.0151	22	1.1911	42	1.4371
3	1.0227	23	1.2016	43	1.4520
4	1.0305	24	1.2122	44	1.4671
5	1.0384	25	1.2229	45	1.4825
6	1.0464	26	1.2336	46	1.4982
7	1.0545	27	1.2445	47	1.5142
8	1.0627	28	1.2556	48	1.5305
9	1.0710	29	1.2699	49	1.5471
10	1.0793	30	1.2784	50	1.5640
11	1.0877	31	1.2899	51	1.5810
12	1.0962	32	1.3017	52	1.5984
13	1.1048	33	1.3138	53	1.6162
14	1.1136	34	1.3262	54	1.6343
15	1.1226	35	1.3389	55	1.6528
16	1.1318	36	1.3519	56	1.6717
17	1.1412	37	1.3653	57	1.6911
18	1.1508	38	1.3791	58	1.7109
19	1.1605	39	1.3933	59	1.7311
20	1.1705	40	1.4079	60	1.7517

(Schiff, A 110 75)

Sp gr of KI+Aq, S=according to Schiff (A 108 340) at 21°, K=according to Kremers (Pogg 96 62), interpolated by Gerlach (Z anal 8 285)

5 10 15 20 25 30% KI,  
S 1.038 1.079 1.123 1.171 1.219  
K 1.038 1.078 1.120 1.166 1.218 1.271

35 40 45 50 55 60% KI  
S 1.483  
K 1.331 1.396 1.469 1.546 1.636 1.734

## Sp gr of KI+Aq at 18°

% KI	Sp gr	% KI	Sp gr	% KI	Sp gr
5	1.0363	30	1.273	55	1.630
10	1.0762	40	1.3966		
20	1.1679	50	1.545		

(Kohlrausch, W Ann 1879 1)

## Sp gr of KI+Aq at 18°

% KI	Sp gr
1.044	1.0062
5.0	1.0363

(Giotrian, W Ann 1883, 18 191)

Sp gr at 16°/4° of KI+Aq containing 32.4875% KI = 1.30238 (Schonrock, Z phys Ch 1893, 11 781)

KI+Aq containing 9.35% KI has sp gr 20°/20° = 1.0726

KI+Aq containing 11.35% KI has sp gr 20°/20° = 1.0892 (Le Blanc and Rohland, Z phys Ch 1896, 19 278)

B-pt of KI+Aq containing pts KI to 100  
pts H<sub>2</sub>O

B pt	Pts KI	B pt	Pts KI	B pt	Pts KI
101°	15	108°	111 5	115	185°
102	30	109	123	116	195
103	45	110	134	117	205
104	60	111	145	118	215
105	74	112	155	118 5	220
106	87	113	165		
107	99 5	114	175		

(Gerlach, Z anal **26** 439)

Sat KI+Aq boils at 119° (Kremers)

Sat KI+Aq forms a crust at 117.5°, and contains 210 pts KI to 100 pts H<sub>2</sub>O, highest temp observed, 118.5° (Gerlach, Z anal **26** 426)

Solubility of KI in I<sub>2</sub>+Aq at 25°

KI mol /l	I g atoms/l
6 15	0 00
6 23	3 64
6 40	11 11
6 36	13 16
6 33	13 2
6 24	17 03

(Abegg, Z anorg 1906, **50** 428)

Solubility of KI+I<sub>2</sub> in H<sub>2</sub>O at 25°

% KI	% I	Solid phase	% KI	% I	Solid phase
29 45	64 34	KI+KI <sub>3</sub>	25 88	68 79	KI <sub>7</sub> +I <sub>2</sub>
28 91	63 88	"	25 57	69 01	"
26 84	66 54	KI <sub>3</sub> +KI <sub>7</sub>	27 86	66 56	KI <sub>3</sub>
27 18	67 14	"	27 27	66 91	"
27 14	66 60	"	26 95	67 17	KI <sub>7</sub>
			25 71	67 91	"

(Foote and Chalker, Am Ch J 1908, **39** 564)

See also under Iodine

KI+Aq sat at 14.5° containing 139.8 pts KI to 100 pts H<sub>2</sub>O dissolves 1.0 pt K<sub>2</sub>SO<sub>4</sub> with separation of 2.2 pts KI, so that solution contains 137.6 pts KI and 1.0 pt K<sub>2</sub>SO<sub>4</sub> to 100 pts H<sub>2</sub>O (Mulder, Rotterdam, **1864**)

100 pts H<sub>2</sub>O dissolve 86.3 pts KI and 2.1 pts Na<sub>2</sub>SO<sub>4</sub> at 14.5° (Mulder, J B **1866** 67)

Sol in AsCl<sub>3</sub>, SnCl<sub>4</sub> and POCl<sub>3</sub> (Walden, Z anorg 190C, **25** 214)

Attacked by dry liquid NO<sub>2</sub> with liberation of I<sub>2</sub> (Frankland, Chem Soc 1901, **79** 1361)

Sol in liq SO<sub>2</sub> (Walden, B 1899, **32** 2864)

Solubility in SO<sub>2</sub> decreases with rise of temp (Walden, Z phys Ch 1903, **42** 456)

Insol in liq CO<sub>2</sub> (Buchner, Z phys Ch 1906, **54** 674)

Very easily sol in liq NH<sub>3</sub> (Franklin, Am Ch J 1898, **20** 829)

Hydrazine dissolves 135.7 pts KI at 12.5-13° (de Bruyn, R t c 1899, **18** 297)

100 pts alcohol of 0.85 sp gr dissolve 18 pts KI at 12.5° 100 pts absolute alcohol dissolve 2.5 pts KI at 13.5° Much more sol in hot alcohol (Baup)

100 pts alcohol of D sp gr at 0° dissolve at 18°—

D 0.9904 0.9851 0.9796 0.9665 0.9528

130.5 119.4 100.1 89.9 76.9 pts KI,

D 0.9390 0.9088 0.8464 0.8322

66.4 48.2 11.4 6.2 pts KI

That is, aqueous alcohol dissolves approximately the same amount of KI that the water present in the alcohol would dissolve, and it is therefore probable that KI is insol in strictly absolute alcohol (Gerardin)

Solubility in 100 pts alcohol of 0.9496 sp gr at

8° 13° 25° 46° 55° 62°  
67.4 69.2 75.1 84.7 87.5 90.2 pts KI  
(Gerardin, A ch (4) **5** 155)

Sol in 68.3 pts absolute alcohol (Eder, Dingl **221** 89), in 370 pts ether (sp gr 0.729), (Eder, l c), in 120 pts alcohol-ether (1 l), (Eder, l c)

Sol in 10-12 pts 90% alcohol, and 40 pts absolute alcohol (Hager, Comm **1883**)

100 pts absolute methyl alcohol dissolve 16.5 pts at 20.5°, 100 pts absolute ethyl alcohol dissolve 1.75 pts at 20.5° (de Bruyn, Z phys Ch **10** 783)

Solubility of KI in methyl alcohol+Aq at 25°

P = % by wt of alcohol in alcohol+Aq

S = Sp gr of alcohol+Aq sat with KI

L = millimols KI in 100 ccm of the solution

P	S 25°/4°	I
0	1 7213	620
10 6	1 634	555
30 8	1 460	431
47 1	1 325	335
64 0	1 185	243
78 1	1 066	169
98 9	0 9700	113
100	0 9018	80

(Herz and Anders, Z anorg 1907, **55** 274)

Solubility of KI in CH<sub>3</sub>OH

G = g KI in 100 g of the solution  
 t<sub>1</sub> = temp of complete solution  
 t<sub>2</sub> = temp at which salt begins to separate out

G	t <sub>1</sub>	t <sub>2</sub>
8 64		266°
12 95	0°	
14 2	20	
14 6		262
14 97	25	
19 2	85	256
26 8	115	242
28 9	144	229
29 6	188	196
33 0		

(Centnerszwer, Z phys Ch 1910, **72** 432)

Solubility of KI in methyl alcohol at t°

t°	g KI in 100 g alcohol	t°	g KI in 100 g alcohol
15	14 50	180	30 7
30	16 20	200	29 1
50	18 9	220	27 5
80	22 5	240	24 8
100	25 0	245	22 6
120	27 2	247	21 0
140	29 2	250	13 8
160	30 6	252 5*	7 6

\*Critical temp of solution

(Tyrer, Chem Soc 1910, **97** 626)

At room temp 1 pt KI by weight is sol in

6 pts methyl alcohol D<sup>15</sup> 0 7990

16 " ethyl " D<sup>15</sup> 0 8322

219 " propyl " D<sup>15</sup> 0 8160

(Rohlund, Z anorg 1898, **18** 325)

Solubility in mixtures of methyl and ethyl alcohol at 25°

P = % methyl alcohol in the solvent

G = g KI in 10 ccm of the solution

S = Sp gr of the sat solution at 25

P	G	S 25°/4
0 00	0 155	0 8015
4 37	0 191	0 8041
10 40	0 225	0 8071
41 02	0 494	0 8295
80 69	1 013	0 8794
84 77	1 072	0 8795
91 25	1 184	0 8908
100 00	1 316	0 9018

(Herz and Kuhn, Z anorg 1908, **60** 155)

Solubility in mixtures of methyl and propyl alcohol at 25°

P = % propyl alcohol in the solvent

G = g KI in 10 ccm of the solution

S = Sp gr of the sat solution

P	G	S 25°/4°
0	1 316	0 9018
11 11	1 096	0 8823
23 8	0 854	0 8629
65 2	0 262	0 8187
91 8	0 060	0 8045
93 75	0 058	0 8041
100	0 043	0 8041

(Herz and Kuhn)

Solubility in mixtures of propyl and ethyl alcohol at 25°

P = % propyl alcohol in the solvent

G = g KI in 10 ccm of the solution

S = Sp gr of the sat solution

P	G	S 25°/4°
0	0 155	0 8015
8 1	0 146	0 7983
17 85	0 137	0 7991
56 6	0 075	0 7988
88 6	0 052	0 8022
91 2	0 049	0 8027
95 2	0 044	0 8029
100	0 043	0 8041

(Herz and Kuhn)

100 g methyl alcohol dissolve 18 04 g KI at 25°

100 g ethyl alcohol dissolve 2 16 g KI at 25°

100 g propyl alcohol dissolve 0 43 g KI at 25°

100 g isomyl alcohol dissolve 0 09 g KI at 25°

(Turner and Bissett, Chem Soc 1913, **103** 1909)

0 45° g is sol in 100 g propyl alcohol (Schlump, Z phys Ch 1894, **14** 276)

Alcoholic solution can be mixed with ½ vol ether without pptn

100 g 95% formic acid dissolve 38 2 g KI at 18 5° (Aschan, Chem Ztg 1913, **37** 1113)



## Solubility in organic solvents at t°

C = pts by wt of KI in 100 cem of the sat solution

L = no of litres which at the saturation temp hold in solution 1 mol KI

S = sp gr of the solution at t°, referred to H<sub>2</sub>O at t°

p = pts by wt of KI in 100 g of the solution

Solvent	t°	C	L	S	p
Water	25°	102 70	0 162	1 7254	59 54
	0°	94 05	0 177	1 6699	56 32
Methyl alcohol	25°	13 48	1 231	0 9003	14 97
	25°	14 26			
	0°	11 61	1 430	0 8064	12 08
Ethyl alcohol	25°	1 520	10 92		--
	0°	1 197	13 87		
Glycol	25°	45 85	0 362		
	25°	47 23	0 351		
	0°	43 28	0 383	1 3954	31 03
Acetonitrile	25°	1 551	10 70		
	25°	1 590	10 44	0 7936	2 003
	0°	1 852	9 00	0 8198	2 259
Propionitrile	25°	0 316	52 53	0 7821	0 404
	25°	0 355	46 76		
	0°	0 344	48 26	0 8005	0 429
	0°	0 412	40 29		
Benzonitrile	25°	0 051	325 5	1 0076	0 050
Nitromethane	25°	0 349	47 56	1 1367	0 307
	25°	0 289	57 44		
	0°	0 366	45 36	1 1627	0 315
	0°	0 314	52 87		
Nitrobenzene	25°	0 0019	87 40		
Acetone	25°	1 038	16 0	0 7968	1 302
	0°	1 732	9 58	0 8227	2 105
Furfural	25°	5 93	2 80	1 2014	4 94
	0°	15 10	1 10		
Benzaldehyde	25°	0 343	48 4	1 0446	0 328
Salicylaldehyde	25°	0 549	30 24	1 1373	0 483
	0°	1 257	13 21	1 1501	1 093
Amisaldehyde	25°	0 720	23 06	1 1180	0 644
	0°	1 520	10 92	1 1223	1 355
Ethyl acetate	25°	0 0013	12 80		
Methyl cyan acetate	25°	2 459	6 75	1 1358	2 165
	0°	3 256	5 10	1 1521	2 827
Ethyl cyan acetate	25°	0 888	18 7	1 0579	0 839
	25°	1 090	15 23	1 0678	1 021

(Walden, Z phys Ch 1906, 55 715)

Insol in CS<sub>2</sub> (Arctowski, Z anorg 1894, 6 257)

Sol in benzonitrile (Naumann, B 1914, 47 1369)

Difficultly sol in methyl acetate (Naumann, B 1909, 42 3789)

Sol in ethyl acetate (Casaseca, C R 30 821)

Insol in ethyl acetate (Naumann, B 1910, 43 314)

Insol in ethylamine (Shinn, J phys Chem 1907, 11 538)

100 pts acetone dissolve 2 930 pts KI at 25° (Krug and M'Elroy, J Anal Ch 6 184)

Sol in acetone, insol in methylal (Eidmann, C C 1899 11 1014)

3 08 pts sol in 100 pts acetone at -2 5°

2 38 " " " 100 " " +22°

1 21 " " " 100 " " 56°

0 26 " " " 100 " pyridine " 10°

0 11 " " " 100 " " 119°

(Laszczyński, B 1894, 27 2287)

Freely sol in glycerine Insol in acetic acid (Berthemot)

Sol in 3 pts glycerine, insol in olive oil (Cap and Garot)

100 g glycerol dissolve 40 g KI at 15 5° (Ossendowski, Pharm J 1907, 79 575)

Potassium triiodide, KI<sub>3</sub>

Very deliquescent, very sol in H<sub>2</sub>O and alcohol (Johnson, Chem Soc 1877, 1 249)

Solution of I in KI contains this salt (see KI) Decomp by heat or shaking with CS<sub>2</sub>, ether, chloroform Sol in alcohol, from which CS<sub>2</sub> does not remove I (Jorgensen, J pr (2) 2 247)

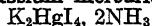
## Potassium periodide

Solubility determinations show that the compds KI<sub>3</sub> and KI<sub>7</sub> are the only periodides of potassium which form solids at 25°

See under KI+I (Foote and Chalker, Am Ch J 1908, 39 566)

KI<sub>7</sub> See above

## Potassium mercuric iodide ammonia,



(Peters, Z anorg 1912, 77 188)

## Potassium silver iodide, KI, AgI

Sol in KI+Aq Sol in hot alcohol (Boullay, A ch 34 377)

2KI, AgI, Sol in KI+Aq Decomp by H<sub>2</sub>O (Boullay)

Hygroscopic (Hellwig, Z anorg 1900, 25 180)

3KI, AgI Decomp by H<sub>2</sub>O (Ditte, C R 93, 415)

KI, 2AgI Sol in methylethylketone (Marsh, Chem Soc 1913, 103 783)

Potassium silver polyiodide, AgK<sub>3</sub>I<sub>12</sub>, 3KI+5H<sub>2</sub>O

Very deliquescent (Johnson, Chem Soc 33 183)

## Potassium tellurium iodide

See Iodotellurate, potassium

Potassium thallic iodide, KI, TI<sub>3</sub>

Decomp by H<sub>2</sub>O Can be crystallized from alcohol (Willm)

3KI, 2TI<sub>3</sub>+3H<sub>2</sub>O Partially decomp by H<sub>2</sub>O (Rammelsberg)

Potassium (tin) stannous iodide, KI, SnI<sub>2</sub>+1½H<sub>2</sub>O

When treated with a small quantity of H<sub>2</sub>O, KI dissolves out, but when more H<sub>2</sub>O is added, the substance is completely dissolved More sol in warm than cold alcohol (Boullay)

**Potassium zinc iodide, KI, ZnI<sub>2</sub>**

Very deliquescent (Rammelsberg, Pogg 3 665)  
 $K_2ZnI_4 + 2H_2O$  Hygroscopic (Ephraim, anorg 1910, 67 382)

**Potassium iodide sulphur dioxide, KI, SO<sub>2</sub>**

(Péchar, C R 1900, 130 1188)  
 $KI, 4SO_2$  (Walden, Z phys Ch 1903, 2 439)  
 $KI, 14SO_2$  (Walden)

**Potassium nitride, K<sub>2</sub>N**

Decomp violently by H<sub>2</sub>O (H Davy)

**Potassium ruthenium dihydronitrosobromide, Ru<sub>2</sub>H<sub>2</sub>NOBr<sub>3</sub>, 2HBr, 3KBr**

Ppt (Brizard, A ch 1900, (7) 21 362)

**Potassium ruthenium nitrosobromide, Ru<sub>2</sub>H<sub>2</sub>NOCl<sub>3</sub>, 3KCl, 2HCl**

Sl sol in H<sub>2</sub>O (Brizard, C R 1899, 129 16)

**Potassium suboxide**

Decomposes H<sub>2</sub>O

Does not exist (Lupton, Chem Soc 1876, 565)

**Potassium oxide, K<sub>2</sub>O**

Very sol in H<sub>2</sub>O with much heat

See Potassium hydroxide

**Potassium dioxide, K<sub>2</sub>O<sub>2</sub>**

Deliquescent Sol in H<sub>2</sub>O

Forms compound K O<sub>2</sub>, 2H<sub>2</sub>O<sub>2</sub> (Schone, 193 241)

**Potassium peroxide, K<sub>2</sub>O<sub>4</sub>**

Deliquescent Very sol with decomp in H<sub>2</sub>O

**Potassium silicon oxyfluoride, SiF<sub>2</sub>(OK)<sub>2</sub> and SiO(F)OK**

(Schiff and Beech, A Suppl 4 33)

**Potassium tantalum oxyfluoride, K<sub>4</sub>Ta<sub>4</sub>O<sub>5</sub>F<sub>14</sub>**

Insol in boiling water Easily sol in HF + q (Marignac, A ch (4) 9 268)

**Potassium phosphide, K<sub>3</sub>P**

Decomp by H<sub>2</sub>O (Joannis, C C 1894, 1 834)

KP<sub>6</sub> Easily decomp by H<sub>2</sub>O (Hugot, R 1895, 121 208)

**Potassium hydrogen phosphide, PH<sub>2</sub>K**

Decomp by H<sub>2</sub>O (Joannis, C R 1894, 19 558)

**Potassium phosphoselenide, KSeP = K<sub>2</sub>Se, P<sub>2</sub>Se**

Sol in cold H<sub>2</sub>O with rapid decomp Sol in alcohol with slight decomp (Hahn, J pr 3 430)

**Potassium phosphotriselenide, 2K<sub>2</sub>Se, P<sub>2</sub>Se<sub>3</sub>**

Deliquescent Decomp violently with H<sub>2</sub>O Sol in alcohol or ether, or in a mixture of the two, with slight decomp, but decomp gradually on the air (Hahn, J pr 93 430)

**Potassium phosphopentaseelenide, K<sub>4</sub>P<sub>2</sub>Se<sub>7</sub> = 2K<sub>2</sub>Se, P<sub>2</sub>Se<sub>5</sub>**

Deliquescent, immediately decomp by H<sub>2</sub>O, alcohol, or ether (Hahn)

**Potassium phosphosulphide, 4K<sub>2</sub>S<sub>2</sub>, P<sub>2</sub>S<sub>3</sub>**

Deliquescent Sol in H<sub>2</sub>O with decomp

**Potassium selenide, K<sub>2</sub>Se**

Sol in H<sub>2</sub>O with subsequent decomp on the air

Insol in liqnd NH<sub>3</sub>, sol in air free H<sub>2</sub>O to a colorless liqnd (Hugot, C R 1899, 129 299)

+2H<sub>2</sub>O Sol in H<sub>2</sub>O with decomp (Clever, Z anorg 1895, 10 143)  
 +9, 14, or 19H<sub>2</sub>O (Fabre, C R 102 613)

**Potassium tetraselenide, K<sub>2</sub>Se<sub>4</sub>**

Easily sol in H<sub>2</sub>O Decomp on standing Sol in liqnd NH<sub>3</sub> (Hugot, C R 1899, 129 299)

**Potassium monosulphide, K<sub>2</sub>S**

Deliquescent Sol in H<sub>2</sub>O and alcohol H<sub>2</sub>O solution decomp on air

Sol in 10 pts glycerine (Cap and Garot, J Pharm (3) 26 81)

Moderately sol in liqnd NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 829)

Insol in acetone and in methylal (Eidmann, C C 1899, II 1014)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

+5H<sub>2</sub>O (Schone, Pogg 131 380)

All potassium sulphides are sol in glycerine, insol in ether and ethyl acetate

**Potassium disulphide, K<sub>2</sub>S<sub>2</sub>**

Sol in H<sub>2</sub>O and alcohol, with gradual decomp

**Potassium trisulphide, K<sub>2</sub>S<sub>3</sub>**

Sol in H<sub>2</sub>O and alcohol, with gradual decomp on the air

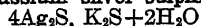
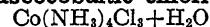
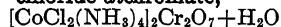
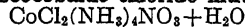
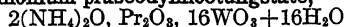
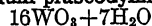
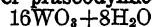
**Potassium tetrasulphide, K<sub>2</sub>S<sub>4</sub>**

Sol in H<sub>2</sub>O and alcohol

+2H<sub>2</sub>O Sol in H<sub>2</sub>O Sl sol in alcohol  
 +8H<sub>2</sub>O Sol in H<sub>2</sub>O Alcohol takes out water (Schone)

**Potassium pentasulphide, K<sub>2</sub>S<sub>5</sub>**

Sol in H<sub>2</sub>O and alcohol

**Potassium palladium sulphide***See Sulphopalladate, potassium***Potassium platinum sulphide***See Sulphoplatinate, potassium***Potassium silver sulphide,**Decomp by  $H_2O$  (Ditte, C R 1895, **120** 91)**Potassium rhodium sulphide,  $3K_2S, Rh_2S_3$** Decomp by  $H_2O$  (Leidie)**Potassium tellurium sulphide***See Sulphotellurate, potassium***Potassium thallium sulphide,  $K_2S, Tl_2S_3$** Not decomposed by  $H_2O$ , or hot  $NH_4OH$ , or  $KOH + Aq$  Decomp by  $HCl$  or moderately conc  $H_2SO_4 + Aq$  Hot  $HNO_3 + Aq$  decomp with separation of S (Schneider, J pr **110** 168)**Potassium tin (stannic) sulphide***See Sulphostannate, potassium***Potassium zinc sulphide,  $K_2S, 3ZnS$** Not attacked by  $H_2O$ , but easily decomp by the most dil acids (Schneider, J pr (2) **8** 29)**Potassium telluride,  $K_2Te$** Sol in  $H_2O$  (Demargay, Bull Soc (2) **40** 99)Sol in  $H_2O$  and liquid  $NH_3$  (Hugot, C R 1899, **129** 388)**Praseocobaltic chloride,**Easily sol in  $H_2O$ Dil  $HCl + Aq$  dissolves traces, conc  $HCl + Aq$  dissolves more Sol in  $NH_4OH + Aq$  with decomp Sol in conc  $H_2SO_4$  without decomp Sl sol in dil  $H_2SO_4 + Aq$  (Rose)**— mercuric chloride,  $Co(NH_3)_4Cl_3, HgCl_2$** Sl sol in cold  $H_2O$ , insol in  $HgCl_2 + Aq$  (Vortmann, B **15** 1892)**— chloride dichromate,**Scarcely sol in cold, easily sol in warm  $H_2O$  (Vortmann, B **15** 1897)**Praseocobaltic chloride nitrate,**Much less sol in  $H_2O$  than the chloride Precipitated from aqueous solution by dil  $HNO_3 + Aq$  (Vortmann, B **15** 1896)**Praseodymicitungstic acid****Ammonium praseodymicitungstate,**Very sl sol in  $H_2O$  Decomp by acids and alkalis (E F Smith, J Am Chem Soc 1904, **26** 1478)**Barium praseodymicitungstate,  $4BaO, Pr_2O_3,$** Ppt Insol in  $H_2O$   
 $6BaO, Pr_2O_3, 16WO_3 + 9H_2O$  Ppt (E F Smith)**Silver praseodymicitungstate,  $4Ag_2O, Pr_2O_3,$** Insol in  $H_2O$  (E F Smith)**Praseodymium, Pr****Praseodymium bromide,  $PrBr_3 + 6H_2O$** Very sol in  $H_2O$ , sol in  $HBr$  (von Schule Z anorg 1898, **18** 353)**Praseodymium carbide,  $PrC_2$** Decomp by  $H_2O$ , insol in conc  $HNO_3$  decomp by dil  $HNO_3$  (Moissan, C R 1900, **131** 597)**Praseodymium chloride,  $PrCl_3$** Very sol in  $H_2O$  Insol in  $PCl_3$  or  $SnCl_4$  Sol in alcohol Insol in ether and most organic solvents (Matignon, C R 1902, **134** 427)2 14 g  $PrCl_3$  dissolve in 100 g pyridine a 15° (Matignon, Int Cong App Chem 1909 **2** 53)100 g  $H_2O$  dissolve 334.2 g  $PrCl_3 + 7H_2O$  or 103.9 g of the anhydrous salt at 13° The aqueous solution sat at 14° has a sp gr  $16^\circ/16^\circ = 1.687$  At 100°, the solubility in  $H_2O$  is unlimited (Matignon A ch 1906, (8) **8** 388)Sol in conc  $HCl$  (von Schule, Z anorg 1898, **18** 352)100 pts of a solution of the salt in  $HCl + Ac$  contain at 13° 41.05 pts of anhydrous salt and 7.25 pts  $HCl$  Sp gr of this solution a 16° = 1.574 (Matignon, A ch 1906, (8) **8** 388)**Praseodymium hydride,  $PrH_3$  (?)**(Muthmann, A 1904, **331** 59)**Praseodymium hydroxide**Sol in citric acid (Baskerville, J Am Chem Soc 1904, **26** 49)**Praseodymium nitride,  $PrN$** Decomp in moist air with evolution of  $NH_3$  (Muthmann, A 1904, **331** 59)

**Praseodymium oxide,  $\text{Pr}_2\text{O}_3$**

Easily sol in  $\text{H}_2\text{O}$  (v Welsbach, M 6 477)

Decomp by heating in the air (Scheele, Z anorg 1898, 17 322)

**Praseodymium monoperoxide,  $\text{Pr}(\text{OH})_2 \text{H}_2\text{O}$**

(Melkoff, Chem Soc 1902, 82 (2) 140)

**Praseodymium superoxide,  $\text{Pr}(\text{OH}) (\text{OOH})$**

Ppt (Melkoff, C C 1902, I 172)

**Praseodymium trisuperoxide,  $\text{Pr}(\text{OOH})_3$**

Ppt (Melkoff)

**Praseodymium peroxide,  $\text{Pr}_2\text{O}_7$**

Sol in acids with evolution of O (v Welsbach)

**Praseodymium oxysulphide,  $\text{Pr}_2\text{SO}_2$**

(Biltz, Z anorg 1911, 71 436)

**Praseodymium disulphide,  $\text{PrS}_2$**

Decomp by heat (Biltz, Z anorg 1911, 71 437)

**Purpureocobaltic salts**

For other purpureocobaltic salts, see—

Chloropurpureocobaltic salts

Bromopurpureocobaltic salts

Nitratopurpureocobaltic salts

Sulphatopurpureocobaltic salts

**Purpureocobaltic cobaltcyanide,**

$\text{Co}(\text{NH}_3)_5\text{Co}(\text{CN})_6 + 1\frac{1}{2}\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$

— **ferricyanide,  $\text{Co}(\text{NH}_3)_5\text{Fe}(\text{CN})_6$**

Insol in cold  $\text{H}_2\text{O}$  Probably belongs to roseo series

— **mercuric hydroxychloride,**

$\text{CoN}_5\text{H}_{11}(\text{HgCl})_3(\text{HgOH})\text{Cl}_3$

Ppt (Vortmann and Morgulis, B 22 2645)

$\text{CoN}_5\text{H}_{11}(\text{HgOH})_3\text{Cl}_3$  Ppt (V and M)

— **mercuriodide, basic,**

$\text{CoN}_5\text{H}_{11}(\text{HgI}_2)_2(\text{HgOH})_3\text{I}_3$

Ppt Sl sol in acids Sol in  $\text{KI} + \text{Aq}$  (Vortmann and Borsbach, B 23 2804)

— **molybdate,  $\text{Co}_2\text{O}_3(\text{NH}_3)_{10}, 7\text{MoO}_3 +$**

$3\text{H}_2\text{O}$  (?)

Insol in  $\text{H}_2\text{O}$  or dil  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Calnot, C R 109 109)

— **sulphate**

See Sulphatopurpureocobaltic salts

— **tungstate,  $\text{Co}(\text{NH}_3)_5\text{O}(\text{WO}_4)$**

Scarcely sol in cold or hot  $\text{H}_2\text{O}$  (Gibbs)

$\text{Co}_2\text{O}_3(\text{NH}_3)_{10}, 10\text{WO}_3 + 9\text{H}_2\text{O}$  (?) Insol

in  $\text{H}_2\text{O}$ , or dil  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  (Carnot, C R 109 147)

**Purpureocobaltic vanadate,  $\text{Co}_2\text{O}_3(\text{NH}_3)_{10}, 5\text{V}_2\text{O}_5 + 9\text{H}_2\text{O}$  (?)**

Ppt Insol in  $\text{H}_2\text{O}$  (Carnot, C R 109 147)

**Purpureocobaltic octamine salts**

See Octamine cobaltic purpureo salts

**Pyrosulphuric acid,  $\text{H}_2\text{S}_2\text{O}_7$**

See Disulphuric acid

**Radium, Ra**

**Radium A**

More sol than Radium B and C in all solvents, sol even in organic solvents especially  $\text{CS}_2$  (Ramstedt, Le Radium, 1913, 10 159)

**Radium B**

More quickly sol than Radium C in  $\text{H}_2\text{O}$  and acids, less quickly sol in alkaline solutions, very sl sol in organic solvents (Ramstedt, Le Radium, 1913, 10 159)

**Radium C**

Sol in common acids, less so in alkaline solutions and in  $\text{H}_2\text{O}$ , only very sl sol in organic solvents (Ramstedt, Le Radium, 1913, 10 159, Chem Soc 1913, 104 (2) 659)

**Radium bromide**

Less sol in  $\text{H}_2\text{O}$  than corresponding Ba comp (Curie, Dissert 1903)

**Radium chloride**

Less sol in  $\text{H}_2\text{O}$  than corresponding Ba comp (Curie, Dissert 1903)

**Radium emanation**

Coefficient of absorption for  $\text{H}_2\text{O} = 0.245$  at  $3^\circ$ , 0.23 at  $20^\circ$ , 0.17 at  $40^\circ$ , 0.135 at  $60^\circ$ , 0.12 at  $70^\circ$ , 0.12 at  $80^\circ$  (Hofmann, Phys Zeit 1905, 6 339)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

Coefficient of solubility = conc of the emanation in the liquid conc of the emanation in the gas

$t^\circ$	Coefficient of solubility
0	0.506
4 3	0.424
5 7	0.398
10 0	0.340
14 0	0.303
17 6	0.280
20 0	0.245
26 8	0.206
31 6	0.193
39 1	0.160

Coefficient of solubility in sea-water of sp gr at  $14^\circ = 1.022$  is 0.255

(Bovle, Phil Mag 1911, (6) 22 850)

Solubility in H <sub>2</sub> O					
Temp	0 5°	17 5°	35°	41°	51°
Sol	0 526	0 283	0 183	0 161	0 138
Temp	60°	74°	79°	82°	91°
Sol	0 127	0 112	0 111	0 111	0 108
(Kofler, M 1913, 34 389)					

Coefficient of solubility of radium emanation at 14° in various solvents

Ethyl alcohol	7 34
Amyl alcohol	9 31
Toluene	13 7
Sea water	0 255
Mercury	0

(Boyle, Phil Mag 1911, (6) 22 851)

Coefficient of solubility emanation of radium in various solvents at t°

Solvents	t=18°	t=0°	t=-18°
Ethyl acetate	7 35	9 41	13 6
Acetone	6 30	7 99	10 8
Absolute alcohol	6 17	8 28	11 4
Aniline	3 80	4 43	
Benzene	12 82	16 54 at 3°	
Chloroform	15 08	20 5	28 5
Cyclohexane	18 04 at 80°		
Water	0 285	0 52	
Ether	15 08	20 09	29 1
Glycerine	0 21		
Hexane	16 56	23 4	35 2
Paraffine oil	9 2	12 6	
Carbon-bisulphide	23 14	33 4	50 3
Toluene	13 24	18 4	27
Xylene	12 75		

(Ramstedt, Le Radium, 1911, 8 255)

Solubility in various oils, etc., at t°

Rape oil		Poppy seed oil		Oil of turpentine	
t°	Solubility	t°	Solubility	t°	Solubility
-3	51 2	-5	50 5	-21	42 5
10	35 3	16	30 2	0	23 1
20	26 1	40	19 1	18	16 6
100	6 2	65	12 4	50	7 5
200	3 3	90	8 4	6 5	4 08

Solubility in 10% dammar resin in oil of turpentine = 16 7 at 18°

Solubility in 5% colophony in amyl alcohol = 11 2 at 20°

Solubility in amyl alcohol = 10 6 at 18°

Solubility in 20% colophony in amyl alcohol = 11 1 at 20°

(Curie, Thesis 1910)

Coefficient of absorption for petroleum =

22 70 at -21°
12 87 at +3°
9 55 at 20°
8 13 at 40°
7 01 at 60°

(Hofmann, Phys Zeit 1905, 6 339)

**Rhodicyanhydric acid, H<sub>3</sub>Rh(CN)<sub>3</sub>**

Not known in the free state

**Potassium rhodicyanide, K<sub>3</sub>Rh(CN)<sub>3</sub>**

Sol in H<sub>2</sub>O Easily decomp by acids  
Very sol in H<sub>2</sub>O (Leidié, C R 1900, 130 89)

**Rhodium, Rh**

Insol in all acids, including aqua regia  
Rhodium "sponge" is sol in HNO<sub>3</sub>+Aq, and somewhat in HCl+Aq when exposed to air

**Rhodium ammonia compounds**

See—

**Bromopurpleorhodum comps,**  
BrRh(NH<sub>3</sub>)<sub>5</sub>X<sub>2</sub>

**Chloropurpleorhodum comps,**  
ClRh(NH<sub>3</sub>)<sub>5</sub>X<sub>2</sub>

**Iodopurpleorhodum comps,**  
IRh(NH<sub>3</sub>)<sub>5</sub>X<sub>2</sub>

**Luteorhodum comps, Rh(NH<sub>3</sub>)<sub>5</sub>X<sub>3</sub>**

**Nitratopurpleorhodum comps,**  
(NO<sub>3</sub>)Rh(NH<sub>3</sub>)<sub>5</sub>X<sub>2</sub>

**Roseorhodum comps, Rh(NH<sub>3</sub>)<sub>5</sub>(OH<sub>2</sub>)X<sub>3</sub>**

**Xanthorhodum comps, (NO<sub>2</sub>)Rh(NH<sub>3</sub>)<sub>5</sub>X<sub>2</sub>**

**Rhodium tribromide, RhBr<sub>3</sub>+2H<sub>2</sub>O**

Very sol in H<sub>2</sub>O (Goloubkine, Chem Soc 1911, 100 (2) 45)

**Rhodium rubidium bromide**

See Bromorhodite, rubidium

**Rhodium sodium bromide**

See Bromorhodite, sodium

**Rhodium dichloride, RhCl<sub>2</sub> (?)**

Insol in H<sub>2</sub>O, HCl, or HNO<sub>3</sub>+Aq Not attacked by boiling KOH or K<sub>2</sub>CO<sub>3</sub>+Aq (Fellenberg)

Decomp by boiling KOH+Aq (Berzelius)

Does not exist (Leidié, C R 106 1076)

**Rhodium trichloride, RhCl<sub>3</sub>**

Insol in acids, even aqua regia When boiled for a long time with KOH+Aq, it becomes sl sol in HCl+Aq

Insol in H<sub>2</sub>O and acids, sol in alkalis+Aq (Leidié, C R 1899, 129 1251)

+4H<sub>2</sub>O Very sl deliquescent Easily sol in H<sub>2</sub>O, HCl+Aq, or alcohol Insol in ether Decomp by H<sub>2</sub>SO<sub>4</sub> only when boiling (Claus, J pr 80 282)

No definite amount of crystal  $\text{H}_2\text{O}$  (Leidie ch (6) 17 271)

**rhodium chloride** with  $\text{MCl}$

See Chlororhodite, M

**rhodium dihydroxide**,  $\text{RhO}_2 \cdot 2\text{H}_2\text{O}$ , or  
**Rhodium rhodate**,  $\text{Rh}_2\text{O}_3 \cdot \text{RhO}_3 + 6\text{H}_2\text{O}$

Sol in  $\text{HCl} + \text{Aq}$

**rhodium sesquihydroxide**,  $\text{Rh}_2\text{O}_3 \cdot \text{H}_2\text{O}$

Only sl sol in conc  $\text{HCl} + \text{Aq}$  (Claus)  
 $+ 2\text{H}_2\text{O}$  Easily sol in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{SO}_3$ ,  
 $\text{INO}_3$ , or  $\text{HSCN} + \text{Aq}$ , also when moist, in  
 $\text{ICl}_2\text{H}_3\text{O}_2 + \text{Aq}$  Sol in conc  $\text{KOH} + \text{Aq}$ , very  
l sol in  $\text{H}_3\text{BO}_3$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$ , and  $\text{HCN}$   
 $- \text{Aq}$  Sol in acid alkali oxalates  $+ \text{Aq}$   
Leidie, C R 107 234)

**rhodium triiodide**,  $\text{RhI}_3$

Ppt (Goloubkine, Chem Soc 1911, 100  
2) 45)

**rhodium monoxide**,  $\text{RhO}$

Not attacked by acids (Deville and De-  
ray, A ch (3) 61 83)

**rhodium sesquioxide**,  $\text{Rh}_2\text{O}_3$

Insol in  $\text{H}_2\text{O}$ , boiling  $\text{KOH} + \text{Aq}$ , or any  
acid, even aqua regia (Claus)

**rhodium dioxide**,  $\text{RhO}_2$

Insol in all acids or alkalies

**rhodium trioxide**,  $\text{RhO}_3$

"Rhodic acid" Known only in solution of  
Potassium rhodate," which is very easily  
ecomp (Claus)

**rhodium oxybromide**,  $\text{Rh}(\text{OH})_2\text{Br} + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Goloubkine, Chem Soc  
911, 100 (2) 45)

**rhodium monosulphide**,  $\text{RhS}$

Insol in aqua regia

**rhodium sesquisulphide**,  $\text{Rh}_2\text{S}_3$

Sol in alkali sulphides  $+ \text{Aq}$  (Debray, C  
t 97 1332)

Insol in alkali sulphides  $+ \text{Aq}$  Not at-  
tacked by  $\text{HNO}_3$ , aqua regia, or  $\text{Br}_2 + \text{Aq}$   
Leidie, Bull Soc (2) 50 664)

**rhodium sodium sulphide**,  $3\text{Na}_2\text{S} \cdot \text{Rh}_2\text{S}_3$

Decomp by  $\text{H}_2\text{O}$  (Leidie)

**rhodium sesquisulphydride**,  $\text{Rh}_2\text{S}_6\text{H}_6$

Easily sol in aqua regia or  $\text{Br}_2 + \text{Aq}$  Insol  
in alkali sulphides  $+ \text{Aq}$  or acids (Leidie,  
Bull Soc (2) 50 664)

**Rhodochromium bromide**,

$\text{HOCr}_2(\text{NH}_3)_{10}\text{Br}_5 + \text{H}_2\text{O}$

Rather difficultly sol in  $\text{H}_2\text{O}$  Decomp by  
boiling or standing Sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
or  $\text{NaOH} + \text{Aq}$  Insol in dil  $\text{HBr} + \text{Aq}$ ,  
 $\text{KBr} + \text{Aq}$ , or alcohol (Jorgensen, J pr (2)  
25 321)

— **bromide, basic**,  $\text{HOCr}_2(\text{NH}_3)_{10}(\text{OH})\text{Br}_4$   
 $+ \text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH}$  or  $\text{NaOH} +$   
 $\text{Aq}$  Insol in alcohol (Jorgensen)

— **bromoplatinate**,  $\text{HOCr}_2(\text{NH}_3)_{10}\text{Br}_3\text{PtBr}_5$ ,  
 $\text{HOCr}_2(\text{NH}_3)_{10}\text{Br}_3(\text{PtBr}_5)_2 + 4\text{H}_2\text{O}$

Ppt (Jorgensen)

— **chloraurate**,  $\text{HOCr}_2(\text{NH}_3)_{10}\text{Cl}_3(\text{AuCl}_4)_2$   
 $+ 2\text{H}_2\text{O}$

Difficultly sol but not insol in  $\text{H}_2\text{O}$  (Jor-  
gensen)

— **chloride**,  $\text{HOCr}_2(\text{NH}_3)_{10}\text{Cl}_5 + \text{H}_2\text{O}$

Sol in about 40 pts of cold  $\text{H}_2\text{O}$  Insol in  
cold dil  $\text{HCl} + \text{Aq}$ ,  $\text{NH}_4\text{Cl} + \text{Aq}$ , or alcohol  
Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Jorgensen, J pr (2)  
25 321)

— **chloriodide, basic**,  
 $\text{HOCr}_2(\text{NH}_3)_{10}(\text{OH})\text{Cl}_2\text{I}_2$

Sl sol in cold  $\text{H}_2\text{O}$ , insol in alcohol  
(Jorgensen)

— **chloroplatinate**,  $\text{HOCr}_2(\text{NH}_3)_{10}\text{Cl}_3\text{PtCl}_5$ ,  
 $\text{HOCr}_2(\text{NH}_3)_{10}\text{Cl}(\text{PtCl}_5)_2 + 4\text{H}_2\text{O}$

Precipitate (Jorgensen)

— **dithionate**,  $[\text{HOCr}(\text{NH}_3)_{10}]_2(\text{S}_2\text{O}_8)_5 +$   
 $2\text{H}_2\text{O}$

Nearly insol in  $\text{H}_2\text{O}$

— **dithionate, basic**,  
 $\text{HOCr}(\text{NH}_3)_{10}\text{OH}(\text{S}_2\text{O}_6)_2 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , cold  $\text{NH}_4\text{OH} + \text{Aq}$ , or  
 $\text{NaOH} + \text{Aq}$

— **iodide**,  $\text{HOCr}_2(\text{NH}_3)_{10}\text{I}_5 + \text{H}_2\text{O}$

Very difficultly sol in  $\text{H}_2\text{O}$  Insol in very  
dil  $\text{HI} + \text{Aq}$  or alcohol Sl sol in  $\text{NH}_4\text{OH}$  or  
 $\text{KOH} + \text{Aq}$  (Jorgensen)

— **nitrate**,  $\text{HOCr}_2(\text{NH}_3)_{10}(\text{NO}_3)$

Rather difficultly sol in  $\text{H}_2\text{O}$ , from which  
it is precipitated by a few drops of  $\text{HNO}_3 +$   
 $\text{Aq}$  Sol in hot dil  $\text{NH}_4\text{OH} + \text{Aq}$

— **nitrate chloroplatinate**,  
 $\text{HOCr}_2(\text{NH}_3)_{10}(\text{NO}_3)(\text{PtCl}_5) + 4\text{H}_2\text{O}$

Precipitate (Jorgensen)

**Rhodochromium sulphate**,

$[\text{HOCr}_2(\text{NH}_3)_{10}]_2(\text{SO}_4)_5 + 2\text{H}_2\text{O}$

Very sl sol in cold  $\text{H}_2\text{O}$  Easily sol in  
cold dil  $\text{H}_2\text{SO}_4 + \text{Aq}$

Almost insol in a mixture of 3 vols  $\text{H}_2\text{O}$ , 1 vol alcohol, and  $\frac{1}{3}$  vol dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Jørgensen)

### Rhodonitrous acid

#### Ammonium rhodonitrite, $(\text{NH}_4)_6\text{Rh}_2(\text{NO}_2)_{12}$

Nearly insol in cold, sl sol in hot  $\text{H}_2\text{O}$   
Insol in conc  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$   
Insol in alcohol (Leidié, C R 111 108)

#### Barium rhodonitrite, $\text{Ba}_3\text{Rh}_2(\text{NO}_2)_{12}$

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  (Lamy)  
 $+12\text{H}_2\text{O}$  Sol in 50 pts  $\text{H}_2\text{O}$  at  $16^\circ$ , and 6.5 pts at  $100^\circ$  (Leidié, C R 111 108)

#### Potassium rhodonitrite, $\text{K}_6\text{Rh}_2(\text{NO}_2)_{12}$

Nearly insol in cold, verv sl sol in boiling  $\text{H}_2\text{O}$  Completely insol in  $\text{KNO}_3 + \text{Aq}$ , and in  $\text{KCl} + \text{Aq}$  (30%  $\text{KCl}$ ), or  $\text{KC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (50%  $\text{KC}_2\text{H}_3\text{O}_2$ ) Insol in alcohol (Leidié, C R 111 106)

#### Sodium rhodonitrite, $\text{Na}_6\text{Rh}_2(\text{NO}_2)_{12}$

Sol in  $2\frac{1}{2}$  pts  $\text{H}_2\text{O}$  at  $17^\circ$ , and 1 pt at  $100^\circ$  Insol in alcohol Decomp by  $\text{HCl} + \text{Aq}$  (Leidié, C R 111 107)

### Rhodosochromium bromide

Sol in  $\text{H}_2\text{O}$ , insol in dil  $\text{HBr} + \text{Aq}$  (1) (Jørgensen, J pr (2) 45 260)

— chloraurate,  $\text{Cr}_2(\text{NH}_3)_6(\text{HO})_3\text{Cl}_3$ ,  $2\text{AuCl}_3 + 2\text{H}_2\text{O}$

Not insol in cold  $\text{H}_2\text{O}$  (Jørgensen)

— chloride,  $\text{Cr}_2(\text{NH}_3)_6(\text{HO})_3\text{Cl}_3 + 2\text{H}_2\text{O}$

Sol in 10.6 pts  $\text{H}_2\text{O}$  at  $18^\circ$ , decomp by boiling Pptd by  $\frac{1}{2}$  to 1 vol dil  $\text{HCl} + \text{Aq}$  Sol in cold dil  $\text{NH}_4\text{OH} + \text{Aq}$  (Jørgensen, J pr (2) 45 260)

— chloroplatinate,  $2\text{Cr}_2(\text{NH}_3)_6(\text{OH})_3\text{Cl}_3$ ,  $3\text{PtCl}_4 + 6\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Jørgensen)

$\text{Cr}_2(\text{NH}_3)_6(\text{OH})_3\text{Cl}_3$ ,  $2\text{PtCl}_4 + 2\text{H}_2\text{O}$  Insol in 95% alcohol (Jørgensen)

— chromate,  $[\text{Cr}_2(\text{NH}_3)_6(\text{OH})_3]_2(\text{CrO}_4)_3 + 7\text{H}_2\text{O}$  (Jørgensen)

Very sl sol in  $\text{H}_2\text{O}$  (Jørgensen)

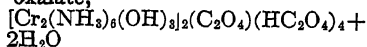
— iodide,  $\text{Cr}_2(\text{NH}_3)_6(\text{OH})_3\text{I}_3 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Insol in dil  $\text{HI} + \text{Aq}$  (Jørgensen)

— nitrate,  $\text{Cr}_2(\text{NH}_3)_6(\text{OH})_3(\text{NO}_3)_3 + \text{H}_2\text{O}$

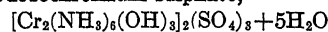
Much less sol in cold  $\text{H}_2\text{O}$  than the chloride Insol in dil  $\text{HNO}_3 + \text{Aq}$  (Jørgensen)

— oxalate,



Sol in cold  $\text{H}_2\text{O}$ , but not very easily (Jørgensen)

### Rhodosochromium sulphate,



Very sl sol in cold  $\text{H}_2\text{O}$  Easily sol in dil  $\text{NH}_4\text{Cl} + \text{Aq}$  (Jørgensen)

$[\text{Cr}_2(\text{NH}_3)_6(\text{OH})_3]\text{SO}_4$ ,  $\text{HSO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  into  $\text{H}_2\text{SO}_4$  and above compound (Jørgensen)

— persulphide,  $[\text{Cr}_2(\text{NH}_3)_6(\text{OH})_3]_2\text{S}_{11} + 4\text{H}_2\text{O}$

Ppt Insol in  $\text{H}_2\text{O}$  (Jørgensen)

### Rhodosulphuric acid

#### Potassium rhodosulphate, $\text{K}_6\text{Rh}_2(\text{SO}_4)_6$

Two modifications

(a) Slowly sol in cold, easily in hot  $\text{H}_2\text{O}$

(b) Insol in  $\text{H}_2\text{O}$

Does not exist (Leidié, C R 107 234)

#### Sodium rhodosulphate

Insol in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ , or aqua regia (Claus)

Does not exist (Leidié)

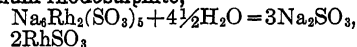
$\text{Na}_2\text{Rh}_2(\text{SO}_4)_4$  Insol in  $\text{H}_2\text{O}$  (Seubert and Kobbé, B 23 2560)

### Rhodosulphurous acid

#### Potassium rhodosulphite, $\text{K}_6\text{Rh}_2(\text{SO}_3)_6 + 6\text{H}_2\text{O}$

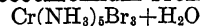
Nearly insol in  $\text{H}_2\text{O}$  Slowly sol in acids Not decomp by boiling  $\text{KOH} + \text{Aq}$  (Claus)

#### Sodium rhodosulphite,



Insol in cold, very sl sol in hot  $\text{H}_2\text{O}$  Easily sol in  $\text{HNO}_3 + \text{Aq}$  (Seubert and Kobbé, B 23 2558)

### Roseochromium bromide,



Easily sol in  $\text{H}_2\text{O}$  Insol in  $\text{HBr} + \text{Aq}$  (Christensen, J pr (2) 23 26)

— bromochromate,  $\text{Cr}(\text{NH}_3)_5\text{Br}(\text{CrO}_4)$

Somewhat sol in  $\text{H}_2\text{O}$ , but decomp on standing (Jørgensen, J pr (2) 25 398)

— bromoplatinate,  $\text{Cr}(\text{NH}_3)_5\text{Br}(\text{PtBr}_6) + 2\text{H}_2\text{O}$

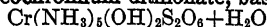
Precipitate Difficultly sol in  $\text{H}_2\text{O}$  (Christensen, l c)

— chloride,  $\text{Cr}(\text{NH}_3)_5\text{Cl} + \text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  with subsequent decomp Insol in alcohol (Christensen, J pr (2) 23 26)

— mercuric chloride,  $\text{Cr}(\text{NH}_3)_5\text{Cl}_3$ ,  $3\text{HgCl}_2 + 2\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  Sol in dil  $\text{HCl} + \text{Aq}$  with decomposition (Christensen, l c)

**roseochromium dithionate, basic,**

Easily sol in very dil HCl + Aq (Jorgensen, J pr (2) 25 308)

**— iodide,  $\text{Cr}(\text{NH}_3)_5\text{I}_3$** 

Easily sol in  $\text{H}_2\text{O}$ , decomp by boiling (Christensen, l c)

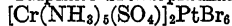
**— nitrate,  $\text{Cr}(\text{NH}_3)_5(\text{NO}_3)_3 + \text{H}_2\text{O}$** 

Rather easily sol in  $\text{H}_2\text{O}$  (Christensen, c)

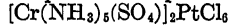
$\text{Cr}(\text{NH}_3)_5(\text{NO}_3)_3(\text{OH}_2)_2$ ,  $\text{HNO}_3$  Decomp y  $\text{H}_2\text{O}$  or alcohol (Jorgensen, J pr (2) 44 3)

**— sulphate,  $[\text{Cr}(\text{NH}_3)_5]_2(\text{SO}_4)_3 + 5\text{H}_2\text{O}$** 

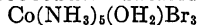
Easily sol in  $\text{H}_2\text{O}$  Precipitated by alcohol (Christensen, l c)

**— sulphate bromoplatinate,**

Difficultly sol in  $\text{H}_2\text{O}$  (Christensen, l c)

**— sulphate chloroplatinate,**

Difficultly sol in  $\text{H}_2\text{O}$  (Christensen, l c)

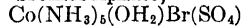
**roseocobaltic bromide,**

Sol in  $\text{H}_2\text{O}$ , insol in  $\text{HBr} + \text{Aq}$  (Jorgensen, J pr (2) 31 49)

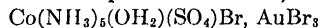
**— bromoplatinate,  $\text{Co}(\text{NH}_3)_5(\text{OH}_2)\text{Br}_3$ ,  $\text{PtBr}_4 + \text{H}_2\text{O}$** 

Somewhat sol in  $\text{H}_2\text{O}$  or dil alcohol Insol n strong alcohol (Jorgensen)

$2\text{Co}(\text{NH}_3)_5(\text{OH}_2)\text{Br}_3$ ,  $3\text{PtBr}_4 + 4\text{H}_2\text{O}$  Ppt (Jorgensen)

**— bromosulphate,**

Sol in  $\text{H}_2\text{O}$  (Krok)

**— bromosulphate bromaurate,****— carbonate**

Vcay sol in  $\text{H}_2\text{O}$

**— chloraurate,  $\text{Co}(\text{NH}_3)_5(\text{OH}_2)\text{Cl}_3$ ,  $\text{AuCl}_3$** 

Moderately sol in cold  $\text{H}_2\text{O}$

**— chloride,  $\text{Co}(\text{NH}_3)_5(\text{OH}_2)\text{Cl}_3$** 

Sol in 48 pts  $\text{H}_2\text{O}$  at  $10^\circ$ , but decomp n heating

100 pts  $\text{H}_2\text{O}$  dissolve 16 12 pts at  $0^\circ$ , and 4 87 pts at  $16^\circ$  (Kurnakoff, J russ Soc 24 269)

Sl sol in 1000 pts fuming  $\text{HCl} + \text{Aq}$ , more asily in 20%  $\text{HCl} + \text{Aq}$  (Rose)

**Roseocobaltic mercuric chloride,**

More easily sol in solvents than the anhydrous purpureo salt (Carstanjen)

$\text{Co}(\text{NH}_3)_5(\text{OH}_2)\text{Cl}_3$ ,  $\text{HgCl}_2$  Sol in  $\text{HCl} + \text{Aq}$  with decomp into above salt (Jorgensen)

**— chloroplatinate,**

Decomp by  $\text{H}_2\text{O}$  (Jorgensen)

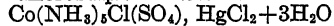
$2\text{Co}(\text{NH}_3)_5(\text{OH}_2)\text{Cl}_3$ ,  $\text{PtCl}_4 + 2\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$

$2\text{Co}(\text{NH}_3)_5(\text{OH}_2)\text{Cl}_3$ ,  $3\text{PtCl}_4 + 6\text{H}_2\text{O}$  Not difficultly sol in warm  $\text{H}_2\text{O}$  (Gibbs)

$\text{Co}(\text{NH}_3)_5\text{Cl}_3$ ,  $\text{PtCl}_4 + \text{H}_2\text{O}$  (Gibbs)

**— chlorosulphate,  $\text{Co}(\text{NH}_3)_5\text{Cl}(\text{SO}_4)$** 

Easily sol in  $\text{H}_2\text{O}$

**— chlorosulphate mercuric chloride,**

Sol in hot  $\text{H}_2\text{O}$ , and can be recrystallized without decomp (Krok)

**— dichromate,**

Can be recrystallized out of weak acetic acid

**— cobalticyanide,  $\text{Co}(\text{NH}_3)_5(\text{OH}_2)\text{Co}(\text{CN})_5$** 

Nearly absolutely insol in cold  $\text{H}_2\text{O}$  (Jorgensen)

+  $\text{H}_2\text{O}$  (Gibbs and Gentile)

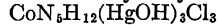
**— dithionate,  $\text{Co}(\text{NH}_3)_5(\text{S}_2\text{O}_6)(\text{OH})$** 

Decomp by  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 58 296)

$\text{Co}(\text{NH}_3)_5(\text{OH}_2)(\text{S}_2\text{O}_6) + 2\text{H}_2\text{O}$  Ppt (Jorgensen)

**— hydroxide,  $\text{Co}(\text{NH}_3)_5(\text{OH})_3$** 

Known only in aqueous solution

**— mercuric hydroxylchloride,**

Ppt Sol in dil acids (Vortmann and Morgulis, B 22 2646)

$\text{CoN}_5\text{H}_{12}(\text{HgOH})_3\text{Cl}_2(\text{OH})$  Ppt Sol in dil acids (Vortmann and Morgulis)

**— iodide,  $\text{Co}(\text{NH}_3)_5(\text{OH}_2)\text{I}_3$** 

Less sol in  $\text{H}_2\text{O}$  than bromide Insol in  $\text{HI} + \text{Aq}$  (Jorgensen)

**— iodosulphate,  $\text{Co}(\text{NH}_3)_5(\text{OH}_2)\text{I}(\text{SO}_4)$** 

Easily sol in  $\text{H}_2\text{O}$  (Krok)

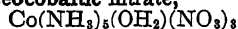
**— mercuriodide,  $[\text{CoN}_5\text{H}_{13}](\text{HgI})_3\text{I}_6$** 

Ppt (Vortmann and Borsbach, B 23 2805)

$\text{CoN}_5\text{H}_{13}(\text{HgI})_2\text{I}_3$  Ppt (Vortmann and Borsbach)

$\text{CoN}_5\text{H}_{13}(\text{HgI})_2\text{I}_2(\text{OH})$  Ppt

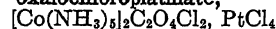
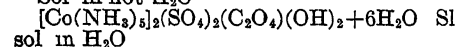
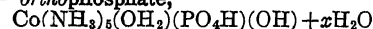
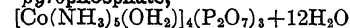


**Roseocobaltic nitrate,**

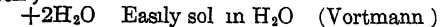
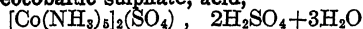
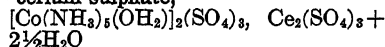
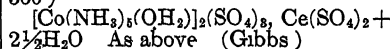
Three modifications

 $\alpha$  Sol in 20 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Jorgensen) $\beta$  Known only in solution Insol in cold  $\text{HNO}_3 + \text{Aq}$  (Gibbs) $\gamma$  Easily sol in hot  $\text{H}_2\text{O}$  (Gibbs) (Purpureo salt?)
 $\text{Co}(\text{NH}_3)_5(\text{OH}_2)(\text{NO}_3)_3$ ,  $\text{HNO}_3$  Decomp by  $\text{H}_2\text{O}$  or alcohol (Jörgensen, J pr (2) 44 63)
**nitrate chloroplatinate,**

Ppt (Jorgensen)

**nitratosulphate,**Sl sol in cold, easily in hot  $\text{H}_2\text{O}$ **oxalate,**  $[\text{Co}(\text{NH}_3)_5(\text{OH}_2)]_2(\text{C}_2\text{O}_4)_3 + 2\text{H}_2\text{O}$ Nearly insol in  $\text{H}_2\text{O}$ **oxalochloroplatinate,**Sol in hot  $\text{H}_2\text{O}$ **oxalosulphate,**  $[\text{Co}(\text{NH}_3)_5]_2(\text{SO}_4)_2\text{C}_2\text{O}_4, \text{H}_2\text{C}_2\text{O}_4 + 2\text{H}_2\text{O}$ Sol in hot  $\text{H}_2\text{O}$ Sl sol in  $\text{H}_2\text{O}$ **orthophosphate,**Nearly insol in  $\text{H}_2\text{O}$ 
 $[\text{Co}(\text{NH}_3)_5(\text{OH}_2)]_2(\text{PO}_4\text{H})_3 + 4\text{H}_2\text{O}$  Very sl sol in cold  $\text{H}_2\text{O}$ , easily in  $\text{H}_2\text{O}$  containing  $\text{HCl}$  (Jorgensen)
**pyrophosphate,**Insol in  $\text{H}_2\text{O}$  (Jorgensen)
 $\text{Co}(\text{NH}_3)_5(\text{OH}_2)(\text{P}_2\text{O}_7\text{Na}_2) + 12\text{H}_2\text{O}$  Nearly insol in cold, easily sol in hot  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$  (Jörgensen, J pr (2) 23 252)
**sulphate,**  $[\text{Co}(\text{NH}_3)_5(\text{OH}_2)]_3(\text{SO}_4)_3 + 3\text{H}_2\text{O}$ 

Three modifications

 $\alpha$  Sl sol in cold  $\text{H}_2\text{O}$  Sol in 58 pts at  $27^\circ$  (Gibbs), 83 5 pts at  $20^\circ$ , and 94 6 pts at  $17^\circ$  (Jorgensen), more easily sol in hot  $\text{H}_2\text{O}$ , and still more easily in  $\text{NH}_4\text{OH} + \text{Aq}$ 
 $\beta$  Sol in 1-2 pts  $\text{H}_2\text{O}$  (Gibbs)
 $\gamma$  Less sol than luteosulphate (Jorgensen)
**Roseocobaltic sulphate, acid,**(Fremy), or  $4[\text{Co}(\text{NH}_3)_5]_2(\text{SO}_4)_3, 9\text{H}_2\text{SO}_4 + 11\text{H}_2\text{O}$  (Jorgensen)
 More easily sol in  $\text{H}_2\text{O}$  than neutral sulphate, into which it is converted by recrystallization Sol in about 13 pts  $\text{H}_2\text{O}$  (Jorgensen)
**cerium sulphate,**
 Sl sol in cold, practically insol in boiling  $\text{H}_2\text{O}$  Sol in acids (Gibbs, Am Ch J 15 560)


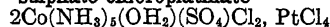
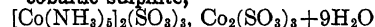
As above (Gibbs)

**sulphate chloraurate**

Three modifications

 $\alpha$   $\text{Co}(\text{NH}_3)_5(\text{OH}_2)(\text{SO}_4)\text{Cl}$ ,  $\text{AuCl}_3$  Ppt (Jorgensen)

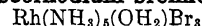
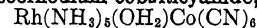
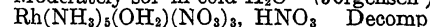
 $\beta$   $\text{Co}(\text{NH}_3)_5(\text{SO}_4)$ ,  $\text{AuCl}_3 + 2\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$  (Gibbs)

 $\gamma$  As above Can be recrystallized from hot  $\text{H}_2\text{O}$ 
**sulphate chloroplatinate**
 Three modifications, all difficultly sol in hot or cold  $\text{H}_2\text{O}$  (Jörgensen)
**sulphite,**  $[\text{Co}(\text{NH}_3)_5(\text{OH}_2)]_2(\text{SO}_3)_3 + \text{H}_2\text{O}$ 
 Sl sol in cold, decomp by hot  $\text{H}_2\text{O}$  (Gibbs)
**cobaltic sulphite,**
 Insol in cold, decomp by hot  $\text{H}_2\text{O}$  (Kunzel)
**Roseocobaltic octamine compounds**

See Roseotetramine cobaltic compounds

**Roseoiridium compounds**

See Iridoaquopentamine compounds

**Roseorhodium bromide,**
 Sol in cold  $\text{H}_2\text{O}$  (Jörgensen, J pr (2) 34 394)
**Roseorhodium cobalticyanide,**Scarcely sol in  $\text{H}_2\text{O}$ **iodosulphate,**  $\text{Rh}(\text{NH}_3)_5(\text{OH}_2)\text{I}(\text{SO}_4)$ 
 Very sl sol in  $\text{H}_2\text{O}$ , easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Jorgensen)
**nitrate,**  $\text{Rh}(\text{NH}_3)_5(\text{OH})(\text{NO}_3)_3$ Moderately sol in cold  $\text{H}_2\text{O}$  (Jorgensen)

Decomp

by  $\text{H}_2\text{O}$  or alcohol (Jorgensen, J pr (2) 44 63)

**Roseorhodium nitrate chloroplatinate,**  
 $[\text{Rh}(\text{NH}_3)_5(\text{OH}_2)(\text{NO}_3)]_2\text{PtCl}_6 + 2\text{H}_2\text{O}$   
 Ppt (Jorgensen)

— **orthophosphate,**  
 $[\text{Rh}(\text{NH}_3)_5(\text{OH}_2)]_2(\text{HPO}_4)_3 + 4\text{H}_2\text{O}$   
 Very sl sol in  $\text{H}_2\text{O}$

— **sodium pyrophosphate,**  
 $[\text{Rh}(\text{NH}_3)_5(\text{OH}_2)]_2\text{Na}_2\text{P}_2\text{O}_7 + 23\text{H}_2\text{O}$   
 Ppt Very sl sol in cold  $\text{H}_2\text{O}$  Easily sol in very dil acids

— **sulphate,**  
 $[\text{Rh}(\text{NH}_3)_5(\text{OH}_2)]_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$   
 Very sl sol in cold, much more in hot  $\text{H}_2\text{O}$

— **sulphate chloroplatinate,**  
 $\text{Rh}(\text{NH}_3)_5(\text{OH}_2)(\text{SO}_4)\text{PtCl}_6$   
 Ppt Nearly insol in  $\text{H}_2\text{O}$  or alcohol

**Roseotetramine cobaltic bromide,**  
 $\text{Co}(\text{NH}_3)_4(\text{OH}_2)_2\text{Br}_2$   
 Sol in  $\text{H}_2\text{O}$ , insol in  $\text{HBr} + \text{Aq}$  Nearly insol in alcohol (Jorgensen, Z anorg 2 295)

— — **chloride,**  $\text{Co}(\text{NH}_3)_4(\text{OH}_2)_2\text{Cl}_2$   
 Easily sol in  $\text{H}_2\text{O}$ , insol in conc  $\text{HCl} + \text{Aq}$ , sol in sat  $\text{HgCl}_2 + \text{Aq}$  (Jorgensen)

— — **cobalticyanide,**  
 $\text{Co}(\text{NH}_3)_4(\text{OH}_2)_2\text{Co}(\text{CN})_6$   
 (Jorgensen)

— — **oxalate sulphate,**  
 $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)]_2(\text{SO}_4)_2\text{C}_2\text{O}_4$   
 Ppt (Jorgensen)

— — **pyrophosphate,**  
 $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)]_2(\text{P}_2\text{O}_7)_3 + 6\text{H}_2\text{O}$   
 Nearly insol in  $\text{H}_2\text{O}$ , but easily sol in very dil acids +  $\text{Aq}$  (Jorgensen)

— — **sulphate,**  
 $[\text{Co}(\text{NH}_3)_4(\text{OH})]_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$   
 Sol in about 35 pts  $\text{H}_2\text{O}$ , and more easily by addition of dil  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Jorgensen)

— — **sulphate bromaurate,**  
 $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)]_2(\text{SO}_4)_2\text{AuBr}_4$   
 Sl sol in cold  $\text{H}_2\text{O}$ , insol in alcohol (Jorgensen)

— — **sulphate chloroplatinate,**  
 $[\text{Co}(\text{NH}_3)_4(\text{OH})]_2(\text{SO}_4)_2\text{PtCl}_6$   
 As the bromaurate (Jorgensen)

## Rubidium, $\text{Rb}_2$

Decomp  $\text{H}_2\text{O}$  with violence Insol in hydrocarbons Sol in liquid  $\text{NH}_3$  (Seely, C N 23 169), (Franklin, Am Ch J 1898, 20 829)

## Rubidium acetylide acetylene $\text{RbC}_2$ , $\text{C}_2\text{H}_2$

Very hygroscopic Insol in  $\text{CCl}_4$  and in ether (Moissan, C R 1903, 136 1220)

## Rubidium amalgam, $\text{RbHg}_{12}$

Stable in contact with  $\text{Hg}$  below  $0^\circ$  Above  $0^\circ$  the composition of the amalgam varies Can be cryst from  $\text{Hg}$  without decomp below  $0^\circ$  (Kerp, Z anorg 1900 25 68)

## Rubidium amide, $\text{RbNH}_2$

Very deliquescent Violently decomp by  $\text{H}_2\text{O}$ , less violently acted on by alcohol (Titherley, Chem Soc 1897, 71 470)

## Rubidium ammonia, $\text{RbNH}_3$

Decomp by  $\text{H}_2\text{O}$  Very sol in liquid  $\text{NH}_3$  (Moissan, C R 1903, 136 1178)

## Rubidium azoimide, $\text{RbN}_3$

Sl hygroscopic Stable in aq solution  
 107 1 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $16^\circ$   
 114 1 " " " 100 "  $\text{H}_2\text{O}$  "  $17^\circ$   
 0 182 " " " 100 " abs alcohol at  $16^\circ$

Insol in pure ether (Curtius, J pr 1898, (2) 58 281)

## Rubidium bromide, $\text{RbBr}$

100 pts  $\text{H}_2\text{O}$  dissolve 98 pts at  $5^\circ$ , 104.8 pts at  $16^\circ$  (Reissig, A 127 33)

Solubility in  $\text{H}_2\text{O}$

100 pts of the solution contain at

0  $5^\circ$  5  $0^\circ$  16  $0^\circ$   
 47 26 49 50 51 17 pts  $\text{RbBr}$

39  $7^\circ$  57  $5^\circ$  113  $5^\circ$   
 56 87 60 39 67 24 pts  $\text{RbBr}$

(Rumbach, B 1905, 38 1557)

Sp gr of  $\text{RbBr}$  containing g equiv  $\text{RbBr}$  per l

C equiv $\text{RbBr}$	Sp gr 6 / 6	Sp gr 18 / 18	Sp gr 30 / 30
0 508	1 06448	1 06389	1 06326
1 020	1 12931	1 12799	1 12626
2 031	1 25622	1 25366	1 25187
4 072	1 50574	1 50107	1 49870

(Clausen, W Ann 1914, (4) 44 1070)

RbBr+Aq containing 6.60% RbBr has  
sp gr  $20^{\circ}/20^{\circ}=1.0525$

RbBr+Aq containing 14.36% RbBr has  
sp gr  $20^{\circ}/20^{\circ}=1.1226$

(Le Blanc and Rohland, Z phys Ch 1896,  
19 279)

Sol in acetone (Eidmann, C C 1899,  
II 1014)

Difficultly sol in acetone (Naumann,  
B 1904, 37 4328)

Insol in methyl acetate (Naumann, B  
1909, 42 3790)

### Rubidium tribromide, RbBr<sub>3</sub>

Very sol in H<sub>2</sub>O, decomp by alcohol  
and ether (Wells and Wheeler, Sil Am J  
143 475)

### Rubidium ruthenium bromide

See Bromoruthenate and bromoruthenite,  
rubidium

### Rubidium selenium bromide

See Bromoselenate, rubidium

### Rubidium tellurium bromide

See Bromotellurate, rubidium

### Rubidium thallic bromide, RbBr, TlBr<sub>3</sub>+H<sub>2</sub>O

Recryst from H<sub>2</sub>O unchanged (Pratt,  
Am J Sci 1895, (3) 49 403)

3RbBr, TlBr<sub>3</sub>+H<sub>2</sub>O Very sol in H<sub>2</sub>O  
(Pratt)

### Rubidium stannic bromide

See Bromostannate, rubidium

### Rubidium bromochloride, RbBr<sub>2</sub>Cl

Easily decomp, even by H<sub>2</sub>O (Wells and  
Wheeler)

RbBrCl<sub>2</sub> Sol in H<sub>2</sub>O, decomp by alcohol  
and ether (Wells and Wheeler)

### Rubidium bromochloriodide, RbBrClI

Sol in H<sub>2</sub>O and alcohol Decomp by ether  
(Wells and Wheeler)

### Rubidium bromiodide, RbBr<sub>2</sub>I

Very sol in H<sub>2</sub>O Sat solution contains  
about 44% RbBr<sub>2</sub>I, and sp gr = 3.84 (Wells  
and Wheeler)

### Rubidium carbide, Rb<sub>2</sub>C<sub>2</sub>

Decomp violently by H<sub>2</sub>O (Moissan,  
C R 1903, 136 1221)

### Rubidium chloride, RbCl

100 pts H<sub>2</sub>O dissolve 76.38 pts at 1°, 82.89  
pts at 7° (Bunsen)

Solubility in H<sub>2</sub>O at t°  
100 pts of the solution contain pts RbCl

t°	Pts RbCl
0 4	43 61
15 5	46 56
57 3	53 71
114 9	59 48

(Rimbach, B 1902, 35 1304)

Solubility of RbCl in H<sub>2</sub>O at t°

t°	G RbCl per 100 g		t°	G RbCl per 100 g	
	H <sub>2</sub> O	Solution		H <sub>2</sub> O	Solution
0	77 0	43 5	60	115 5	53 6
10	84 4	45 8	70	121 4	54 8
20	91 1	47 7	80	127 2	56 0
30	97 6	49 4	90	133 1	57 1
40	103 5	50 9	100	138 9	58 9
50	109 3	52 2	112 9	146 6	59 5

(Berkeley, Phil Trans Roy Soc 1904, 203,  
A 189)

Sat RbCl+Aq at 25° contains 48.57%  
RbCl (Foote, Am Ch J 1906, 35 242)

Sp gr of RbCl+Aq containing in 100 pts  
H<sub>2</sub>O

13 14 25 88 33 13 pts RbCl  
1 1066 1 2156 1 2675 sp gr

(Tammann, W Ann 24 1885)

A normal solution of RbCl has sp gr at  
25° = 1.0610 (Wagner, Z phys Ch 1890,  
5 39)

RbCl+Aq containing 6.64% RbCl has  
sp gr  $20^{\circ}/20^{\circ}=1.0502$

RbCl+Aq containing 10.59% RbCl has  
sp gr  $20^{\circ}/20^{\circ}=1.0815$  (Le Blanc and Roh-  
land, Z phys Ch 1896, 19 278)

Sp gr  $20^{\circ}/4^{\circ}$  of a normal solution of RbCl  
= 1.085405 (Haigh, J Am Chem Soc  
1912, 34 1151)

Sp gr of RbCl+Aq sat at t°

t°	Sp gr	t°	Sp gr
0 55	1 4409	60 25	1 5558
18 7	1 4865	75 15	1 5746
31 5	1 5118	89 35	1 5905
44 7	1 5348	114*	1 6148

\* Boiling point

(Berkeley)

Sp gr of RbCl containing g equiv RbCl  
per l

G equiv RbCl	Sp gr 6°/6°	Sp gr 18°/18°	Sp gr 30°/30°
0 5123	1 06410	1 04538	1 04503
1 001	1 08916	1 08810	1 08749
2 073	1 18200	1 17959	1 17828
3 984	1 34334	1 33967	1 33757

(Clausen, W Ann 1914, (4) 44 1069)

Very sl sol in liquid  $\text{NH}_3$  (Franklin, Am J 1898, 20 829)

**Solubility in alcohols at 25°**

100 g methyl alcohol dissolve 1.41 g  
100 g ethyl alcohol dissolve 0.078 g  
100 g propyl alcohol dissolve 0.015 g  
100 g isoamyl alcohol dissolve 0.0025 g

(Turner and Bissett, Chem Soc 1913, 103 909)

Insol in anhydrous pyridine and in 97% pyridine + Aq. Very sl sol in 95% pyridine + Aq, sl sol in 93% pyridine + Aq (Kahnberg, J Am Chem Soc 1908, 30 1107). Insol in methyl acetate (Naumann, B 909, 42 3790), acetone, (Naumann, B 1904, 7 4329), (Eidmann, C C 1899, II 1014)

**rubidium ruthenium trichloride**

See Chlororuthenite, rubidium

**rubidium ruthenium tetrachloride**

See Chlororuthenate, rubidium

**rubidium oxyruthenium chloride,**  
 $\text{Rb}_2\text{RuO}_2\text{Cl}_4$

Ppt, decomp by  $\text{H}_2\text{O}$ , sol in cold HCl (Howe, J Am Chem Soc 1901, 23 779)

**rubidium tellurium chloride**

See Chlorotellurate, rubidium

**rubidium thallic chloride,**  $2\text{RbCl}$ ,  $\text{TiCl}_3 + \text{H}_2\text{O}$

Can be recryst from  $\text{H}_2\text{O}$  without change (Pratt, Am J Sci 1895, (3) 49 399)

$3\text{RbCl}$ ,  $\text{TiCl}_3$ . Crystallizes from HCl solution (Neumann, A 244 348)

+  $\text{H}_2\text{O}$ . Very sol in cold  $\text{H}_2\text{O}$  (Pratt, Am J Sci 1895, (3) 49 398)

+  $2\text{H}_2\text{O}$ . Efflorescent in dry air. Sol in 5 pts  $\text{H}_2\text{O}$  at 18°, and 16 pts at 100° (Godefroy, Zeitschr d allgem oesterr apotheker 1880 No 9)

**rubidium stannic chloride**

See Chlorostannate, rubidium

**rubidium titanium chloride,**  $2\text{RbCl}$ ,  $\text{TiCl}_3 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Stahler, B 1904, 37 4408)

**rubidium tungsten chloride,**  $\text{Rb}_4\text{W}_2\text{Cl}_6$

Sl sol in cold, more sol in hot  $\text{H}_2\text{O}$

Sol in very dil  $\text{NaOH} + \text{Aq}$

Nearly insol in most organic solvents (Olsson, B 1913, 46 574)

**rubidium uranous chloride,**  $\text{Rb}_2\text{UCl}_6$

As K salt (Aloy, Bull Soc 1899, (3) 21 64)

**Rubidium uranyl chloride,**  $2\text{RbCl}$ ,  $(\text{UO}_2)\text{Cl}_2 + 2\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$

100 pts of the solution contain at

24 8° 80 3°

57 8 65 73 pts  $\text{UO}_2\text{Cl}_2$ ,  $2\text{RbCl}$

(Rumbach, B 1904, 37 467)

**Rubidium vanadium chloride,**  $\text{Rb}_2\text{VCl}_5 + \text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  and alcohol

Decomp by  $\text{H}_2\text{O}$  on standing so that it dissolves (Stahler, B 1904, 37 4411)

**Rubidium zinc chloride,**  $2\text{RbCl}$ ,  $\text{ZnCl}_2$

Easily sol in  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq}$  (Godefroy, B 8 9)

**Rubidium chloride selenium dioxide,**  $\text{RbCl}$ ,  $2\text{SeO}_2 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Muthmann, B 1893, 26 1013)

**Rubidium chloriodide,**  $\text{RbCl}_2\text{I}$

Properties are similar to those of  $\text{RbBrClI}$  (Wells)

$\text{RbCl}_2\text{I}$ . Sol in alcohol, not attacked by ether (Wells and Wheeler, Sill Am J 144 42)

Sol in  $\text{POCl}_3$  (Walden, Z anorg 1900, 25 212)

Nearly insol in  $\text{AsBr}_3$  (Walden, Z anorg 1902, 29 374)

Very stable, sl sol in  $\text{H}_2\text{O}$  at 0°, only very sl sol in HCl (Erdmann, Arch Pharm 1894, 232 32) (C C 1894, I 670)

**Rubidium fluoride,**  $\text{RbF}$

Very sol in  $\text{H}_2\text{O}$  (Eggeling, Z anorg 1905, 46 174)

100 g  $\text{H}_2\text{O}$  dissolve 130.6 g  $\text{RbF}$  at 18° (de Forcrand, C R 1911, 152 1210)

Sol in dil HF (Pennington, J Am Chem Soc 1896, 18 57)

Insol in liquid  $\text{NH}_3$  (Core, Am Ch J 1898, 20 829)

**Rubidium hydrogen fluoride,**  $\text{RbF}$ , HF

Very deliquescent

Insol in alcohol and ether (Chabrie, C R 1905, 140 91)

Very hygroscopic. Sol in  $\text{H}_2\text{O}$  (Eggeling, Z anorg 1905, 46 175)

$\text{RbF}$ ,  $2\text{HF}$ . Very sl sol in  $\text{H}_2\text{O}$  (Eggeling, Z anorg 1905, 46 176)

**Rubidium silicon fluoride**

See Fluosilicate, rubidium

**Rubidium tantalum fluoride**

See Fluotantalate, rubidium

**Rubidium uranyl fluoride,**  $4\text{RbF}$ ,  $\text{UO}_2\text{F}_2 + 6\text{H}_2\text{O}$

(Ditte, C R 91 115)

**Rubidium hydride, RbH**

Decomp by  $H_2O$  with evolution of  $H_2$  (Moissan, C R 1903, 136 589)

**Rubidium hydroxide, RbOH**

Deliquescent, and very sol in  $H_2O$  Sol in alcohol (Bunsen)

Sat RbOH + Aq contains 64.17% RbOH at 15° (de Forcrand, C R 1909, 149 1344)

**Rubidium iodide, RbI**

100 pts  $H_2O$  dissolve 137.5 pts at 6.9°, 152 pts at 17.4° (Reissig, A 127 33)

Sat RbI + Aq at 25° contains 61.93% RbI (Foote and Chalker, Am Ch J 1908, 39 567)

Sp gr of RbI + Aq containing

	5%	10%	cold sat	hot sat
Sp gr	1.0353	1.0755	1.726	1.9629

(Erdmann, Arch Pharm 1894, 232 25)

Sp gr of RbI + Aq containing g equiv RbI per l,

G equiv RbI	Sp gr 6°/6°	Sp gr 18°/18°	Sp gr 30°/30°
0.510	1.08347	1.08268	1.08226
1.025	1.16751	1.16569	1.16433
2.025	1.33012	1.32637	1.32531
4.015	1.64781	1.64144	1.63780

(Lausen, W Ann 1914, (4) 44 1070)

Nearly insol in  $AsBr_3$  (Walden, Z anorg 1902, 29 374)

Sol in  $AsCl_3$  (Walden, Z anorg 1900, 25 214), liquid  $SO_2$  (Walden, Z anorg 1902, 30 161),  $S_2Cl_2$  (Walden, Z anorg 1900, 25 217),  $SO_2Cl_2$  (Walden),  $POCl_3$  (Walden)

Sol in methyl acetate (Naumann, B 1909, 42 3789)

Solubility in organic solvents at t°

C = pts by wt of RbI in 100 ccm of the sat solution

L = no of litres which at the saturation temp hold in solution 1 mol RbI

Solvent	t°	C	L
Furfural	25°	4.93	4.31
Acetonitrile	25°	1.350	15.73
"	0°	1.478	14.36
Propionitrile	25°	0.305	69.61
"	0°	0.274	77.48
Nitromethane	25°	0.518	41.00
"	0°	0.567	37.44
Acetone	25°	0.674	31.5
"	0°	0.960	22.1

(Walden, Z phys Ch 1906, 55 718)

**Rubidium triiodide, RbI<sub>3</sub>**

Very sol in  $H_2O$  Sol in about  $\frac{1}{2}$  pt  $H_2O$  at 20°, sol in alcohol Decomp by ether (Wells and Wheller, Sill Am J 143 475)

Solubility determinations show that RbI<sub>3</sub> is the only polyiodide of rubidium formed at 25° RbI<sub>7</sub> and RbI<sub>8</sub> mentioned by Abegg and Hamburger (Z anorg 50, 403) could not be obtained (Foote and Chalker, Am Ch J 1908, 39 567)

**Rubidium silver iodide, 2RbI, AgI**

Easily decomp by  $H_2O$  (Wells and Wheeler, Sill Am J 144 155)

RbI, AgI +  $\frac{1}{2}H_2O$  (Marsh, Chem Soc 1913, 103 783)

RbI, 2AgI Not deliquescent

Very sol in acetone (Marsh, Chem Soc 1913, 103 783)

**Rubidium tellurium iodide**

See Iodotellurate, rubidium

**Rubidium thallic iodide, RbI, TlI<sub>3</sub> + 2H<sub>2</sub>O**

Decomp by  $H_2O$  (Pratt, Am J Sci 1895, (3) 49 403)

**Rubidium nitride,**

Decomp by heat (Franz Fischer, B 1910, 43 1468)

See also Rubidium azonide

**Rubidium dioxide, RbO<sub>2</sub>**

Decomp by  $H_2O$  (Erdmann, A 1897, 294 68)

**Rubidium sulphide, Rb<sub>2</sub>S + 4H<sub>2</sub>O**

Deliquescent, very sol in  $H_2O$  (Biltz, Z anorg 1906, 48 299)

**Rubidium disulphide, Rb<sub>2</sub>S<sub>2</sub>**

Anhydrous

Sol in  $H_2O$

Very hygroscopic (Biltz, Z anorg 1906, 50 72)

+  $H_2O$  From Rb<sub>2</sub>S<sub>2</sub> + Aq

Hygroscopic (Biltz)

**Rubidium trisulphide, Rb<sub>2</sub>S<sub>3</sub>**

Anhydrous

Sol in  $H_2O$

Hygroscopic (Biltz, Z anorg 1906, 50 75)

+  $H_2O$  From Rb<sub>2</sub>S<sub>3</sub> + Aq (Biltz)

**Rubidium tetrasulphide, Rb<sub>2</sub>S<sub>4</sub> + 2H<sub>2</sub>O**

Sol in  $H_2O$  (Biltz, Z anorg 1906, 48 304)

**Rubidium pentasulphide, Rb<sub>2</sub>S<sub>5</sub>**

Deliquescent Decomp by  $H_2O$

Very easily sol in 70% alcohol

Insol in ether, ethyl sulphide or  $CHCl_3$  (Biltz, B 1905, 38 127)

**tubidium hydrogen sulphide, RbHS**

Deliquescent, very sol in  $H_2O$  (Biltz, anorg 1906, 48 300)

**tubidium copper tetrasulphide, RbCuS<sub>4</sub>**

Decomp very slowly in the air  
Sl sol in  $H_2O$   
Very slowly decomp by cold conc, more rapidly by hot conc, and still more rapidly by dil HCl,  $H_2SO_4$  and  $HNO_3$  Sl sol in alcohol (Biltz, B 1907, 40 978)

**Ruthenic acid****Barium ruthenate, BaRuO<sub>4</sub> + H<sub>2</sub>O**

Ppt (Debray and Joly, C R 106 1494)

**Calcium ruthenate, CaRuO<sub>4</sub>**

Ppt

**Magnesium ruthenate, MgRuO<sub>4</sub>**

Ppt

**Potassium ruthenate, K<sub>2</sub>RuO<sub>4</sub> + H<sub>2</sub>O**

Very sol in  $H_2O$

**Perruthenic acid****Potassium perruthenate, KRuO<sub>4</sub>**

Sl sol in  $H_2O$  (Debray and Joly, C R 106 1494)

**Sodium perruthenate, NaRuO<sub>4</sub> + H<sub>2</sub>O**

Sl sol in  $H_2O$

**Ruthenium, Ru**

Not attacked by acids, except aqua regia, which dissolves it only very slightly (Claus, Jogg 65 218)

**Ruthenium ammonium comps**

See Ruthenodiamine comps, etc

**Ruthenium tribromide, RuBr<sub>3</sub>**

Sol in  $H_2O$  Solution decomposes slowly on standing, but rapidly on heating (Gutbier, Z anorg 1905, 45 178)

**Ruthenium tribromide, ammonia,**

$2RuBr_3, 7NH_3$

Sol in  $H_2O$  and ammonia with slight warming

Insol in alcohol (Gutbier, Z anorg 1905, 45 182)

**Ruthenium dichloride, RuCl<sub>2</sub>**

Insol in acids, even in aqua regia Sl attacked by acids Traces are dissolved by boiling with conc KOH + Aq  
+  $H_2O$  Known only in aqueous solution (Claus, A 59 238)

**Ruthenium trichloride, RuCl<sub>3</sub>**

Deliquescent Sol in  $H_2O$  and alcohol, but solution is decomp by heating into  $Ru_2O_3$  and HCl (Claus)

Pure  $RuCl_3$  is insol in cold  $H_2O$ , mineral, or organic acids Slowly decomp by boiling  $H_2O$  Insol in  $CCl_4$ ,  $CS_2$ ,  $CHCl_3$ ,  $PCl_3$ , or ether Slowly sol in hot absolute alcohol, but decomp into  $Ru(OH)Cl_2$  by 95% alcohol (Joly, C R 114 292)

Hydroscopic

Sol in  $H_2O$ , decomp at 50°

Sol in alcohol (Gutbier, Z anorg 1905, 45 174)

See also Ruthenium nitrosochloride

**Ruthenium tetrachloride, RuCl<sub>4</sub>**

Sol in  $H_2O$  and alcohol (Claus)

**Ruthenium trichloride with MCl**

See Chlororuthenite, M

**Ruthenium tetrachloride with MCl**

See Chlororuthenate, M

**Ruthenium sesquihydroxide, Ru<sub>2</sub>O<sub>3</sub>H<sub>3</sub>**

Sol in acids, insol in alkalis Less sol in  $NH_4OH$  + Aq than any other oxide of the Pt metals (Claus)

**Ruthenium dihydroxide, RuO<sub>4</sub>H<sub>4</sub> + 3H<sub>2</sub>O**

Sol in acids and alkalis (Claus, A 59 237)

Contains NO Joly, C R 107 994)

**Ruthenium triiodide, RuI<sub>3</sub>**

Ppt (Claus)

Insol in  $H_2O$ , KI + Aq, and alcohol (Gutbier, Z anorg 1905, 45 181)

**Ruthenium triiodide ammonia,**

$2RuI_3, 7NH_3$

Sol in  $H_2O$  and ammonia with slight warming

Insol in alcohol (Gutbier, Z anorg 1905, 45 182)

**Ruthenium nitrosochloride, RuCl<sub>3</sub>(NO) + H<sub>2</sub>O, and 5H<sub>2</sub>O**

Slowly sol in cold, easily in hot  $H_2O$  (Joly, C R 108 855)

**Ruthenium dihydronitrosochloride,**

$NO Ru_2H_2Cl_3, 2HCl$

Sol in  $H_2O$  (Brizard, A ch 1900, (7) 21 353)

**Ruthenium silver nitrosochloride,**

$NO Ru_2H_2Cl_3, 2HCl, 3AgCl$

Ppt (Brizard, A ch 1900, (7) 21, 357)

**Ruthenium nitrososessquioxide, Ru<sub>2</sub>O<sub>3</sub>(NO)<sub>2</sub> + 2H<sub>2</sub>O**

Ppt (Joly, C R 108 854)

**Ruthenium dihydronitrosohydroxide,**  
 $\text{NO Ru}_2\text{H}_2(\text{OH})_2 + 2\text{H}_2\text{O}$ 

Sl sol in cold  $\text{H}_2\text{O}$  with decomp (Brizard, A ch 1900, (7) 21 349)

**Ruthenium dihydronitrosooxychloride,**  
 $\text{NO Ru}_2\text{H}_2\text{Cl}_2\text{OH} + 2\text{H}_2\text{O}$ 

Ppt (Brizard, A ch 1900, (7) 21 349)

**Ruthenium monoxide, RuO**

Insol in acids (Claus, A 59 236)

**Ruthenium sesquioxide, Ru<sub>2</sub>O<sub>3</sub>**

Insol in acids Mixture of Ru and RuO<sub>2</sub> (Debray and Joly, C R 106 1494)

See Ruthenium nitrosos sesquioxide

**Ruthenium dioxide, RuO<sub>2</sub>**

Insol in acids (Debray and Joly)

**Ruthenium trioxide, RuO<sub>3</sub>**

"Ruthenic acid" Known only in its salts

**Ruthenium tetroxide, RuO<sub>4</sub>**

Rather difficultly and slowly sol in  $\text{H}_2\text{O}$  (Claus)

Decomp in aqueous solution into Ru<sub>2</sub>O<sub>3</sub> + 2H<sub>2</sub>O (Debray and Joly)

**Ruthenium pentoxide, Ru<sub>2</sub>O<sub>5</sub>**

(Debray and Joly, C R 106 1494)

+ 2H<sub>2</sub>O Ppt (Debray and Joly)

**Ruthenium heptoxide, Ru<sub>2</sub>O<sub>7</sub>**

"Perruthenic acid" Known only in its salts

**Ruthenium oxide, Ru<sub>4</sub>O<sub>9</sub>**

(Debray and Joly)

**Ruthenium oxychloride, Ru(OH)Cl<sub>2</sub>**

Very sol in  $\text{H}_2\text{O}$ , but decomp by an excess (Joly, C R 114 293)

**Ruthenium silicide, RuSi**

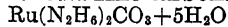
Insol in boiling acids, slowly attacked by a mixture of fused  $\text{KHSO}_4$  and  $\text{KNO}_3$  (Moissan, C R 1903, 137 231)

**Ruthenium trisulphide, RuS<sub>3</sub>**

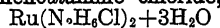
Ppt (Antony, Gazz ch 1900, 30 539)

**Ruthenomonamine hydroxide,**

See Ruthenosamine hydroxide

**Ruthenodiamine carbonate,**

Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol (Claus)

**Ruthenodiamine chloride,**

Not very sol in cold, easily sol in hot  $\text{H}_2\text{O}$   
Insol in alcohol

See Ruthenonitrosodiamine comps

— mercuric chloride,  $\text{Ru}(\text{N}_2\text{H}_5\text{Cl})_2, \text{HgCl}_2$

Nearly insol in cold, sol in hot  $\text{H}_2\text{O}$  (Gibbs, Sill Am J (2) 34, 350)

— chloroplatinate,  $\text{Ru}(\text{N}_2\text{H}_5\text{Cl})_2, \text{PtCl}_4$

Sl sol in  $\text{H}_2\text{O}$  (Claus)

— hydroxide,  $\text{Ru}(\text{N}_2\text{H}_5\text{OH})_2$

Known only in aqueous solution

— nitrate,  $\text{Ru}(\text{N}_2\text{H}_5\text{NO}_3)_2 + 2\text{H}_2\text{O}$

Somewhat difficultly sol in cold, easily in hot  $\text{H}_2\text{O}$  Insol in alcohol

— sulphate,  $\text{Ru}(\text{N}_2\text{H}_5)_2\text{SO}_4 + 4\text{H}_2\text{O}$

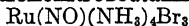
Moderately sol in  $\text{H}_2\text{O}$  Insol in alcohol (Claus)

**Ruthenocyanhydric acid, H<sub>4</sub>Ru(CN)<sub>8</sub>**

Easily sol in  $\text{H}_2\text{O}$  and alcohol Less sol in ether (Claus, J B 1855 444)

**Potassium ruthenocyanide, K<sub>4</sub>Ru(CN)<sub>8</sub> + 3H<sub>2</sub>O**

Sl efflorescent Very sol in  $\text{H}_2\text{O}$ , sl sol in dil alcohol (Claus)

**Ruthenonitrosodiamine bromide,**

Sl sol in  $\text{H}_2\text{O}$  (Joly, C R 111 969)

$\text{Ru}(\text{NO})\text{OH}(\text{NH}_3)_4\text{Br}_2$  Less sol than corresponding chloride (Joly, C R 108 300)

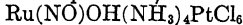
— chloride,  $\text{Ru}(\text{NO})(\text{NH}_3)_4\text{Cl}_3$

Sl sol in  $\text{H}_2\text{O}$  (Joly, C R 111 969)

$\text{Ru}(\text{NO})\text{OH}(\text{NH}_3)_4\text{Cl}_2$  Sol in  $\text{H}_2\text{O}$  (Joly, C R 108 1300)

$\text{Ru}(\text{NO})(\text{NH}_3)_4\text{Cl}_3 + 2\text{H}_2\text{O} = \text{Ru}(\text{NO})\text{OH}(\text{NH}_3)_4\text{Cl}_2, \text{HCl} + \text{H}_2\text{O}$  (?)  
Very sol in  $\text{H}_2\text{O}$  (Joly, C R 111 969)

— chloroplatinate,



Scarcely sol in boiling  $\text{H}_2\text{O}$  (Joly, C R 108 1300)

$\text{Ru}(\text{NO})(\text{NH}_3)_4\text{Cl}_3, \text{PtCl}_4$  Ppt (Joly, C R 111 969)

— iodide,  $\text{Ru}(\text{NO})(\text{NH}_3)_4\text{I}_3$

Sl sol in  $\text{H}_2\text{O}$  (Joly, C R 111 969)

$\text{Ru}(\text{NO})\text{OH}(\text{NH}_3)_4\text{I}_2$  Less sol than the corresponding bromide (Joly, C R 108 1300)

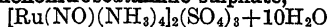
— nitrate,  $\text{Ru}(\text{NO})(\text{NH}_3)_4(\text{NO}_3)_3$

More sol in  $\text{H}_2\text{O}$  than

$\text{Ru}(\text{NO})\text{OH}(\text{NH}_3)_4(\text{NO}_3)_2$  (Joly, C R 111 969)

$\text{Ru}(\text{NO})\text{OH}(\text{NH}_3)_4(\text{NO}_3)_2$  Sl sol in cold  $\text{H}_2\text{O}$ , insol in conc  $\text{HNO}_3 + \text{Aq}$  (Joly, C R 108 1300)

**Ruthenonitrosodiamine sulphate,**



Sl sol in  $\text{H}_2\text{O}$  (Joly, C R 111 969)

$[\text{Ru}(\text{NO})(\text{NH}_3)_4]_2(\text{SO}_4)_3 \cdot \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$  Decomp by cold  $\text{H}_2\text{O}$  (Joly)

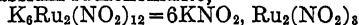
$\text{Ru}(\text{NO})(\text{OH})(\text{NH}_3)_4\text{SO}_4 + \text{H}_2\text{O}$  Most sol in  $\text{H}_2\text{O}$  of this class of salts (Joly, C R 108 1300)

**Ruthenonitrous acid**

**Ammonium ruthenonitrite,**  $\text{RuH}_2(\text{NO}_2)_4 \cdot 3\text{NH}_4\text{NO}_2 + 2\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$ , practically insol in  $\text{KCl} + \text{Aq}$  (Brizard, A ch 1900, (7) 21 368)

**Potassium ruthenonitrite,**



Easily sol in  $\text{H}_2\text{O}$ , alcohol, or ether (Gibbs, Sill Am J (2), 34 344)

Sl sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{KNO}_2 + \text{Aq}$  (Claus)

$\text{K}_4\text{Ru}_2(\text{NO}_2)_{10} = \text{Ru}_2\text{O}_2(\text{N}_2\text{O}_3)_3, 4\text{KNO}_2$  Very sol in  $\text{H}_2\text{O}$  (Joly and Vèzes, C R 109 367)

$\text{K}_8\text{Ru}_5(\text{NO}_2)_{14} = \text{Ru}_2\text{O}_2(\text{N}_2\text{O}_3)_2, 8\text{KNO}_2$  Sl sol in  $\text{H}_2\text{O}$  Sol in cold dil acids (Joly and Vèzes)

$\text{Ru}_2\text{H}_2(\text{NO}_2)_4, 3\text{KNO}_2 + 4\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  Aqueous solution decomp sl on ong boiling Almost insol in conc  $\text{KCl} + \text{Aq}$  (Brizard, C R 1899, 129 216)

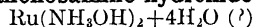
**silver ruthenonitrite,**  $\text{NO Ru}_2\text{H}_2(\text{NO}_2)_4, 3\text{AgNO}_2 + 2\text{H}_2\text{O}$

Ppt (Brizard, A ch 1900, (7) 21 368)

**Sodium ruthenonitrite,**  $\text{Ru}_2(\text{NO}_2)_6, 4\text{NaNO}_2 + 4\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  without decomp (Joly, C R 1894, 118 469)

**Ruthenosamine hydroxide,**



Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Claus)

**Samarium, Sm**

The element has not been isolated

**Samarium bromide,**  $\text{SmBr}_3 + 6\text{H}_2\text{O}$

Very deliquescent (Cleve)

**Samarium carbide,**  $\text{SmC}_2$

Decomp by water and acids (Moissan, C R 1900, 131 925)

**Samarium dichloride,**  $\text{SmCl}_2$

Decomp by  $\text{H}_2\text{O}$  with liberation of  $\text{H}_2$  and formation of samarium oxide and samarium oxychloride Insol in  $\text{CS}_2$ ,  $\text{CHCl}_3$ , benzene, abs alcohol, pyridine and toluene (Matignon, C R 1906, 142 85)

**Samarium trichloride,**  $\text{SmCl}_3$

The anhydrous salt is very hygroscopic and easily sol in  $\text{H}_2\text{O}$  (Matignon, C R 1902, 134 1309)

Very sol in  $\text{H}_2\text{O}$  Very sol in abs alcohol 6.38 g are sol in 100 grams pyridine at ord temp, insol in quinoline (Matignon, A ch 1906, (8) 8 406)

$+3\text{H}_2\text{O}$  Deliquescent

**Samarium chloride ammonia,**  $\text{SmCl}_3 + \text{NH}_3, +2\text{NH}_3, +3\text{NH}_3, +4\text{NH}_3, +5\text{NH}_3, +8\text{NH}_3, +9.5\text{NH}_3, +11.5\text{NH}_3$

(Matignon, C R 1905, 140 143)

**Samarium fluoride,**  $\text{SmF}_3 + \frac{1}{2}\text{H}_2\text{O}$

Precipitate Insol in  $\text{H}_2\text{O}$  and dil acids, (Cleve)

**Samarium iodide,**  $\text{SmI}_3$

(Matignon, A ch 1906, (8) 8 413)

**Samarium hydroxide,**  $\text{Sm}_2(\text{OH})_8$

Insol in alkalis, easily sol in acids, and decomposes ammonium salts (Cleve, C N 51 145)

**Samarium oxide,**  $\text{Sm}_2\text{O}_3$

Easily sol in acids (Cleve, C N 51 145)

**Samarium peroxide,**  $\text{Sm}_4\text{O}_9$

Precipitate (Cleve)

**Samarium oxychloride,**  $\text{SmOCl}$

(Matignon, A ch 1906, (8) 8 412)

**Samarium sulphide,**  $\text{Sm}_2\text{S}_3$

(Matignon, A ch 1906, (8) 8 415)

**Scandium, Sc**

Element has not been isolated

**Scandium bromide,**  $\text{Sc}_2\text{Br}_6 + 3\text{H}_2\text{O}$ , and  $+12\text{H}_2\text{O}$

(Crookes, Roy Soc Proc 1908, 80 A, 518)

**Scandium chloride,**  $\text{Sc}_2\text{Cl}_6 + 3\text{H}_2\text{O}$ , and  $+12\text{H}_2\text{O}$

(Crookes, Roy Soc Proc 1908, 80 A, 518)

**Scandium hydroxide**

Easily sol in conc  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$  (Crookes, Roy Soc Proc 1908, 80 A, 518)



**Scandium oxide,  $\text{Sc}_2\text{O}_3$** 

Easily sol by boiling with conc  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$

**Scandium sulphide,  $\text{Sc}_2\text{S}_3$** 

Decomp by  $\text{H}_2\text{O}$  and by acids with evolution of  $\text{H}_2\text{S}$  (Wirth, Z anorg 1914, 87 5)

**Selenantimonic acid****Sodium selenantimonate,  $\text{Na}_3\text{SbSe}_4 + 9\text{H}_2\text{O}$** 

Sol in 2 pts cold  $\text{H}_2\text{O}$  Insol in alcohol (Hofacker, A 107 6)

Sl sol in  $\text{H}_2\text{O}$ , unstable (Pouget, A ch 1899, (7) 18 562)

**Selenantimonous acid****Potassium orthoselenantimonite,  $\text{K}_2\text{SbSe}_3$** 

Ppt Decomp by  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 560)

**Potassium paraselenantimonite,  $\text{K}_2\text{Sb}_2\text{Se}_7 + 3\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$ , unstable (Pouget, A ch 1899, (7) 18 560)

**Sodium orthoselenantimonite,  $\text{Na}_3\text{SbSe}_3 + 9\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  Aqueous solution on standing deposits red crystals of sodium selenantimonate,  $\text{Na}_3\text{SbSe}_4 + 9\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 562)

**Sodium paraselenantimonite,  $\text{Na}_2\text{Sb}_2\text{Se}_7$** 

(Pouget, A ch 1899, (7) 18 561)

**Selenic acid,  $\text{H}_2\text{SeO}_4$** 

Very sol in  $\text{H}_2\text{O}$  with evolution of heat

If aqueous solution is evaporated at temp of  $165^\circ$ , acid has 2 524 sp gr, at temp of  $267^\circ$ , acid has 2 60 sp gr, at temp of  $285^\circ$ , acid has 2 625 sp gr Decomp to  $\text{H}_2\text{SeO}_3$  at higher temp (Mitscherlich, Pogg 9 623)

By evaporation at  $265^\circ$ , acid of 2 609 sp gr containing 95%  $\text{H}_2\text{SeO}_4$  is obtained. If brought at same temp in vacuo over  $\text{H}_2\text{SO}_4$ , acid of 2 627 sp gr with 97 5%  $\text{H}_2\text{SeO}_4$  is obtained (Fabian, A Suppl 1 243)

**Sp gr of  $\text{H}_2\text{SeO}_4 + \text{Aq}$** 

% $\text{H}_2\text{SeO}_4$	Sp gr	% $\text{H}_2\text{SeO}_4$	Sp gr
99 73	2 6083	90 0	2 3848
99 50	2 6051	89 0	2 3568
99 00	2 6975	88 0	2 3291
98 5	2 5863	87 0	2 3061
98 0	2 5767	86 0	2 2795
97 5	2 5695	85 0	2 5558
97 0	2 5601	84 0	2 2258
96 0	2 5388	83 0	2 1946
95 0	2 5163	82 0	2 1757
94 0	2 4925	81 0	2 1479
93 0	2 4596	80 0	2 1216
92 0	2 4322	79 0	2 0922
91 0	2 4081	73 50	1 9675

**Sp gr of  $\text{H}_2\text{SeO}_4 + \text{Aq}$  at  $20^\circ$  compared with**

$\text{H}_2\text{O}$  at  $4^\circ$

Wts corrected to vacuum

Sp gr	% $\text{H}_2\text{SeO}_4$	Sp gr	% $\text{H}_2\text{SeO}_4$	Sp gr	% $\text{H}_2\text{SeO}_4$
1 000		1 295	32 64	1 590	54 62
1 005	0 9	1 300	33 08	1 595	54 92
1 010	1 56	1 305	33 50	1 600	55 28
1 015	2 12	1 310	33 92	1 605	55 62
1 020	2 92	1 315	34 36	1 610	55 96
1 025	3 62	1 320	34 82	1 615	56 30
1 030	4 16	1 325	35 26	1 620	56 60
1 035	4 70	1 330	35 72	1 625	56 88
1 040	5 32	1 335	36 10	1 630	57 20
1 045	6 08	1 340	36 43	1 635	57 48
1 050	6 66	1 345	36 88	1 640	57 70
1 055	7 34	1 350	37 34	1 645	58 04
1 060	7 92	1 355	37 80	1 650	58 47
1 065	8 56	1 360	38 24	1 655	58 86
1 070	9 20	1 365	38 66	1 660	59 24
1 075	9 82	1 370	39 10	1 665	59 56
1 080	10 44	1 375	39 50	1 670	59 74
1 085	11 02	1 380	39 98	1 675	59 94
1 090	11 62	1 385	40 06	1 680	60 18
1 095	12 20	1 390	40 66	1 685	60 36
1 100	12 88	1 395	41 10	1 690	60 58
1 105	13 58	1 400	41 56	1 695	60 80
1 110	14 14	1 405	41 98	1 700	61 06
1 115	14 66	1 410	42 36	1 705	61 36
1 120	15 20	1 415	42 78	1 710	61 64
1 125	15 74	1 420	43 16	1 715	61 90
1 130	16 32	1 425	43 56	1 720	62 24
1 135	16 86	1 430	43 94	1 725	62 48
1 140	17 38	1 435	44 32	1 730	62 76
1 145	17 90	1 440	44 52	1 735	63 06
1 150	18 44	1 445	45 00	1 740	63 32
1 155	18 92	1 450	45 32	1 745	63 60
1 160	19 48	1 455	45 68	1 750	63 86
1 165	20 02	1 460	46 04	1 755	64 04
1 170	20 58	1 465	46 36	1 760	64 24
1 175	21 08	1 470	46 70	1 765	64 42
1 180	21 60	1 475	47 01	1 770	64 62
1 185	22 22	1 480	47 32	1 775	64 84
1 190	22 66	1 485	47 66	1 780	65 06
1 195	23 18	1 490	47 98	1 785	65 28
1 200	23 70	1 495	48 28	1 790	65 48
1 205	24 26	1 500	48 54	1 795	65 66
1 210	24 84	1 505	48 92	1 800	65 90
1 215	25 30	1 510	49 30	1 805	66 12
1 220	25 84	1 515	49 68	1 810	66 36
1 225	26 30	1 520	50 02	1 815	66 64
1 230	26 84	1 525	50 34	1 820	66 90
1 235	27 28	1 530	50 68	1 825	67 16
1 240	27 70	1 535	51 04	1 830	67 46
1 245	28 18	1 540	51 38	1 835	67 72
1 250	28 58	1 545	51 66	1 840	68 02
1 255	29 06	1 550	51 98	1 845	68 30
1 260	29 44	1 555	52 28	1 850	68 50
1 265	29 82	1 560	52 56	1 855	68 70
1 270	30 26	1 565	52 88	1 860	68 92
1 275	30 76	1 570	53 28	1 865	69 12
1 280	31 26	1 575	53 56	1 870	69 34
1 285	31 74	1 580	53 94	1 875	69 56
1 290	32 18	1 585	54 30	1 880	69 72

(Cameron and Macallan, Lond R Soc Proc

Sp gr of  $\text{H}_2\text{SeO}_4 + \text{Aq}$ —Concluded

Sp	gr	% $\text{H}_2\text{SeO}_4$	Sp	gr	% $\text{H}_2\text{SeO}_4$	Sp	gr	% $\text{H}_2\text{SeO}_4$
1	85	69 94	2	125	80 25	2	365	89 14
1	90	70 14	2	130	80 42	2	370	89 30
1	95	70 38	2	135	80 68	2	375	89 48
1	00	70 64	2	140	80 74	2	380	89 60
1	05	70 78	2	145	80 96	2	385	89 72
1	10	71 00	2	150	81 14	2	390	89 84
1	15	71 21	2	155	81 36	2	395	89 96
1	20	71 38	2	160	81 60	2	400	90 10
1	25	71 68	2	165	81 80	2	405	90 20
1	30	72 00	2	170	82 02	2	410	90 30
1	35	72 38	2	175	82 22	2	415	90 46
1	40	72 66	2	180	82 44	2	420	90 74
1	45	72 88	2	185	82 64	2	425	91 00
1	50	73 12	2	190	82 78	2	430	91 24
1	55	73 34	2	195	82 96	2	435	91 46
1	60	73 54	2	200	83 10	2	440	91 70
1	65	73 74	2	205	83 24	2	445	92 00
1	70	73 98	2	210	83 44	2	450	92 28
1	75	74 22	2	215	83 62	2	455	92 56
1	80	74 44	2	220	83 78	2	460	92 85
1	85	74 66	2	225	83 96	2	465	93 02
1	90	74 86	2	230	84 14	2	470	93 20
1	95	75 08	2	235	84 30	2	475	93 36
2	00	75 28	2	240	84 48	2	480	93 68
2	05	75 46	2	245	84 60	2	485	94 02
2	10	75 66	2	250	84 82	2	490	94 32
2	15	75 88	2	255	85 02	2	495	94 48
2	20	76 06	2	260	85 26	2	500	94 64
2	25	76 14	2	265	85 44	2	505	94 80
2	30	76 48	2	270	85 60	2	510	94 96
2	35	76 68	2	275	85 78	2	515	95 32
2	40	76 84	2	280	85 96	2	520	95 58
2	45	77 08	2	285	86 16	2	525	95 86
2	50	77 36	2	290	86 38	2	530	96 10
2	55	77 50	2	295	86 60	2	535	96 41
2	60	77 62	2	300	86 82	2	540	96 68
2	65	77 80	2	305	87 04	2	545	96 92
2	70	78 06	2	310	87 26	2	550	97 12
2	75	78 24	2	315	87 46	2	555	97 30
2	80	78 48	2	320	87 66	2	560	97 48
2	85	78 68	2	325	87 84	2	565	97 68
2	90	78 84	2	330	88 00	2	570	97 94
2	95	79 08	2	335	88 18	2	575	98 20
2	00	79 28	2	340	88 34	2	580	98 46
2	05	79 50	2	345	88 48	2	585	98 70
2	10	79 68	2	350	88 66	2	590	99 04
2	15	79 90	2	355	88 82	2	595	99 36
2	20	80 10	2	360	88 98			

(L mer and Lenher J phys Chem 1909, 13 509)

sol in conc or fuming  $\text{H}_2\text{SO}_4$   
 sol in liquid  $\text{NH}_3$  (Franklin, Am Ch  
 J 898, 20 830)  
 recomb by alcohol  
 $\text{H}_2\text{O}$  (Cameron and Macallan, C N  
 59 232)  
 $2\text{H}_2\text{O}$ , and  $+6\text{H}_2\text{O}$  (?) (C and M)  
 $4\text{H}_2\text{O}$  (Kremann and Hofmeier, M  
 19 3, 29 1117)

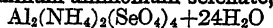
## Selenates

All the neutral and acid salts of  $\text{H}_2\text{SeO}_4$  are sol in  $\text{H}_2\text{O}$ , except  $\text{BaSeO}_4$ ,  $\text{SrSeO}_4$ ,  $\text{CaSeO}_4$ , and  $\text{PbSeO}_4$ , which are nearly or quite insol in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$

Aluminum selenate,  $\text{Al}_2(\text{SeO}_4)_3$ 

Resembles in every way aluminum sulphate (Berzelius)

## Aluminum ammonium selenate,



More sol in  $\text{H}_2\text{O}$  than the corresponding sulphate (Wohllwill, A 114 191)

Aluminum caesium selenate,  $\text{Al}_2\text{Cs}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ 

(Peterson, B 9 1563)

Much more sol in  $\text{H}_2\text{O}$  than the corresponding sulphate (Fabre, C R 105 114)

Aluminum potassium selenate,  $\text{Al}_2\text{K}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ 

More sol in  $\text{H}_2\text{O}$  than common alum (Weber, Pogg 108 615)

Aluminum rubidium selenate,  $\text{Al}_2\text{Rb}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ 

(Peterson, B 9 1563)

Much more sol in  $\text{H}_2\text{O}$  than the corresponding sulphate (Fabre, C R 105 114)

Aluminum sodium selenate,  $\text{Al}_2\text{Na}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ 

Sl efflorescent Very sol in  $\text{H}_2\text{O}$  (Wohllwill, A 114 191)

Aluminum thallium sulphate,  $\text{Al}_2\text{Tl}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  (Fabre, C R 105 114)

Aluminum selenate potassium sulphate,  $\text{Al}_2(\text{SeO}_4)_3, \text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  (v Gerichten, A 168 222)

Ammonium selenate,  $(\text{NH}_4)_2\text{SeO}_4$ 

Easily sol in  $\text{H}_2\text{O}$

100 g  $\text{H}_2\text{O}$  dissolve 117 g  $(\text{NH}_4)_2\text{SeO}_4$  at  $7^\circ$ , 164 g at  $59^\circ$ , 197 g at  $100^\circ$  (Tutton, Proc Roy Soc 1907, 79, A 351)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 826)

Ammonium hydrogen selenate,  $\text{NH}_4\text{HSeO}_4$ 

Sol in  $\text{H}_2\text{O}$  (Topsoe)

Ammonium cadmium selenate,  $(\text{NH}_4)_2\text{SeO}_4, \text{CdSeO}_4 + 2\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  (Topsoe, W A B 66, 2 2)

$+6\text{H}_2\text{O}$  Efflorescent Very easily sol in  $\text{H}_2\text{O}$  (Topsoe)

**Ammonium cerous selenate,**  
 $(\text{NH}_4)_2\text{Ce}_2(\text{SeO}_4)_4 + 9\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  (Jolin)

**Ammonium chromium selenate,**  
 $(\text{NH}_4)_2\text{Cr}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Fabre, C R 105 114)

**Ammonium cobaltous selenate,**  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{CoSeO}_4 + 6\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  (Topsoë)

**Ammonium cupric selenate,**  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{CuSeO}_4 + 6\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Topsoë)

**Ammonium didymium selenate,**  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{D}_{12}(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  (Cleve)  
 $+10\text{H}_2\text{O}$  (Cleve, Bull Soc (2) 43 363)

**Ammonium erbium selenate,**  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{Er}_2(\text{SeO}_4)_3 + 4\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  (Cleve)

**Ammonium ferrous selenate,**  $(\text{NH}_4)_2\text{Fe}(\text{SeO}_4)_2$   
 $+6\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  (Topsoë)  
 $+2\text{H}_2\text{O}$

**Ammonium lanthanum selenate,**  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{La}_2(\text{SeO}_4)_3 + 9\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Cleve)

**Ammonium magnesium selenate,**  
 $(\text{NH}_4)_2\text{Mg}(\text{SeO}_4)_2 + 6\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  (Topsoë)

**Ammonium manganous selenate,**  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{MnSeO}_4 + 6\text{H}_2\text{O}$   
 Not deliquescent Easily sol in  $\text{H}_2\text{O}$   
 (Topsoë)

**Ammonium nickel selenate,**  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{NiSeO}_4 + 6\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Topsoë)

**Ammonium samarium selenate,**  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{Sm}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  (Cleve)

**Ammonium thallium selenate,**  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{Tl}_2(\text{SeO}_4)_3 + 8\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Fortin, C C 1903, II 706)

**Ammonium uranyl selenate,**  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $(\text{UO}_2)_2\text{SeO}_4 + 2\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  (Sendtner)

**Ammonium yttrium selenate,**  $(\text{NH}_4)_2\text{SeO}_4$ ,  
 $\text{Y}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$   
 Very sol in  $\text{H}_2\text{O}$  (Cleve)

**Ammonium zinc selenate,**  
 $(\text{NH}_4)_2\text{SeO}_4, \text{ZnSeO}_4 + 6\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Topsoë)

**Antimony selenate**  
 Insol in  $\text{H}_2\text{O}$  Not very sol in acids Sol  
 in  $\text{H}_2\text{SeO}_4$  (Cameron and Macallan)

**Barium selenate,**  $\text{BaSeO}_4$   
 Somewhat more sol in  $\text{H}_2\text{O}$  and dil acids  
 than  $\text{BaSO}_4$  (Rose) 100 ccm  $\text{H}_2\text{O}$  dissolve  
 11.8 mg in the cold, and 13.8 mg at  $100^\circ$   
 (Petersson, Z anal 12 287)  
 Not decomp by  $\text{H}_2\text{SO}_4$  Insol in  $\text{HNO}_3$  +  
 Aq (Berzeli) but decomp by solution of  
 alkalis at ordinary temp  
 Very slowly decomp by  $\text{HCl}$  + Aq (Rose,  
 Pogg 95 426)

**Bismuth selenate**  
 Insol in, and not decomp by cold or hot  
 $\text{H}_2\text{O}$  (Cameron and Macallan)

**Cæsium selenate,**  $\text{Cs}_2\text{SeO}_4$   
 Sol in  $\text{H}_2\text{O}$  (Petersson, B 9 1561)  
 100 g  $\text{H}_2\text{O}$  at  $12^\circ$  dissolve 244.8 g  $\text{Cs}_2\text{SeO}_4$   
 (Tutton, Chem Soc 1897, 71 850)  
 Sp gr of  $\text{Cs}_2\text{SeO}_4$  + Aq at  $20^\circ$  compared  
 with  $\text{H}_2\text{O}$  at  $4^\circ$ , containing  

% $\text{Cs}_2\text{SeO}_4$	45.94	53.43
Sp gr	1.5841	1.7432

 (Tutton)

**Cæsium hydrogen selenate,**  $\text{CsHSeO}_4$   
 Ppt Very hygroscopic (Norris, Am Ch  
 J 1901, 26 322)

**Cæsium chromic selenate,**  $\text{Cs}_2\text{Cr}_2(\text{SeO}_4)_4 +$   
 $24\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Fabre, C R 105 114)

**Cæsium cobaltous selenate,**  $\text{Cs}_2\text{Co}(\text{SeO}_4)_2 +$   
 $6\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Topsoë)

**Cæsium indium selenate,**  $\text{CsIn}(\text{SeO}_4)_2 +$   
 $12\text{H}_2\text{O}$   
 Efflorescent, sol in  $\text{H}_2\text{O}$  (Mathews, J  
 Am Chem Soc 1908, 30 215)

**Cæsium iron (ferric) selenate,**  $\text{Cs}_2\text{Fe}_2(\text{SeO}_4)_3$   
 $+24\text{H}_2\text{O}$   
 Sl sol in  $\text{H}_2\text{O}$  (Roncigholo, Gazz cl  
 it 1905, 35 (2) 553)

**Cæsium magnesium selenate,**  $\text{Cs}_2\text{MgSeO}_4 +$   
 $6\text{H}_2\text{O}$   
 (Tutton, Chem Soc 1905, 87, 1163)

**Cæsium zinc selenate,**  $\text{Cs}_2\text{Zn}(\text{SeO}_4)_2 + 6\text{H}_2\text{O}$   
 (Tutton, Zeit Kryst 1900, 33 14)

**Cadmium selenate**,  $\text{CdSeO}_4 \cdot 2\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  (v Hauer, W A B 39 2 3)

**Cadmium potassium selenate**,  $\text{CdSeO}_4 \cdot \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$ , can be recrystallized without comp (v Hauer, W A B 54 209)

**Calcium selenate**,  $\text{CaSeO}_4 \cdot 2\text{H}_2\text{O}$   
Less sol in hot than in cold  $\text{H}_2\text{O}$  (v Hauer, J pr 80 214)  
Sat  $\text{CaSeO}_4 + \text{Aq}$  contains at  
- 1° +5° 20° 37° 67°  
4 73 76 68 51%  $\text{CaSeO}_4$   
(Etard, A ch 1894, (7) 2 551)

**Chrous selenate**,  $\text{Ce}_2(\text{SO}_4)_3 \cdot 6\text{H}_2\text{O}$ ,  $9\text{H}_2\text{O}$ , or  $12\text{H}_2\text{O}$   
More sol in cold than hot  $\text{H}_2\text{O}$  (Jolin)  
+4 $\text{H}_2\text{O}$  Very easily in cold, sl sol in hot  
F O (Cingolani, C C 1908, I 1606)  
Stable above 100°  
+5 $\text{H}_2\text{O}$  Stable at 92–100°  
+7 $\text{H}_2\text{O}$  Stable at 80–92°  
+8 $\text{H}_2\text{O}$  Stable at 50–78°  
+10 $\text{H}_2\text{O}$  Stable at 34–40°  
+11 $\text{H}_2\text{O}$  Stable at 12–28°  
+12 $\text{H}_2\text{O}$  Stable at 0–12° (Cingolani, C A 1908 2658)

Solubility of  $\text{Ce}_2(\text{SeO}_4)_3$  in  $\text{H}_2\text{O}$  at t°  
(salt calculated as anhydrous  $\text{Ce}_2(\text{SO}_4)_3$  dissolved in 100 cc  $\text{H}_2\text{O}$ )

	$\text{Usng}$ $\text{Ce}_2(\text{SeO}_4)_3$ +11 $\text{H}_2\text{O}$	$\text{Usng}$ $\text{Ce}_2(\text{SeO}_4)_3$ +4 $\text{H}_2\text{O}$	t	$\text{Usng}$ $\text{Ce}_2(\text{SeO}_4)_3$ +11 $\text{H}_2\text{O}$	$\text{Usng}$ $\text{Ce}_2(\text{SeO}_4)_3$ +4 $\text{H}_2\text{O}$
		39 55	60°	13 68	
1 6	37		60 8		13 12
1 6		36 9	78 2	5 52	
2 6	33 84		80 5		4 56
2 8		33 2	91	2 02	
3 2	33 15		95 4	1 53	
4 6	32 16		95		1 785
4 9		31 89	100		2 513

(Cingolani, I c)

**Crous potassium selenate**,  $\text{Ce}_2(\text{SeO}_4)_3 \cdot 5\text{K}_2\text{SO}_4$   
More sol in  $\text{H}_2\text{O}$  than the corresponding sulphate (Jolin)

**Crous sodium selenate**,  $\text{Ce}_2(\text{SeO}_4)_3 \cdot \text{Na}_2\text{SeO}_4 + 5\text{H}_2\text{O}$   
White sol in  $\text{H}_2\text{O}$  (Jolin)

**Chromic potassium selenate**,  $\text{Cr K}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$   
Resembles the sulphate in every particular

**Chromic rubidium selenate**,  $\text{Cr}_2\text{Rb}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$

**Chromic sodium selenate**,  $\text{Cr}_2\text{Na}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Fabre, C R 105 114)

**Chromic thalious selenate**,  $\text{Cr}_2\text{Tl}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Fabre, C R 105 114)

**Chromic selenate potassium sulphate**,  
 $\text{Cr}_2(\text{SeO}_4)_3 \cdot \text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (v Gerichten)

**Cobaltous selenate, basic**,  $4\text{CoO}$ ,  $3\text{SeO}_3 + \text{H}_2\text{O}$   
Insol in  $\text{H}_2\text{O}$ , sol in acids (Bogdan, Bull Soc (3) 9 586)  
 $\text{Co}_3(\text{OH})_2(\text{SeO}_4)_3$  Insol in  $\text{H}_2\text{O}$  Sol in acids (Bogdan, C C 1895 630)

**Cobaltous selenate**,  $\text{CoSeO}_4 + 5\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  (Topsoë)  
+6 $\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Topsoë)  
+7 $\text{H}_2\text{O}$  Efflorescent Extremely sol in  $\text{H}_2\text{O}$  (Topsoë)  
+18 $\text{H}_2\text{O}$  Very unstable (Copaux, A ch 1905, (8) 6 553)

**Cobaltous potassium selenate**,  $\text{CoSeO}_4 \cdot \text{K}_2\text{SeO}_4 + 6\text{H}_2\text{O}$   
More sol in  $\text{H}_2\text{O}$  than corresponding sulphate (v Hauer, W A B 39 837)

**Cobaltous rubidium selenate**,  $\text{CoRb}_2(\text{SeO}_4)_2 + 6\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Topsoë)

**Cobaltous thalious selenate**,  $\text{CoTl}_2(\text{SeO}_4)_2 + 6\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Topsoë)

**Cupric selenate, basic**,  $3\text{CuO}$ ,  $2\text{SeO}_3 + 4\text{H}_2\text{O}$   
Insol in  $\text{H}_2\text{O}$ , sol in acids (Bogdan, Bull Soc (3) 9 588)  
+5 $\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$  (Metzner, C R 1898, 127 55)  
+ $\text{H}_2\text{O}$ , and +2 $\text{H}_2\text{O}$  (Metzner)

**Cupric selenate**,  $\text{CuSeO}_4 + 5\text{H}_2\text{O}$   
Solubility in  $\text{H}_2\text{O}$  —  
257 g salt in 1 l sat solution at 15°  
346 " " 1 l " " 35°  
435 " " 1 l " " 55°  
Aq solution decomp at 70° (Metzner, C R 1898, 127 55)  
+ $\text{H}_2\text{O}$ , and +2 $\text{H}_2\text{O}$  (Metzner)

**Cupric hydrazine selenate**,  $\text{N}_2\text{H}_4 \cdot \text{H}_2\text{SeO}_4 \cdot \text{CuSeO}_4 + \frac{1}{2}\text{H}_2\text{O}$   
Decomp in aq solution (Rumini, C C 1907, I 86)

<b>Cupric magnesium selenate</b> , $\text{CuMg}_2(\text{SeO}_4)_4 + 28\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ (Wohlwill)	<b>Glucinum selenate</b> , $\text{GlSeO}_4 + 4\text{H}_2\text{O}$ Very sol in $\text{H}_2\text{O}$ (Atterberg)
<b>Cupric nickel selenate</b> , $\text{CuSeO}_4$ , $\text{NiSeO}_4 + 14\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ (Wohlwill)	<b>Gold (auric) selenate</b> , $\text{Au}_2(\text{SeO}_4)_3$ Insol in $\text{H}_2\text{O}$ Sol in hot conc $\text{H}_2\text{SeO}_4 + \text{Aq}$ Somewhat sol in $\text{H}_2\text{SO}_4$ and $\text{HNO}_3 + \text{Aq}$ Decomp by $\text{HCl} + \text{Aq}$ (Lenher, J Am Chem Soc 1902, 24 355)
<b>Cupric potassium selenate</b> , $\text{CuSeO}_4$ , $\text{K}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ Sl sol in $\text{H}_2\text{O}$ (Topsoe)	<b>Indium selenate</b> , $\text{In}_2(\text{SeO}_4)_3 + 10\text{H}_2\text{O}$ Hydroscopic, easily sol in $\text{H}_2\text{O}$ (Mathers, J Am Chem Soc 1908, 30 214)
<b>Cupric zinc selenate</b> , $\text{CuZn}_3(\text{SeO}_4)_4 + 28\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ (Wohlwill)	<b>Iron (ferrous) selenate</b> , $\text{FeSeO}_4 + 5\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ (Wohlwill, A 114 169) $+ 7\text{H}_2\text{O}$ Efflorescent, and sol in $\text{H}_2\text{O}$ (Topsoe)
<b>Cupric selenate ferrous sulphate</b> , $2\text{CuSeO}_4$ , $3\text{FeSO}_4 + 35\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ (Wohlwill)	<b>Iron (ferrous) potassium selenate</b> , $\text{FeSeO}_4$ , $\text{K}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ Easily sol in $\text{H}_2\text{O}$ Solution decomp somewhat on standing (Topsoe)
<b>Cupric selenate magnesium sulphate</b> , $\text{CuSeO}_4$ , $3\text{MgSO}_4 + 28\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ (Wohlwill)	<b>Iron (ferric) rubidium selenate</b> , $\text{Rb}_2\text{Fe}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ Sl sol in $\text{H}_2\text{O}$ (Roncogliolo, Gazz ch it 1905, 35 (2) 553)
<b>Cupric selenate zinc sulphate</b> , $\text{CuSeO}_4$ , $3\text{ZnSO}_4 + 28\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ (Wohlwill)	<b>Iron (ferric) selenate potassium sulphate</b> , $\text{Fe}_2(\text{SeO}_4)_3$ , $\text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ (v Gerichten)
<b>Didymium selenate</b> , $\text{D}_{12}(\text{SeO}_4)_3 + 5\text{H}_2\text{O}$ , and $6\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ $+ 8\text{H}_2\text{O}$ Easily sol in $\text{H}_2\text{O}$ (Cleve) $+ 10\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ (Cleve)	<b>Lanthanum selenate</b> , $\text{La}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$ , and $10\text{H}_2\text{O}$ Easily sol in cold $\text{H}_2\text{O}$ (Cleve) $+ 12\text{H}_2\text{O}$ (Frenchs and Smith, A 191 355)
<b>Didymium potassium selenate</b> , $\text{D}_{12}(\text{SeO}_4)_3$ , $\text{K}_2\text{SeO}_4 + 9\text{H}_2\text{O}$ Not deliquescent Easily sol in $\text{H}_2\text{O}$ (Cleve)	<b>Lanthanum potassium selenate</b> , $\text{La}_2(\text{SeO}_4)_3$ , $\text{K}_2\text{SeO}_4 + 9\text{H}_2\text{O}$ Quite sol in $\text{H}_2\text{O}$ (Cleve)
<b>Didymium sodium selenate</b> , $\text{D}_{12}(\text{SeO}_4)_3$ , $\text{Na}_2\text{SeO}_4 + 4\text{H}_2\text{O}$ Easily sol in $\text{H}_2\text{O}$ (Cleve)	<b>Lanthanum sodium selenate</b> , $\text{La}_2(\text{SeO}_4)_3$ , $\text{Na}_2\text{SeO}_4 + 4\text{H}_2\text{O}$ Easily sol in $\text{H}_2\text{O}$ (Cleve)
<b>Dysprosium selenate</b> , $\text{Dy}_2(\text{SeO}_4)_3 + 8\text{H}_2\text{O}$ Easily sol in $\text{H}_2\text{O}$ , insol in alcohol (Jantsch, B 1911, 44 1275)	<b>Lead selenate, basic</b> , $2\text{PbO}$ , $\text{SeO}_3$ Decomp by acids with separation of $\text{PbSeO}_4$ $3\text{PbO}$ , $\text{PbSeO}_4 + \text{H}_2\text{O}$ Ppt (Stromholm, Z anorg 1904, 38 443)
<b>Erbium selenate</b> , $\text{Er}_2(\text{SeO}_4)_3 + 8\text{H}_2\text{O}$ , and $9\text{H}_2\text{O}$ Easily sol in $\text{H}_2\text{O}$ (Topsoe)	<b>Lead selenate</b> , $\text{PbSeO}_4$ Insol in $\text{H}_2\text{O}$ or $\text{HNO}_3 + \text{Aq}$ (Schafarik, W A B 47 256) Min <i>Kerstenite</i>
<b>Erbium potassium selenate</b> , $\text{Er}_2(\text{SeO}_4)_3$ , $\text{K}_2\text{SeO}_4 + 8\text{H}_2\text{O}$ Easily sol in $\text{H}_2\text{O}$ (Cleve)	<b>Lithium selenate</b> , $\text{Li}_2\text{SeO}_4 + \text{H}_2\text{O}$ Not deliquescent Easily sol in $\text{H}_2\text{O}$ (Topsoe)
<b>Gadolinium selenate</b> , $\text{Gd}_2(\text{SeO}_4)_3 + 10\text{H}_2\text{O}$ Decomp in the air (Benedicks, Z anorg 1900, 22 410)	
<b>Gadolinium potassium selenate</b> , $\text{Gd}_2(\text{SeO}_4)_3$ , $3\text{K}_2\text{SeO}_4 + 4\text{H}_2\text{O}$ Sol in $\text{H}_2\text{O}$ (Benedicks, Z anorg 1900, 22 412)	

- agnesium selenate**,  $\text{MgSeO}_4 \cdot 6\text{H}_2\text{O}$   
Solubility resembles closely that of  $\text{MgSO}_4$  (opsoe)
- agnesium potassium selenate**,  $\text{MgK}_2(\text{SeO}_4)_2 \cdot 6\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  (Topsoe)
- agnesium rubidium selenate**,  $\text{MgSeO}_4 \cdot \text{Rb}_2\text{SeO}_4 \cdot 6\text{H}_2\text{O}$   
(Tutton, Chem Soc 1905, 87 1163)
- anganous selenate**,  $\text{MnSeO}_4 \cdot 2\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  (Topsoe)  
+  $5\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  Solution comp on warming or standing (Topsoe)
- anganous potassium selenate**,  $\text{K}_2\text{SeO}_4 \cdot \text{MnSeO}_4$   
Not deliquescent Easily sol in  $\text{H}_2\text{O}$  (opsoe)
- ercurous selenate**,  $6\text{Hg}_2\text{O} \cdot 5\text{SeO}_3$   
Very sl sol in  $\text{H}_2\text{O}$  Sl attacked by boiling  $\text{HNO}_3$  Insol in  $\text{HCl} + \text{Aq}$  (Kohler, Jgg 89 146)  
 $\text{Hg}_2\text{SeO}_4$  Very sl sol in  $\text{H}_2\text{O}$ , insol in  $\text{Cl} + \text{Aq}$  (Cameron and Davy, C N 44)
- ercuric selenate, basic**,  $6\text{HgO} \cdot 2\text{SeO}_3 \cdot \text{H}_2\text{O}$   
Insol in  $\text{H}_2\text{O}$ , or cold  $\text{HNO}_3 + \text{Aq}$  Sol in dil  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$  (Kohler)  
 $\text{HgSeO}_4 \cdot 2\text{HgO}$  Sol in 10,330 pts  $\text{H}_2\text{O}$  (Cameron and Davy)
- ercuric selenate**,  $\text{HgSeO}_4 \cdot \text{H}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$  with formation of basic lt (Kohler)  
Sol in  $\text{H}_2\text{SeO}_4$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ , it decomp by  $\text{H}_2\text{O}$  to  $2\text{HgO}$ ,  $\text{HgSeO}_4$  (Cameron and Davy, C N 44 63)
- nickel selenate**,  $\text{NiSeO}_4 \cdot 6\text{H}_2\text{O}$   
Very easily sol in  $\text{H}_2\text{O}$  (v Hauer, W A 39 305)
- nickel potassium selenate**,  $\text{NiSeO}_4 \cdot \text{K}_2\text{SeO}_4 \cdot 6\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Topsoe)
- nickel thallium selenate**,  $\text{NiSeO}_4 \cdot \text{Tl}_2\text{SeO}_4 \cdot 6\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Petersson)
- aluminum selenate**  
Sol in boiling  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  sol in alcohol (Cameron and Macallan, and R Soc Proc 46 13)
- Potassium selenate**,  $\text{K}_2\text{SeO}_4$   
Nearly equally sol in cold and hot  $\text{H}_2\text{O}$  (Mitscherlich, Pogg 9 623)  
100 g  $\text{H}_2\text{O}$  dissolve 110.5 g  $\text{K}_2\text{SeO}_4$  at  $0^\circ$ , 112.8 g at  $20^\circ$ , 122.2 g at  $100^\circ$  (Etard, C R 1888, 106 741)  
Sat  $\text{K}_2\text{SeO}_4 + \text{Aq}$  contains at  

$-20^\circ$	$-5^\circ$	$+5^\circ$
51.5	51.7	52.0% $\text{K}_2\text{SeO}_4$

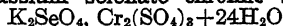
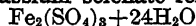
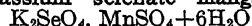
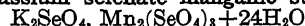
  

$18^\circ$	$97^\circ$
52.6	54.9% $\text{K}_2\text{SeO}_4$

(Etard, A ch 1894, (7) 2 550)  
100 g  $\text{H}_2\text{O}$  at  $12^\circ$  dissolve 115.0 g  $\text{K}_2\text{SeO}_4$  (Tutton, Chem Soc 1897, 71 850)  
Sp gr of  $\text{K}_2\text{SeO}_4 + \text{Aq}$  at  $20^\circ$  compared with  $\text{H}_2\text{O}$  at  $4^\circ$ , containing  

% $\text{K}_2\text{SeO}_4$	35.76	41.79	50.00
Sp gr	1.3591	1.4385	1.5590

(Tutton, Chem Soc 1897, 71 851)
- Potassium hydrogen selenate**,  $\text{KHSO}_4$   
Sol in  $\text{H}_2\text{O}$
- Potassium praseodymium selenate**,  $3\text{K}_2\text{SeO}_4 \cdot \text{Pr}_2(\text{SeO}_4)_3 \cdot 4\text{H}_2\text{O}$   
Sl sol in  $\text{H}_2\text{O}$  (von Scheele, Z anorg 1893, 18 361)
- Potassium samarium selenate**,  $\text{K}_2\text{SeO}_4 \cdot \text{Sm}_2(\text{SeO}_4)_3 \cdot 6\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  (Cleve, Bull Soc (2) 43 166)
- Potassium sodium selenate**,  $3\text{K}_2\text{SeO}_4 \cdot \text{Na}_2\text{SeO}_4$   
Sol in  $\text{H}_2\text{O}$  (Topsoe)
- Potassium thallium selenate**,  $\text{K}_2\text{SeO}_4 \cdot \text{Tl}_2(\text{SeO}_4)_3 \cdot 8\text{H}_2\text{O}$   
Very sol in dil acids (Fortini, C C 1903, II 706)
- Potassium uranyl selenate**,  $\text{K}_2\text{SeO}_4 \cdot (\text{UO}_2)\text{SeO}_4 \cdot 2\text{H}_2\text{O}$   
Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  (Sendtner)
- Potassium yttrium selenate**,  $\text{K}_2\text{SeO}_4 \cdot \text{Y}_2(\text{SeO}_4)_3 \cdot 6\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  (Cleve)
- Potassium zinc selenate**,  $\text{K}_2\text{SeO}_4 \cdot \text{ZnSeO}_4 \cdot 2\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Topsoe)  
+  $6\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Topsoe)
- Potassium selenate aluminum sulphate**,  $\text{K}_2\text{SeO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (v Gerichten)

**Potassium selenate chromic sulphate,**Sol in  $\text{H}_2\text{O}$  (v Gerichten)**Potassium selenate ferric sulphate,  $\text{K}_2\text{SeO}_4,$** Sol in  $\text{H}_2\text{O}$  (v Gerichten)**Potassium selenate manganous sulphate,**Sol in  $\text{H}_2\text{O}$  (v Gerichten, A 168 225)**Potassium selenate manganic sulphate,**Sol in  $\text{H}_2\text{O}$  (v Gerichten)**Praseodymium selenate,  $\text{Pr}_2(\text{SeO}_4)_2$** Sol in  $\text{H}_2\text{O}$  (von Schule, Z anorg 1898, 18 360)+ $8\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$ , sol in  $\text{H}_2\text{SO}_4$  (von Schule)**Rubidium selenate,  $\text{Rb}_2\text{SeO}_4$** Sol in  $\text{H}_2\text{O}$  (Petersson)100 g  $\text{H}_2\text{O}$  at  $12^\circ$  dissolve 158.9 g  $\text{Rb}_2\text{SeO}_4$  (Tutton, Chem Soc 1897, 71 850)Sp gr of  $\text{Rb}_2\text{SeO}_4 + \text{Aq}$  at  $20^\circ$  compared with  $\text{H}_2\text{O}$  at  $4^\circ$ , containing

% $\text{Rb}_2\text{SeO}_4$	40.60	47.07
Sp gr	1.4688	1.5806

(Tutton)

**Rubidium hydrogen selenate,  $\text{RbHSeO}_4$** Sol in equal pts  $\text{H}_2\text{O}$ , very hygroscopic (Norris, Am Ch J 1901, 26 321)**Rubidium zinc selenate,  $\text{Rb}_2\text{Zn}(\text{SeO}_4)_2 + 6\text{H}_2\text{O}$** 

(Tutton, Zeit Kryst 1900, 33 8)

**Samarium selenate,  $\text{Sm}_2(\text{SeO}_4)_3 + 8\text{H}_2\text{O}$** More sol in  $\text{H}_2\text{O}$  than  $\text{Sm}_2(\text{SO}_4)_3 + 12\text{H}_2\text{O}$  Efflorescent (Cleve)**Scandium selenate,  $\text{Sc}_2(\text{SeO}_4)_3 + 2\text{H}_2\text{O}$ , and  $+8\text{H}_2\text{O}$** 

(Crookes, Roy Soc Proc 1908, 80, A 518)

**Silver selenate,  $\text{Ag}_2\text{SeO}_4$** As  $\text{Ag}_2\text{SO}_4$  (Mitscherlich, Pogg 12 138)**Silver selenate ammonia,  $\text{Ag}_2\text{SeO}_4, 4\text{NH}_3$** Easily sol in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp (Mitscherlich, Pogg 12 141)**Sodium selenate,  $\text{Na}_2\text{SeO}_4$** Very sol in  $\text{H}_2\text{O}$ , forming supersat solutions Cryst also with  $10\text{H}_2\text{O}$ , which effloresce Maximum point of solubility is at  $33^\circ$  (Mitscherlich)Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	% $\text{Na}_2\text{SeO}_4$	Mols $\text{H}_2\text{O}$ to 1 mol $\text{Na}_2\text{SeO}_4$	Mols anhy- drous salt to 100 mols $\text{H}_2\text{O}$
35 2	45 47	17 59	7 94
39 5	45 26	12 70	7 87
50	44 49	13 10	7 63
75	42 83	14 00	7 14
100	42 14	14 42	6 93

(Funk, B 1900, 33 3697)

+ $10\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	% $\text{Na}_2\text{SeO}_4$	Mols $\text{H}_2\text{O}$ to 1 mol $\text{Na}_2\text{SeO}_4$	Mols anhy- drous salt to 100 mols $\text{H}_2\text{O}$
0	11 74	79 08	1 26
15	25 01	31 48	3 18
25 2	36 91	17 95	5 57
27	39 13	16 30	6 13
30	44 05	13 33	7 50

(Funk)

Sp gr of sat solution at  $18^\circ = 1.315$  (Funk)**Sodium selenate vanadate** $\text{Se}_2\text{Selenovanadate}$ , sodium**Strontium selenate,  $\text{SrSeO}_4$** Insol in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ , decomp by long boiling with  $\text{HCl} + \text{Aq}$ **Tellurium selenate,  $2\text{TeO}_2, \text{SeO}_3$** 

As sulphate (Metzner, A ch 1898, (7) 15 203)

**Thallous selenate,  $\text{Tl}_2\text{SeO}_4$** Sl sol in cold, much more in hot  $\text{H}_2\text{O}$  Insol in alcohol and ether (Kuhlmann)100 g  $\text{H}_2\text{O}$  dissolve 2.13 g at  $9.3^\circ$ , 2.4 g at  $12^\circ$ , 10.86 g at  $100^\circ$  (Tutton, Proc Roy Soc 1907, 79 A, 351)2.8 g are sol in 100 g  $\text{H}_2\text{O}$  at  $20^\circ$ , 8.5 g at  $80^\circ$  (Glauser, Z anorg 1910, 66 437)**Thallous hydrogen selenate,  $\text{HTlSeO}_4 + 3\text{H}_2\text{O}$** 

(Oettinger)

**Thallous zinc selenate,  $\text{TlSeO}_4, \text{ZnSeO}_4 + 6\text{H}_2\text{O}$** Easily sol in  $\text{H}_2\text{O}$ , but less than the corresponding sulphate (Werther, Bull Soc 1865 60)**Thorium selenate,  $\text{Th}(\text{SeO}_4)_4 + 9\text{H}_2\text{O}$** 100 pts  $\frac{1}{2}\text{H}_2\text{O}$  dissolve 0.498 pt  $\text{Th}(\text{SeO}_4)_4$  at  $0^\circ$ , and 1.972 pts at  $100^\circ$  (Cleve)

**Tin** (stannic) selenate, basic,  $\text{SnO}(\text{SeO}_4) + \text{H}_2\text{O}$   
 1 l. l. l. Sol in  $\text{H}_2\text{O}$  (Ditte, C R 231)

**Uranyl** selenate,  $(\text{UO}_2)\text{SeO}_4, \text{H}_2\text{SeO}_4 + 18\text{H}_2\text{O}$   
 1 ry deliquescent  
 2  $\text{UO}_2\text{SeO}_4, \text{H}_2\text{SeO}_4 + 12\text{H}_2\text{O}$  Efflorescent  
 Sol in  $\text{H}_2\text{O}$  (Sendtner, A 195 325)

**Yttrium** selenate,  $\text{Yb}_2(\text{SeO}_4)_3$   
 1 anhydrous  
 15  $\text{H}_2\text{O}$  (?), +8  $\text{H}_2\text{O}$  Ppt (Cleve, Z 1902, 32 145)

**Yttrium** selenate,  $\text{Y}_2(\text{SeO}_4)_3$   
 1 anhydrous Sol in  $\text{H}_2\text{O}$  with hissing and evolution of heat (Popp)  
 8  $\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Cleve)  
 9  $\text{H}_2\text{O}$  Efflorescent

**Zinc** selenate,  $\text{ZnSeO}_4 + 5\text{H}_2\text{O}$   
 1 l in  $\text{H}_2\text{O}$  (Topsoe)  
 6  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Topsoe)  
 7  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

**Selenious acid**,  $\text{H}_2\text{SeO}_3$   
 1 l. l. l. in moist, efflorescent in dry air  
 Very sol in cold, and in nearly every proportion in hot  $\text{H}_2\text{O}$  Easily sol in alcohol (Berzelius)

Sp gr of  $\text{H}_2\text{SeO}_3$  and of  $\text{H}_2\text{SeO}_3 + \text{Aq}$  at t°  
 Two series of experiments

		t	Sp gr at t°
$\text{H}_2$	$\text{O}_3 + \text{Aq}$ (A)	18 0	1 4386
	vol A + 0 5 vol $\text{H}_2\text{O}$	18 0	1 3179
	" + 1 0 "	17 7	1 2337
	" + 1 5 "	16 6	1 2045
	" + 2 0 "	14 0	1 1984
	" + 2 5 "	17 0	1 1712
	" + 3 0 "	19 2	1 1600
	" + 3 0 "	19 2	1 1600
$\text{H}_2$	$\text{O}_3 + \text{Aq}$ (B)	15 8	1 4698
	vol B + 0 5 vol $\text{H}_2\text{O}$	16 5	1 3191
	" + 1 0 "	13 0	1 2515
	" + 1 5 "	14 2	1 2074
	" + 2 0 "	17 0	1 1992
	" + 2 5 "	16 5	1 1793
	" + 3 0 "	14 2	1 1678
	" + 3 0 "	14 2	1 1678

(de Connick, C C 1905, I 1693)

See also Selenium dioxide

sol in liquid  $\text{NH}_3$  (Gore, Am Ch J 186, 20 830)

**Selenites**

alkali selenites are sol in  $\text{H}_2\text{O}$  The other neutral selenites are insol in  $\text{H}_2\text{O}$ , but sol in  $\text{H}_2\text{O}_3 + \text{Aq}$ , Pb, and Ag salts slowly The

neutral salts are insol in  $\text{HCl} + \text{Aq}$  The acid salts of the heavy metals are sol in  $\text{H}_2\text{O}$

**Aluminum** selenite, basic,  $4\text{Al}_2\text{O}_3, 9\text{SeO}_2 + 36\text{H}_2\text{O}$

Precipitate (Nilson, Upsala 1875)

**Aluminum** selenite,  $\text{Al}_2(\text{SeO}_3)_3$

Precipitate (Berzelius)  
 +7  $\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Nilson) Sol in  $\text{H}_2\text{SeO}_3 + \text{Aq}$   
 +3  $\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in acids (Boutzoureano, A ch (6) 17 289)

**Aluminum** selenite, acid,  $\text{Al}_2\text{O}_3, 4\text{SeO}_2 + 3\text{H}_2\text{O}$

(Boutzoureano)  
 2  $\text{Al}_2\text{O}_3, 9\text{SeO}_2 + 12\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Nilson)  
 $\text{Al}_2\text{O}_3, 6\text{SeO}_2$  Very sol in  $\text{H}_2\text{O}$  (Berzelius)  
 +5  $\text{H}_2\text{O}$  (Nilson)  
 +2  $\text{H}_2\text{O}$  (Boutzoureano)

**Ammonium** selenite,  $(\text{NH}_4)_2\text{SeO}_3$

Deliquescent Very sol in  $\text{H}_2\text{O}$   
 Precipitated from aqueous solution by alcohol Insol in ether (Muspratt, A 70 275)

**Ammonium hydrogen** selenite,  $\text{NH}_4\text{HSeO}_3$

Not deliquescent Sol in  $\text{H}_2\text{O}$  (Berzelius)

**Ammonium trihydrogen** selenite,

$\text{NH}_4\text{H}_3(\text{SeO}_3)_2$

Deliquescent (Berzelius)

**Ammonium vanadium** selenite

See Vanadioselenite, ammonium

**Ammonium uranyl** selenite,  $(\text{NH}_4)_2\text{SeO}_3, (\text{UO}_2)\text{SeO}_3$

Completely insol in  $\text{H}_2\text{O}$  (Sendtner)

**Antimony** selenite,  $\text{Sb}_2(\text{SeO}_3)_3, \text{SeO}_2$

(Nilson, Bull Soc (2) 23 494)

**Barium** selenite,  $\text{BaSeO}_3$

Sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{SeO}_3 + \text{Aq}$  So in acids (Nilson)  
 +  $\text{H}_2\text{O}$  (Nilson)

**Barium pyroselenite**,  $\text{BaSe}_2\text{O}_5$

Very sl sol in cold, more in warm  $\text{H}_2\text{O}$  (Berzelius)

**Bismuth** selenite,  $\text{Bi}_2(\text{SeO}_3)_3, \text{H}_2\text{SeO}_3$

(Nilson)

$\text{Bi}_2(\text{SeO}_3)_3$  (Nilson)

**Cadmium** selenite,  $\text{CdSeO}_3$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{SeO}_3 + \text{Aq}$  (Muspratt, Chem Soc 2 65)



$2\text{CdO}$ ,  $3\text{SeO}_2 + \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in acids (Boutzoureano)  
 $+ \frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Boutzoureano)

**Cadmium selenite ammonia**,  $\text{CdSeO}_3$ ,  $\text{NH}_3$   
 Insol in cold or hot  $\text{H}_2\text{O}$  (Boutzoureano, ch (6) 17 289)

**selenite**,  $\text{CaSeO}_3 + \frac{1}{3}\text{H}_2\text{O}$   
 sol in  $\text{H}_2\text{O}$  (Berzelius) More  
 $\text{O}_3 + \text{Aq}$  (Nilson)

**hydrogen selenite**,  $\text{CaH}_2(\text{SeO}_3)_2 +$   
 in  $\text{H}_2\text{O}$  (Nilson)  
 11 Easily sol in  $\text{H}_2\text{O}$  (Nil-

**nite, basic**,  $2\text{Ce}_2\text{O}_3$ ,  $5\text{SeO}_2 +$   
 -te (Nilson)

**selenite**,  $\text{Ce}_2(\text{SeO}_3)_3 + 3\text{H}_2\text{O}$   
 Insol in  $\text{H}_2\text{O}$  Sol in much selenious acid  
 John)  
 $+ 12\text{H}_2\text{O}$  (Nilson)

**Cerous selenite, acid**,  $\text{Ce}_2\text{O}_3$ ,  $4\text{SeO}_2 + 5$ , or 6  
 $\text{H}_2\text{O}$

| Insol in  $\text{H}_2\text{O}$ , but sol in selenious, and  
 other acids (John)  
 $\text{Ce}_2\text{O}_3$ ,  $6\text{SeO}_2 + 5\text{H}_2\text{O}$  Not decomp by  
 $\text{H}_2\text{O}$  (Nilson)

**Ceric selenite**,  $\text{Ce}(\text{SeO}_3)_2$

Insol in  $\text{H}_2\text{O}$   
 Sl sol in conc  $\text{HNO}_3$  Sol in dil acids  
 Sol in  $\text{H}_2\text{O}_2 + \text{Aq}$  (Barbieri, B 1910, 43  
 2215)

**Chromium selenite, basic**,  $4\text{Cr}_2\text{O}_3$ ,  $9\text{SeO}_2 +$   
 $64\text{H}_2\text{O}$

Precipitate (Nilson)

**Chromic selenite**,  $\text{Cr}_2(\text{SeO}_3)_3 + 3\text{H}_2\text{O}$

(Boutzoureano)  
 $+ 15\text{H}_2\text{O}$  (Nilson)  
 Very sl sol or insol in  $\text{H}_2\text{O}$ , sl sol in  
 $\text{H}_2\text{SeO}_3 + \text{Aq}$ , sol in hot conc  $\text{HCl} + \text{Aq}$   
 (Taquet, C R 96 107)

**Chromic selenite, acid**,  $\text{Cr}_2\text{O}_3$ ,  $4\text{SeO}_2 + 13\text{H}_2\text{O}$

Slowly sol in  $\text{HCl} + \text{Aq}$  Insol in  $\text{H}_2\text{O}$   
 (Nilson)  
 $\text{Cr}_2\text{O}_3$ ,  $5\text{SeO}_2 + 9\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$   
 (Nilson)

**Chromic diselenite**

Insol in  $\text{H}_2\text{O}$ , sol in acids (Taquet, C  
 R 97 1435)

**Cobaltous selenite**,  $\text{CoSeO}_3$

Insol in  $\text{H}_2\text{O}$  (Berzelius)  
 $+ \frac{1}{3}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in acids  
 (Boutzoureano, A ch (6) 17 289)

**Cobaltous hydrogen selenite**,  $\text{CoH}_2(\text{SeO}_3)_2$

Sol in  $\text{H}_2\text{O}$  (Berzelius)  
 $+ 2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with decomp  
 (Boutzoureano)

**Cuprous selenite**

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
 (Berzelius)

**Cupric selenite, basic**,  $2\text{CuO}$ ,  $\text{SeO}_2$

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
 (Boutzoureano)  
 Sol in acids

**Cupric selenite**,  $\text{CuSeO}_3 + \frac{1}{2}\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{SeO}_3 + \text{Aq}$  (Berzelius)  
 $+ \text{H}_2\text{O}$ , and  $2\text{H}_2\text{O}$  (Boutzoureano)  
 $+ 2\text{H}_2\text{O}$  Min *Chalcomenite* Insol in  $\text{H}_2\text{O}$   
 or  $\text{H}_2\text{SeO}_3 + \text{Aq}$  (Friedel and Sarasin, Zeit  
 Kryst 1881, 6 300)

**Cupric selenite, acid**,  $\text{CuO}$ ,  $2\text{SeO}_2 + \text{H}_2\text{O} =$   
 $\text{CuH}_2(\text{SeO}_3)_3$

Insol in  $\text{H}_2\text{O}$  Sol in acids (Nilson)  
 $+ 2\text{H}_2\text{O}$  As above (Boutzoureano)  
 $+ 4\text{H}_2\text{O}$  As above (B)

**Cupric selenite ammonia**,  $\text{CuSeO}_3$ ,  $\text{NH}_3 +$   
 $\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Boutzoureano, A ch  
 (6) 17 289)

**Didymium selenite, basic**,  $3\text{D}_2\text{O}_3$ ,  $8\text{SeO}_2 +$   
 $28\text{H}_2\text{O}$

Precipitate (Nilson)  
 $+ 21\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Cleve, Bull  
 Soc (2) 43 363)

**Didymium selenite**,  $\text{D}_2(\text{SeO}_3)_3 + 6\text{H}_2\text{O}$

Precipitate (Smith)

**Didymium selenite, acid**,  $\text{D}_2\text{O}_3$ ,  $4\text{SeO}_2 +$   
 $5\text{H}_2\text{O}$

Precipitate (Cleve)  
 Composition is  $\text{D}_2(\text{SeO}_3)_3 + 6\text{H}_2\text{O}$  (Smith)  
 $+ 9\text{H}_2\text{O}$  (Nilson)  
 $2\text{D}_2\text{O}_3$ ,  $9\text{SeO}_2 + 18\text{H}_2\text{O}$  (Nilson)

**Erbium selenite**,  $\text{Er}_2(\text{SeO}_3)_3 + 5\text{H}_2\text{O}$ , and  
 $9\text{H}_2\text{O}$

Precipitate (Nilson)

**Erbium hydrogen selenite**,  $\text{Fr}_2\text{H}_2(\text{SeO}_3)_4 +$   
 $4\text{H}_2\text{O}$

Decomp by hot  $\text{H}_2\text{O}$

**Gadolinium hydrogen selenite**,  
 $\text{Gd}_2(\text{SeO}_3)_3 \cdot 6\text{H}_2\text{O}$   
 pt (Benedicks, Z anorg 1900, 22  
 41)

**Lithium selenite, basic**,  $5\text{LiO} \cdot 2\text{SeO}_2 + 10\text{H}_2\text{O}$   
 precipitate (Nilson) According to Atter-  
 berg is  $7\text{LiO} \cdot 3\text{SeO}_2 + 14\text{H}_2\text{O}$   
 (2)  $\text{Li}_2\text{O} \cdot \text{SeO}_2 + 4\text{H}_2\text{O}$  (Atterberg, Bull Soc  
 19 497)  
 (A)  $\text{LiO} \cdot 2\text{SeO}_2 + 6\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$   
 (Atterberg)

**Lithium selenite**,  $\text{LiSeO}_4 + 2\text{H}_2\text{O}$   
 sol in little  $\text{H}_2\text{O}$ , decomp by excess  
 (Nilson)

**Lithium selenite, acid**  
 (a)  $3\text{LiO} \cdot 5\text{SeO}_2 + 3\text{H}_2\text{O}$ , (b)  $\text{LiO} \cdot 2\text{SeO}_2$   
 +  $\text{Li}_2\text{O}$ , (c)  $3\text{LiO} \cdot 7\text{SeO}_2 + 5\text{H}_2\text{O}$ , (d)  $\text{LiO} \cdot$   
 $3\text{SeO}_2 + 2\text{H}_2\text{O}$  All are very sl sol in cold  
 or warm  $\text{H}_2\text{O}$  a, b, and c are sol in warm  
 H<sub>2</sub>O containing HCl, d is sol only in boiling  
 HCl + Aq (Nilson)

**Lithium selenite, basic**,  $\text{Li}_3\text{Se}_3\text{O}_{30} + 64\text{H}_2\text{O}$   
 (Nilson)

**Lithium selenite**,  $\text{Li}_2(\text{SO}_3)_3 + 6\text{H}_2\text{O}$   
 l sol in  $\text{H}_2\text{O}$  (Nilson)

**Lithium hydrogen selenite**,  $\text{Li}_2(\text{SeO}_3)_3 \cdot$   
 $3\text{H}_2\text{SeO}_3 + 4\text{H}_2\text{O}$   
 sol in  $\text{H}_2\text{O}$  (Nilson)  
 (H)  $\text{Li}_2(\text{SeO}_3)_3 \cdot 3\text{H}_2\text{SeO}_3 + 12\text{H}_2\text{O}$  Sol in  
 H<sub>2</sub>O (Nilson)

**Lithium (ferrous) selenite**  
 ppt Sol in HCl + Aq with partial separa-  
 tion of Se (Berzelius)

**Lithium (ferrous) hydrogen selenite**  
 sl sol in  $\text{H}_2\text{O}$  (Berzelius)

**Lithium (ferric) selenite, basic**,  $2\text{Li}_2\text{O} \cdot 3\text{SeO}_2 +$   
 $x\text{H}_2\text{O}$   
 nsol in  $\text{H}_2\text{O}$  (Berzelius)  
 $\text{Li}_2\text{O} \cdot 2\text{SeO}_2$  Insol in  $\text{H}_2\text{O}$ , easily sol in  
 acids (Boutzoureano, A ch (6) 17 289)  
 (a)  $\text{Li}_2\text{O} \cdot 3\text{SeO}_2 + 2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$   
 (Nilson)

**Lithium (ferric) selenite**,  $\text{Fe}_2(\text{SeO}_3)_3 + 4\text{H}_2\text{O}$   
 [nsol in  $\text{H}_2\text{O}$  (Muspratt, Chem Soc 2  
 5)  
 +  $\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Boutzoureano,  
 A ch (6) 17 289)  
 +  $3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (B)  
 +  $10\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (B)

**Iron (ferric) selenite, acid**,  $\text{Fe}_2\text{O}_3 \cdot 6\text{SeO}_2 +$   
 $x\text{H}_2\text{O}$   
 Insol in  $\text{H}_2\text{O}$  Sol in HCl + Aq (Ber-  
 zelius)  
 +  $2\text{H}_2\text{O}$  (Boutzoureano, A ch (6) 17  
 289)  
 $\text{Fe}_2\text{O}_3 \cdot 4\text{SeO}_2 + \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in  
 acids (Boutzoureano)

**Lanthanum selenite, basic**,  $3\text{La}_2\text{O}_3 \cdot 8\text{SeO}_2 +$   
 $28\text{H}_2\text{O}$   
 Precipitate (Nilson)

**Lanthanum selenite**,  $\text{La}_2(\text{SeO}_3)_3 + 9\text{H}_2\text{O}$ , or  
 $12\text{H}_2\text{O}$   
 Insol in  $\text{H}_2\text{O}$  (Nilson)

**Lanthanum selenite, acid**,  $\text{La}_2\text{H}_4(\text{SeO}_3)_5 +$   
 $4\text{H}_2\text{O}$   
 (Nilson)  
 $\text{La}_2\text{H}_5(\text{SeO}_3)_6 + 2\text{H}_2\text{O}$  (Cleve)

**Lead selenite**,  $\text{PbSeO}_3$   
 Scarcely sol in  $\text{H}_2\text{O}$ , even when it contains  
 $\text{H}_2\text{SeO}_3$  Sl sol in  $\text{HNO}_3 + \text{Aq}$  (Berzelius)

**Lithium selenite**,  $\text{Li}_3\text{SeO}_3 + \text{H}_2\text{O}$   
 Difficultly sol in  $\text{H}_2\text{O}$  (Nilson, Bull Soc  
 (2) 21 253)

**Lithium hydrogen selenite**,  $\text{LiHSO}_3$   
 Very sol in  $\text{H}_2\text{O}$  (Nilson)

**Lithium trihydrogen selenite**,  $\text{LiH}_3(\text{SeO}_3)_2$   
 Not deliquescent Sol in  $\text{H}_2\text{O}$  (Nilson)

**Lithium vanadium selenite**  
 See Vanadioselenite, lithium

**Magnesium selenite**,  $\text{MgSeO}_3 + 2\text{H}_2\text{O}$   
 Insol in  $\text{H}_2\text{O}$ , sol in dil acids, especially  
 if warm, also in  $\text{H}_2\text{SeO}_3 + \text{Aq}$  (Boutzour-  
 eano, A ch (6) 18 302)  
 +  $3\text{H}_2\text{O}$  Very sl sol in hot  $\text{H}_2\text{O}$  (Ber-  
 zelius)  
 +  $6\text{H}_2\text{O}$  As the  $2\text{H}_2\text{O}$  salt (Boutzour-  
 eano)  
 +  $7\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  Easily sol in  
 acetic, and mineral acids (Hilger, Z anal  
 13 132)

**Magnesium hydrogen selenite**,  $\text{MgH}_2(\text{SeO}_3)_2$   
 +  $3\text{H}_2\text{O}$   
 Very deliquescent Easily sol in  $\text{H}_2\text{O}$   
 (Nilson)  
 Insol in alcohol (Muspratt)  
 $\text{MgO} \cdot 2\text{SeO}_2$  Insol in  $\text{H}_2\text{O}$ , sol in acids  
 (Boutzoureano)

**Magnesium tetrahydrogen selenite**,  
 $\text{MgH}_4(\text{SeO}_3)_3$ , and +  $3\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Nilson)

**Manganous selenite,  $\text{MnSeO}_3 + \text{H}_2\text{O}$** 

Precipitate (Nilson)  
 $+ 2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Berzelius)  
 Sol in cold  $\text{HCl} + \text{Aq}$  (Muspratt)  
 $+ \frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in dil acids  
 (Boutzoureano)

**Manganous selenite, acid,  $\text{MnSe}_2\text{O}_5$** 

Sol in  $\text{H}_2\text{O}$  (Berzelius, Nilson)  
 $\text{MnO}, 2\text{SeO}_2 + \text{H}_2\text{O} = \text{MnH}_2(\text{SeO}_3)_2$   
 (Boutzoureano, A ch (6) 17 289)  
 $+ 5\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  to  $\text{MnSeO}_3$   
 (Boutzoureano)

**Manganic selenite, basic,  $\text{Mn}_2\text{O}_3, 2\text{SeO}_2$** 

Insol in  $\text{H}_2\text{O}$ , cold  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3 + \text{Aq}$ ,  
 insol in hot dil  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$   
 (Laugier, C R 104 1508)  
 Sol in warm  $\text{HCl} + \text{Aq}$  with decomp

**Manganic selenite,  $\text{Mn}_2(\text{SeO}_3)_3 + 5\text{H}_2\text{O}$**   
(Laugier)**Manganic selenite, acid,  $\text{Mn}_2\text{O}_3, 4\text{SeO}_2$** 

Insol in  $\text{H}_2\text{O}$ , cold  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3 + \text{Aq}$   
 Insol in dil hot  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3 + \text{Aq}$  Sol  
 in cold  $\text{HCl} + \text{Aq}$ , and in  $\text{H}_2\text{SO}_4 + \text{Aq}$  with  
 separation of Se (Laugier, C R 104 1508)

**Mercurous selenite, basic,  $3\text{Hg}_2\text{O}, 2\text{SeO}_2 + 5\text{H}_2\text{O}$**   
(Boutzoureano)**Mercurous selenite,  $\text{Hg}_2\text{SeO}_3$** 

Insol in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{SeO}_3 + \text{Aq}$  Sol in hot  
 $\text{HNO}_3 + \text{Aq}$  (Kohler, Pogg 89 146)  
 Sl sol in  $\text{HCl} + \text{Aq}$ , and  $\text{KOH} + \text{Aq}$  (Berzelius)

**Mercurous selenite, acid,  $3\text{Hg}_2\text{O}, 4\text{SeO}_2$** 

Insol in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{SeO}_3 + \text{Aq}$  Sl sol in  
 boiling  $\text{HNO}_3 + \text{Aq}$  (Kohler)

**Mercuric selenite, basic,  $7\text{HgO}, 4\text{SeO}_2$** 

Insol in  $\text{H}_2\text{O}$  Sl sol in  $\text{HNO}_3 + \text{Aq}$   
 Easily sol in  $\text{HCl} + \text{Aq}$  (Kohler, Pogg 89 146)

**Mercuric selenite,  $\text{HgSeO}_3$** 

Insol in  $\text{H}_2\text{O}$  (Berzelius) Nearly insol  
 in  $\text{HNO}_3 + \text{Aq}$  Sol in  $\text{K}_2\text{SeO}_3 + \text{Aq}$  (Divers,  
 Chem Soc 48 585)

Insol in dil  $\text{HNO}_3 + \text{Aq}$ , sol in  $\text{HCl} + \text{Aq}$   
 (Rosenheim and Pritze, Z anorg 1909, 63 278)

Solubility in  $\text{Na}_2\text{SeO}_3 + \text{Aq}$  at  $25^\circ$

$\text{Na}_2\text{SeO}_3 + \text{Aq}$ Normality	% $\text{HgSeO}_3$
2 0	2 73
1 0	1 39
0 5	0 70
0 25	0 53
0 125	0 32
0 0625	0 18

(Rosenheim and Pritze, Z anorg 1909, 63 281)

$\text{HgSeO}_3, \text{H}_2\text{SeO}_3$  Easily sol in  $\text{H}_2\text{O}$ , very  
 sl sol in alcohol (Berzelius)  
*See also selenium dioxide*

**Mercuric sodium selenite,  $\text{HgSeO}_3, \text{Na}_2\text{SeO}_3$** 

Decomp by  $\text{H}_2\text{O}$  and alkalis with pptn  
 of  $\text{HgSeO}_3$  (Rosenheim and Pritze, Z  
 anorg 1909, 63 279)

**Mercuric selenite sodium chloride,**

$\text{HgSeO}_3, \text{NaCl} + 2\text{H}_2\text{O}$   
 Decomp by  $\text{H}_2\text{O}$  (Rosenheim and Pritze,  
 Z anorg 1909, 63 280)

**Nickel selenite,  $\text{NiSeO}_3 + \text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{H}_2\text{SeO}_3 + \text{Aq}$  (Muspratt,  
 Chem Soc 2 52)  
 $+ \frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Boutzoureano,  
 A ch (6) 17 28)

**Nickel selenite, acid**

Sol in  $\text{H}_2\text{O}$  (Berzelius)

**Potassium selenite,  $\text{K}_2\text{SeO}_3 + \text{H}_2\text{O}$** 

Very deliquescent Sol in nearly all pro-  
 portions in  $\text{H}_2\text{O}$  Insol in alcohol, which  
 separates it as oil from aqueous solution  
 (Muspratt, Chem Soc 2 52)

**Potassium hydrogen selenite,  $\text{KHSeO}_3$** 

Very deliquescent Very sl sol in alcohol  
 (Muspratt, Chem Soc 2 52)

**Potassium trihydrogen selenite,  $\text{KH}_3(\text{SeO}_3)_2$** 

Very deliquescent Pptd from  $\text{H}_2\text{O}$  by  
 alcohol (Muspratt)  
 Not deliquescent (Nilson)

**Potassium hydrogen pyroselenite,  $\text{KHSe}_2\text{O}_5 + \text{H}_2\text{O}$** 

(Muthmann, B 1893, 26 1015)

**Potassium uranyl selenite,  $\text{K}_2\text{SeO}_3, (\text{UO}_2)\text{SeO}_3$** 

Absolutely insol in  $\text{H}_2\text{O}$  (Sendtner)

**Praseodymium hydrogen selenite,**

$\text{Pr}_2(\text{SeO}_3)_3, \text{H}_2\text{SeO}_3 + 3\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (von Scheele, Z anorg  
 1898, 18 362)

**Samarium selenite, basic,  $3\text{Sm}_2\text{O}_3, 8\text{SeO}_2 + 7\text{H}_2\text{O}$** 

Precipitate (Cleve)

**Samarium selenite, acid,  $\text{Sm}_2\text{O}_3, 4\text{SeO}_2 + 5\text{H}_2\text{O}$** 

Precipitate (Cleve)

**Scandium selenite,  $\text{Sc}_2(\text{SeO}_3)_3 + \text{H}_2\text{O}$** 

Insol precipitate

<b>Selenium</b> hydrogen selenite, $\text{Se}_2(\text{SeO}_3)_3$ , $3\text{H}_2\text{SeO}_3$ sol in $\text{H}_2\text{O}$ Not attacked by cold dil aq, but easily if warmed	<b>Tin (stannic) selenite</b> Insol in $\text{H}_2\text{O}$ , sol in $\text{HCl} + \text{Aq}$ , from which it is pptd by $\text{H}_2\text{O}$ (Berzelius)
<b>Silver</b> selenite, $\text{Ag}_2\text{SeO}_3$ ry sl sol in cold, somewhat more sol in hot $\text{H}_2\text{O}$ Easily sol in hot $\text{HNO}_3 + \text{Aq}$ , from which it is precipitated by $\text{H}_2\text{O}$ (Berzelius) sol in $\text{K}_2\text{SeO}_3 + \text{Aq}$ , sl sol in dil $\text{HNO}_3 + \text{Aq}$ (Divers, Chem Soc 49 585)	<b>Uranic selenite</b> , $\text{U}_2\text{O}_3$ , $\text{SeO}_2$ Insol in $\text{H}_2\text{O}$ (Boutzoureano) $+ 2\text{H}_2\text{O}$ (B)
<b>Silver</b> selenite ammonia, $\text{Ag}_3\text{SeO}_3$ , $\text{NH}_3$ sol in boiling $\text{H}_2\text{O}$ (Boutzoureano, A ch (6) 17 289)	<b>Uranic selenite, acid</b> , $2\text{U}_2\text{O}_3$ , $3\text{SeO}_2 + 7\text{H}_2\text{O}$ Insol in $\text{H}_2\text{O}$ (Boutzoureano, A ch (6) 17 289)
<b>Sodium</b> selenite, $\text{Na}_2\text{SeO}_3$ ry sol in $\text{H}_2\text{O}$ Insol in alcohol (Berzelius) $5\text{H}_2\text{O}$	<b>Uranyl selenite</b> , $(\text{UO}_2)\text{SeO}_3 + 2\text{H}_2\text{O}$ Precipitate (Nilson)
<b>Sodium</b> selenite, acid, $\text{NaHSeO}_3$ permanent Sol in $\text{H}_2\text{O}$ $\text{a}_4\text{Se}_3\text{O}_8$ Sol in $\text{H}_2\text{O}$ (Sacc, A ch (3) 21 19) $\text{aH}_3(\text{SeO}_3)_2$ Not deliquescent Sol in $\text{H}_2$	<b>Uranyl selenite, acid</b> , $3\text{UO}_3$ , $5\text{SeO}_2 + 7\text{H}_2\text{O}$ , or $9\text{H}_2\text{O}$ Insol in $\text{H}_2\text{O}$ $\text{UO}_3$ , $2\text{SeO}_2 + \text{H}_2\text{O} = (\text{UO}_3)_2\text{H}_2(\text{SeO}_3)_2$ Absolutely insol in $\text{H}_2\text{O}$ and $\text{H}_2\text{SeO}_3 + \text{Aq}$ (Sendtner, A 195 325)
<b>Sodium vanadium selenite</b> e Vanadioselenite, sodium	<b>Vanadium selenite</b> See Vanadioselenious acid
<b>Strontium</b> selenite, $\text{SrSeO}_3 + 7\text{H}_2\text{O}$ precipitate Insol in $\text{H}_2\text{O}$ Sol in $\text{HNO}_3$ , + q (Muspratt)	<b>Ytterbium selenite</b> , $\text{Yb}_2(\text{SeO}_3)_3$ Insol precipitate
<b>Strontium hydrogen selenite</b> , $\text{SrH}_2(\text{SeO}_3)_2$ asily sol in hot or cold $\text{H}_2\text{O}$ (Nilson) early insol in hot or cold $\text{H}_2\text{O}$ (Berzelius)	<b>Ytterbium hydrogen selenite</b> , $\text{Yb}_2\text{H}_2(\text{SeO}_3)_4 + 4\text{H}_2\text{O}$ Insol in $\text{H}_2\text{O}$
<b>Tellurous</b> selenite, $\text{H}_2\text{SeO}_3$ asily sol in $\text{H}_2\text{O}$ Insol in alcohol and chl i (Kuhlmann, Bull Soc (2) 1 330)	<b>Yttrium selenite</b> , $\text{Y}_2(\text{SeO}_3)_3 + 12\text{H}_2\text{O}$ Insol in $\text{H}_2\text{O}$ or $\text{H}_2\text{SeO}_3 + \text{Aq}$ (Berzelius) Sol in hot $\text{H}_2\text{SeO}_3 + \text{Aq}$ (Nilson)
<b>Tellurous hydrogen selenite</b> , $\text{H}_2\text{HSeO}_3$ [ore sol in $\text{H}_2\text{O}$ than the above comp (K hlin ann)]	<b>Yttrium hydrogen selenite</b> , $\text{Y}_2\text{H}_2(\text{SeO}_3)_4 + 3\text{H}_2\text{O}$ Sl sol in $\text{H}_2\text{O}$ Easily sol in $\text{HCl}$ or $\text{HNO}_3 + \text{Aq}$ (Cleve)
<b>Telluric</b> selenite, $\text{H}_2(\text{SeO}_3)_3$ sol in $\text{H}_2\text{O}$ Sol in dil $\text{HNO}_3$ asily decomp by $\text{HCl}$ and $\text{H}_2\text{SO}_4$ (Marrin, Z anorg 1909, 62 177)	<b>Zinc selenite</b> , $\text{ZnSeO}_3$ Insol in $\text{H}_2\text{O}$ , sol in acids (Boutzoureano, A ch (6) 18 289) $+ 2\text{H}_2\text{O}$ Insol in $\text{H}_2\text{O}$ Sol in $\text{H}_2\text{SeO}_3$ , or $\text{HNO}_3 + \text{Aq}$ (Muspratt, Chem Soc 2 52)
<b>Tellurium</b> selenite, $\text{H}(\text{SeO}_3)_2 + \text{H}_2\text{O}$ , or $8\text{H}_2\text{O}$ sol in $\text{H}_2\text{O}$ , easily sol in $\text{HCl} + \text{Aq}$ (Nilson)	<b>Zinc hydrogen selenite</b> , $\text{ZnH}_2(\text{SeO}_3)_2$ Easily sol in $\text{H}_2\text{O}$ (Berzelius) $+ 2\text{H}_2\text{O}$ Sol in cold $\text{H}_2\text{O}$ (Boutzoureano) $\text{ZnO}$ , $4\text{SeO}_2 + 3\text{H}_2\text{O}$ Easily sol in $\text{H}_2\text{O}$ (Wohler, A 63 279)
<b>Tellurium</b> selenite, acid, $2\text{ThO}_2$ , $7\text{SeO}_2 + 16\text{H}_2\text{O}$ $\text{hO}_2$ , $5\text{SeO}_2 + 5\text{H}_2\text{O}$ (Nilson)	<b>Zinc selenite ammonia</b> , $\text{ZnSeO}_3$ , $\text{NH}_3$ Insol in cold or hot $\text{H}_2\text{O}$ (Boutzoureano, A ch (6) 17 289)
	<b>Zirconium selenite, basic</b> , $4\text{ZrO}_2$ , $3\text{SeO}_2 + 18\text{H}_2\text{O}$ Precipitate Sl sol in $\text{HCl} + \text{Aq}$ (Nilson)

**Zirconium selenite,  $Zr(SeO_3)_2$** 

Absolutely insol in  $H_2O$ , difficultly sol in boiling  $HCl + Aq$  (Nilson)  
 $+ H_2O$  (Nilson)

**Selenium, Se**

Insol in  $H_2O$  Schultz (J pr (2) 32 390) has obtained a soluble colloidal modification which can be isolated by dialysis

Insol in  $HCl + Aq$  Decomp by  $HNO_3 + Aq$  Sol in fuming  $H_2SO_4$  (Schultz-Sellack, B 4 113)

1000 pts  $CS_2$  dissolve 1 pt cryst Se at boiling-point (46.6°), and 0.16 pt at 0° (Mitscherlich, J B 1855 314) Solubility of Se in  $CS_2$  is variable—1 pt Se is sol in 1376–2464–3746 pts  $CS_2$  at 20° (Rammelsberg, B 7 669) Cryst Se, which is sol in  $CS_2$ , becomes insol in  $CS_2$  after heating to 110°, but after fusion is again sol (Otto)

*Four modifications*—(1) Amorphous red, (2) crystalline red, (3) granular gray, (4) laminated 1 and 2 are sol in  $CS_2$ , 3 and 4 are insol in  $CS_2$ . All forms are sol in  $SeCl_2$ , from which crystallizes a black modification, insol in  $CS_2$ .  $CCl_4$  with trace of  $CS_2$  dissolves red Se slightly, black Se not at all  $Se(C_2H_5)_2$  dissolves all modifications in small but apparently equal quantities (Rathke, A 152 181)

According to Saunders (J phys Chem 1900, 4 428) selenium exists in three modifications

1 Liquid, including vitreous, amorphous, and colloidal selenium

**a Vitreous**

Sol in liquid  $NH_3$  at 25° (Franklin, Am Ch J 1898, 20 820)

Insol in liquid  $NH_3$  between -30° and +10° Franklin's results are due to impure selenium and not completely dry  $NH_3$  (Hugot, A Ch 1900, (7) 21 5)

Almost insol in  $CS_2$  (Schutzenberger *Chimie générale* 1 438)

Action of light increases solubility in  $CS_2$  (Saunders, J phys Chem 1900, 4 456)

Solubility in methylene iodide at 12° is 1.3 pts in 100 (Retgers, Z anorg 1893, 3 343)

Sol in  $CSe_2$ , ethyl selenide, and in ethyl sulphide

Very sol in  $Se_2Cl_2$  (Rathke, A 1869, 152 181)

**b Amorphous**

Completely sol in  $CS_2$  at ord temp if Se has not been heated If heated or extracted with warm  $CS_2$  it becomes partly insol (Peterson, Z phys Chem 1891, 81 612)

Passes into red crystalline form in solution in  $CS_2$ ,  $C_6H_6$ , isobutyric acid, acetophenone, acetone  $CHCl_3$ , thiophene, toluene, benzonitrile, ethyl acetate, and alcohol (Saunders, J phys Chem 1900, 4 463)

Solution in quinoline, aniline, pyridine,

etc, cause conversion into gray metallic form

**c Colloidal**

Forms colloidal solution with  $H_2O$

A colloidal solution of Se in  $H_2O$  can be obtained It is not decomp by boiling, but is decomp by electrolytes with separation of red selenium (Gutbier, Z anorg 1902, 32 106)

**2 Red crystalline**

Sol in  $CS_2$

**3 Gray, crystalline or metallic**

Sol in selenium chloride and other solvents as vitreous Se (Rathke, A 1869, 152 181)

Sl sol in  $CS_2$ , toluene, nitrobenzene, quinoline, aniline, and  $KOH$  Pptd from conc  $KOH + Aq$  in long needles with mpt 219° (Coste, C R 1909, 149 674)

Sol in many organic substances at high temp as quinoline, ethyl benzoate, aniline and naphthalene (Saunders, J phys Chem 1900, 4 469)

Completely insol in  $CS_2$  (Saunders, J phys Chem 1900, 4 474)

**Solubility of the two modifications of gray crystalline Se in  $CS_2$** 

100 cc boiling  $CS_2$  dissolve mg Se

I	II	III
Mg Se	Mg Se	Mg Se
3 2	4 1	2 7
2 8	4 0	2 2
3 6	2 9	1 9
3 3	2 8	1 0
2 2	2 9	2 0
	4 0	

I Se heated 1 hr at 140° Modification A

II Modification A

III Se heated 48 hrs at 190°–200° Modification B

(Marc, Z anorg 1907, 53 302)

$Se_2Br_2$  dissolves 22% Se (Schneider, Pogg 128 327)

Red Se is sol in  $(NH_4)_2SO_3 + Aq$  (Uelsmann, A 116 122)

Sol in alkalis and  $Mg$  sulphites +  $Aq$

365 pts  $K_2SO_3 + Aq$  dissolve 102 pts Se  
 360 pts  $MgSO_3, 3H_2O + Aq$  dissolve 116 pts Se

Insol in  $BaSO_3 + Aq$  (Rathke and Zschiesche, J pr 92 145)

Sol in  $KCN + Aq$  with formation of  $KSeCN$  (Franklin, Am Ch J 1898, 20 830)

100 pts methylene iodide dissolve 1.3 pts Se at 12° (Retgers, Z anorg 3 343)

Sol in quinoline, but reacts with the solvent with evolution of  $H_2$  (Beckmann and Gabel, Z anorg 1906, 51 236)

**Selenium monobromide,  $\text{Se}_2\text{Br}_2$** 

Insol in  $\text{H}_2\text{O}$ , but gradually decomp by. Decomp by absolute alcohol and benzene. Sol in  $\text{C}_2\text{H}_5\text{I}$ , but soon decomposed. Miscible with  $\text{CS}_2$ , less sol in  $\text{CHCl}_3$  and  $\text{C}_6\text{H}_6$  (Schneider, Pogg 128 327)

**Selenium tetrabromide,  $\text{SeBr}_4$** 

Sol in  $\text{H}_2\text{O}$  with decomp. Decomp by alcohol. Sol in  $\text{HCl} + \text{Aq}$ , sl sol in  $\text{CS}_2$ ,  $\text{CHCl}_3$ , and  $\text{C}_2\text{H}_5\text{Br}$  (Schneider, Pogg 1450)  
Decomp by  $\text{C}_2\text{H}_5\text{I}$

**Selenium bromotrichloride,  $\text{SeCl}_3\text{Br}$** 

Insol in  $\text{CS}_2$  (Fvans and Ramsay, Chem Soc 45 62)

**Selenium tetrabromide sulphur trioxide,  $\text{SeBr}_4, 2\text{SO}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Prandtl, Z anorg 19, 62 242)

**Selenium tribromochloride,  $\text{SeClBr}_3$** 

See Selenium chlorotribromide

**Selenium monochloride,  $\text{Se}_2\text{Cl}_2$** 

Gradually decomp by  $\text{H}_2\text{O}$ . Dissolves a modifications of selenium on heating (Athke, A 152 181). Insol in conc  $\text{H}_2\text{SO}_4$ , easily sol in fuming  $\text{H}_2\text{SO}_4$ . Sol in  $\text{CHCl}_3$ ,  $\text{CH}_2\text{Cl}_2$ ,  $\text{CCl}_4$ . Gradually decomp by  $\text{H}_2\text{O}$ , alcohol, and ether (Divers and Shimosé, I 17 862). Sol in  $\text{CS}_2$  (Evans and Ramsay, Chem Soc 45 62)

**Selenium tetrachloride,  $\text{SeCl}_4$** 

Deliquescent on moist air. Decomp with  $\text{H}_2\text{O}$  (Berzelius, A ch 9 225). Insol in  $\text{H}_2\text{O}$ . Easily sol in hot  $\text{POCl}_3$ , from which it crystallizes on cooling (Michaelis, Zeit chem (2) 6 460). Very sl sol in  $\text{CS}_2$  (Evans and Ramsay, Chem Soc 45 62)

**Selenium dichlorobromide,  $\text{SeCl}_2\text{Br}_2$** 

(Evans and Ramsay, Chem Soc 45 62)

**Selenium chlorotribromide,  $\text{SeClBr}_3$** 

Very sl sol in  $\text{CS}_2$  (Fvans and Ramsay)

**Selenium trichlorobromide,  $\text{SeCl}_3\text{Br}$** 

See Selenium bromotrichloride

**Selenium fluoride**

Sol in conc  $\text{HF} + \text{Aq}$ . Decomp immediately by  $\text{H}_2\text{O}$  (Knox)

**Selenium moniodide,  $\text{Se}_2\text{I}_2$** 

Decomp by  $\text{H}_2\text{O}$ . All solvents of iodine dissolve out that element (Schneider, Pogg 129 627)

**Selenium tetraiodide,  $\text{SeI}_4$** 

Slowly decomp by much  $\text{H}_2\text{O}$ . Iodine is dissolved out by all solvents of that element (Schneider, Pogg 129 627)

**Selenium nitride**

See Nitrogen selenide

**Selenium monoxide,  $\text{SeO}$  (?)**

Sl sol in  $\text{H}_2\text{O}$  (Berzelius)  
Does not exist (Sacc)

**Selenium dioxide,  $\text{SeO}_2$** 

Deliquescent. Easily sol in  $\text{H}_2\text{O}$  and alcohol. Sol in glacial  $\text{HC}_2\text{H}_3\text{O}_2$  (Hinsberg, A 260 40)

Solubility in  $\text{H}_2\text{O}$  between  $-3^\circ$  and  $+36^\circ$  = 45.0 + 0.7692t (Etard, C R 1888, 106 742)

1 pt is sol in 2.67 pts  $\text{H}_2\text{O}$  at  $11.3^\circ$   
1 pt " " " 2.60 " " "  $14^\circ$   
1 pt " " " 2.54 " " "  $15.6^\circ$

(de Coninck, C R 1906, 142 571)

Sp gr of  $\text{SeO}_2 + \text{Aq}$  at  $t^\circ$

$t^\circ$	% $\text{SeO}_2$	Sp gr
15.1	1	0.9923
15.3	2	1.0068
13.0	3	1.0200
13.0	4	1.0302
14.5	5	1.0346
14.8	6	1.0402
14.1	7	1.0535
15.0	8	1.0571
15.6	9	1.0719
15.2	10	1.0743

(de Coninck, C R 1906, 142 571)

**See also Selenious acid**

1 pt  $\text{SeO}_2$  is sol in 9.84 pts alcohol ( $93^\circ$ ) at  $14^\circ$

1 pt  $\text{SeO}_2$  is sol in 15.0 pts methyl alcohol at  $11.8^\circ$

1 pt  $\text{SeO}_2$  is sol in 23.0 pts acetone at  $15.3^\circ$

1 pt  $\text{SeO}_2$  is sol in 90.0 pts acetic acid at  $12.9^\circ$  (de Coninck, C R 1906, 142 572)

Traces dissolve in acetic anhydride. Sol in phenyl mercaptan (Hinsberg, A 1890, 260 40)

Insol in pure  $\text{C}_6\text{H}_6$  (Clausnizer, A 1879, 196 271)

See Selenious acid

**Selenium trioxide,  $\text{SeO}_3$** 

Not obtained in a pure state (Cameron and Macallan)

See Selenic acid

**Selenium dioxide hydrobromic acid,  $\text{SeO}_2$ ,  $4\text{HBr}$** 

Decomp at  $55^\circ$  (Ditte, A ch (5) 10 82)  
 $\text{SeO}_2$ ,  $5\text{HBr}$  Decomp at  $65^\circ$  (Ditte, A ch (5) 10 82)

**Selenium dioxide hydrochloric acid,  $\text{SeO}_2$ ,  $2\text{HCl}$** 

Decomp at  $26^\circ$   
 $\text{SeO}_2$ ,  $4\text{HCl}$  Decomp at  $0^\circ$  Sol in  $\text{H}_2\text{O}$  without evolution of gas (Ditte, A ch (5) 10 82)

**Selenium dioxide sulphur trioxide,  $\text{SeO}_2$ ,  $\text{SO}_3$** 

Decomp violently by  $\text{H}_2\text{O}$  (Weber, B. 19 3185)  
 Composition may be  $(\text{SeO})\text{SO}_4$  (?)

**Selenium oxy-compounds**

See Selenyl compounds

**Selenium diphosphide,  $\text{P}_2\text{Se}$** 

See Phosphorus monoselenide

**Selenium tetraphosphide,  $\text{P}_4\text{Se}$** 

See Phosphorus semiselenide

**Selenium monosulphide,  $\text{SeS}$** 

Insol in  $\text{H}_2\text{O}$  and ether Sol in  $\text{CS}_2$   
 Decomp by alcohol (Ditte, C R 73 625, 660)

Other compounds of Se and S are probably mixtures of the two elements

**Selenium disulphide,  $\text{SeS}_2$** 

Compound of this formula is a mixture of  $\text{SeS}$  and  $\text{S}$  (Ditte, C R 73 625, 660).

**Selenium sulphoxide,  $\text{SeSO}_3$** 

Decomp by  $\text{H}_2\text{O}$  Sol in fuming  $\text{H}_2\text{SO}_4$ , conc  $\text{H}_2\text{SO}_4$  Sol in  $\text{H}_2\text{SO}_4$  of 1.806 sp gr without decomp (Weber, Pogg 156 531)

Decomp by  $\text{H}_2\text{O}$ , sol in  $\text{H}_2\text{SO}_4$  (Divers and Shmosé, B 17 858)

**Selenuretted hydrogen,  $\text{H}_2\text{Se}$** 

See Hydrogen selenide

**Selenoarsenic acid****Potassium selenoarsenate,  $\text{KAsSe}_3+2\text{H}_2\text{O}$** 

Only sl sol in cold  $\text{H}_2\text{O}$ , sol in warm  $\text{H}_2\text{O}$  with decomp, more stable in  $\text{KOH}+\text{Aq}$  (Clever, Z anorg 1895, 10 132)

**Sodium selenoarsenate,  $\text{Na}_3\text{AsSe}_4+9\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$ , very unstable (Szarvasy, B 1895, 28 2658)

**Selenoarsenous acid****Sodium selenoarsenite,  $\text{Na}_3\text{AsSe}_3+9\text{H}_2\text{O}$** 

Moderately sol in  $\text{H}_2\text{O}$  (Clever and Muthmann, Z anorg 1895, 10 139)

**Selenobismuthous acid****Potassium metaselenobismuthite,  $\text{Bi}_2\text{Se}_3$ ,  $\text{K}_2\text{Se}$  or  $\text{KBiSe}_2$** 

Insol in cold dil  $\text{HCl}+\text{Aq}$  Sol on warming, with evolution of  $\text{H}_2\text{Se}$  (Hilger and van Scherpenberg, Mitt Pharm II 4)

**Selenocyanhydric acid,  $\text{HSeCN}$** 

Known only in aqueous solution

**Ammonium selenocyanide,  $\text{NH}_4\text{SeCN}$** 

Very deliquescent, and sol in  $\text{H}_2\text{O}$

**Barium —,  $\text{Ba}(\text{SeSCN})_2$** 

Very sol in  $\text{H}_2\text{O}$

**Lead —,  $\text{Pb}(\text{SeCN})_2$** 

Sl sol in cold, sol with sl decomp in boiling  $\text{H}_2\text{O}$  Insol in alcohol

**Mercurous —,  $\text{Hg}_2(\text{SeCN})_2$** 

Ppt

**Mercuric —,  $\text{Hg}(\text{SeCN})_2$** 

Sl sol in cold  $\text{H}_2\text{O}$  Easily sol in  $\text{MCN}$ ,  $\text{MSCN}$ , or  $\text{MSeCN}+\text{Aq}$ , also sol in hot  $\text{HgCl}_2+\text{Aq}$  (Cameron and Davy, C N 44 63)

Decomp by hot  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1909, 63 276)

**Mercuric potassium —,  $\text{Hg}(\text{SeCN})_2$ ,  $\text{KSeCN}$** 

Easily sol in  $\text{H}_2\text{O}$  Sl sol in cold alcohol (Cameron and Davy, C N 44 63)

**Mercuric selenocyanide chloride,**

$\text{Hg}(\text{SeCN})_2$ ,  $\text{HgCl}_2$

Sol in boiling  $\text{H}_2\text{O}$  and in abs alcohol  
 Decomp by long boiling with  $\text{H}_2\text{O}$  (Rosenheim and Pritze, Z anorg 1909, 63 276)

**Platinum potassium — (Potassium platinum-selenocyanide)  $\text{K}_2\text{Pt}(\text{SeCN})_6$** 

Sol in  $\text{H}_2\text{O}$  and alcohol (Clarke, B 11 1375)

**Potassium —,  $\text{KSeCN}$** 

Very deliquescent, and sol in  $\text{H}_2\text{O}$  with absorption of heat More sol in  $\text{H}_2\text{O}$  than  $\text{KSCN}$  Sol in alcohol

**Potassium — mercuric bromide,  $\text{KSeCN}$ ,  $\text{HgBr}_2$** 

Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  or alcohol (Cameron and Davy, C N 44 63)

- Potassium selenocyanide mercuric chloride**,  $\text{KSeCN}$ ,  $\text{HgCl}_2$   
as the bromide
- Potassium — mercuric iodide**,  $\text{KSeCN}$ ,  $\text{HgI}_2$   
sol in cold, easily in hot  $\text{H}_2\text{O}$  or alcohol  
(Cameron and Davy)
- Potassium — mercuric sulphocyanide**,  $\text{KSeCN}$ ,  $\text{Hg}(\text{SCN})_2$   
sol in cold, much more in hot  $\text{H}_2\text{O}$  or alcohol  
Somewhat sol in ether (Cameron and Davy)
- Silver —**,  $\text{AgSeCN}$   
insol in  $\text{H}_2\text{O}$  Almost insol in  $\text{NH}_4\text{OH}$  +  
A or cold dil acids Quickly decomp by  
hot conc acids
- Sodium —**,  $\text{NaSeCN}$   
very sol in  $\text{H}_2\text{O}$
- Selenomolybdic acid**
- Potassium selenomolybdate**,  $5\text{K}_2\text{O}$ ,  $6\text{SeO}_2$ ,  $17\text{MoO}_3$   
readily sol in  $\text{H}_2\text{O}$  without decomp  
(Cobbs, Am Ch J 1895, 17 177)
- Selenopentathionic acid**
- Sodium selenopentathionate**,  $\text{Na}_2\text{S}_4\text{SeO}_6$   
A dil solution may be boiled for some time  
without change (Norris and Fay, Am Ch  
J 1900, 23 121)
- Selenophosphoric acid**
- Ammonium selenophosphate**,  
 $2(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $2\text{SeO}_3 + 3\text{H}_2\text{O}$   
sol in  $\text{H}_2\text{O}$  with decomp (Weinland, B  
1913, 36 1402)
- Barium selenophosphate**,  
 $2\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $2\text{SeO}_3 + 3\text{H}_2\text{O}$   
sol in  $\text{H}_2\text{O}$  with decomp  
 $3.5\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{SeO}_3 + 5.5\text{H}_2\text{O}$  Easily  
sol in  $\text{H}_2\text{O}$  (Weinland)
- Barium selenophosphate**,  
 $2\text{Rb}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $2\text{SeO}_3 + 3\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  with decomp (Weinland)
- Barium selenophosphorous acid**
- Potassium triselenophosphite**,  
 $\text{K}_2\text{H}_2\text{PSe}_3 + 2\frac{1}{2}\text{H}_2\text{O}$   
Decomp by moist air and dil acids, sol  
in conc  $\text{KOH}$  + Aq, sl sol in cold, easily sol  
in hot  $\text{H}_2\text{O}$  (Muthmann, Z anorg 1897,  
198)
- Selenosamic acid**,  $\text{HSeO}_2\text{NH}_2$   
Known only in its salts
- Ammonium selenosamate**,  $(\text{NH}_4)_2\text{SeO}_2\text{NH}_2$   
Deliquescent Decomp slowly by  $\text{H}_2\text{O}$   
into  $(\text{NH}_4)_2\text{SeO}_3$   
1 pt is sol in 116 pts cold alcoholic am-  
monia at  $12^\circ$  More sol in hot alcoholic  
ammonia Sl attacked by cold  $\text{HCl}$  or  $\text{HNO}_3$   
(Cameron and Macallan, C N 1888, 57 163)
- Ammonium hydrogen selenosamate**,  
 $\text{NH}_4\text{H}(\text{SeO}_2\text{NH}_2)_2$   
Deliquescent Sol in 14 pts alcohol at  
 $14^\circ$  (Cameron and Macallan, Proc Roy  
Soc 44 112)
- Selenostannic acid**
- Ammonium selenostannate**,  $3\text{SnSe}_2$   $(\text{NH}_4)_2\text{Se}$   
 $+ 3\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Ditte, C R 95 641)
- Platinum potassium —**,  $\text{K}_2\text{Se}$ ,  $3\text{PtSe}$ ,  $\text{SnSe}_2$   
Insol in hot or cold  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$ , or  
 $\text{KOH}$  + Aq Not attacked by hot  $\text{HCl}$  + Aq  
(Schneider, J pr (2) 44 507)
- Platinum sodium —**,  $\text{NaSe}$ ,  $3\text{PtSe}$ ,  $\text{SnSe}_2$   
Properties as the corresponding K salt  
(Schneider)
- Potassium —**,  $\text{K}_2\text{SnSe}_3 + 3\text{H}_2\text{O}$   
Easily sol in  $\text{H}_2\text{O}$  (Ditte, C R 95 441)
- Selenosulphantimonic acid**
- Sodium selenosulphantimonate**,  $\text{Na}_3\text{SbSeS}_3 +$   
 $9\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Hofacker, A 107 6)  
 $\text{Na}_3\text{SbS}_{1.5}\text{Se}_2 + 9\text{H}_2\text{O}$  Somewhat sol in  
 $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 564)
- Selenosulphantimonous acid**
- Potassium selenosulphantimonite**,  
 $\text{Sb}_4\text{S}_5\text{Se}_6\text{K}_{10} + 4\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7)  
18 563)
- Sodium selenosulphantimonite**,  $\text{Na}_3\text{SbS}_{1.5}\text{Se}_2 +$   
 $9\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18  
564)
- Selenosulpharsenic acid**
- Potassium selenosulpharsenate**,  $3\text{K}_2\text{S}$ ,  $\text{As}_2\text{Se}_3$   
 $+ 12\text{H}_2\text{O}$   
Very unstable in the air Very sol in  $\text{H}_2\text{O}$   
Fairly stable in aqueous solution Decomp  
by acids (Clever, Z anorg 1895, 10 134)



**Sodium selenosulpharsenate**,  $\text{Na}_3\text{AsS}_3\text{Se} + 8\text{H}_2\text{O}$

Decomp by acids, stable in dry air (Messinger, B 1897, 30 801)

$3\text{Na}_2\text{S}, \text{As}_2\text{Se}_3 + 18\text{H}_2\text{O}$  Quite sol in  $\text{H}_2\text{O}$ , quite stable in air (Clever, Z anorg 1895, 10 140)

$\text{Na}_4\text{As}_2\text{S}_5\text{Se}_3 + 16\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$ , decomp by acids (Messinger, B 1897, 30 803)

$\text{Na}_4\text{As}_2\text{S}_7\text{Se} + 16\text{H}_2\text{O}$  Stable in dry air, easily sol in  $\text{H}_2\text{O}$ , decomp by acids (Messinger, B 1897, 30 800)

$\text{Na}_3\text{AsS}_2\text{Se}_2 + 9\text{H}_2\text{O}$  Decomp in aq solution by dil acids (Messinger, B 1897, 30 802)

$\text{Na}_3\text{AsSSe}_3 + 9\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , decomp by aq acids hygroscopic (Messinger)

### Selenosulphophosphorous acid

**Potassium selenosulphophosphite**,  $2\text{K}_2\text{S}, \text{P}_2\text{Se}_3 + 5\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , decomp by acids (Muthmann, Z anorg 1897, 13 198)

### Selenosulphostannic acid

**Ammonium selenosulphostannate**,  $(\text{NH}_4)_2\text{S}, 3\text{SnSe}_2 + 3\text{H}_2\text{O}$

Easily decomp (Ditte, C R 1882, 95 643)

**Potassium** —  $\text{K}_2\text{SnSe}_2\text{S} + 3\text{H}_2\text{O}$

Verv easily sol in  $\text{H}_2\text{O}$  (Ditte, C R 95 641)

**Sodium** —  $\text{Na}_2\text{SnSe}_2\text{S} + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Ditte, C R 95 641)

### Selenosulphoxyarsenic acid

**Sodium selenosulphoxyarsenate**,  $\text{Na}_3\text{AsO}_2\text{SSe} + 10\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  but solution rapidly decomp (Messinger, B 1897, 30 798)

$\text{Na}_6\text{As}_2\text{S}_2\text{SeO}_5 + 24\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Messinger)

$\text{Na}_4\text{As}_2\text{SeS}_3\text{O}_4 + 20\text{H}_2\text{O}$  Stable in dry air Sl sol in  $\text{H}_2\text{O}$ , decomp by dil acids (Messinger)

$\text{Na}_6\text{As}_2\text{S}_3\text{Se}_2\text{O}_3 + 20\text{H}_2\text{O}$  Ppt (Messinger)

$\text{Na}_4\text{As}_3\text{S}_2\text{Se}_2\text{O}_8 + 36\text{H}_2\text{O}$  Decomp by aq acids, sol in  $\text{H}_2\text{O}$ , quite stable (Messinger)

### Selenosulphur trioxide, $\text{SeSO}_3$

See Selenium sulphoxide

### Selenosulphuric acid, $\text{H}_2\text{SeSO}_3$

Known only in its salts

**Potassium selenosulphate**,  $\text{K}_2\text{SeSO}_3 + x\text{H}_2\text{O}$

Deliquescent in moist air, decomp by  $\text{H}_2\text{O}$  (Rathke, J pr 95 1)

### Selenotrithionic acid, $\text{H}_2\text{S}_2\text{SeO}_6$

Known only in solution, which is stable in dark (Schulze, J pr (2) 32 390)

### Barium selenotrithionate

Sol in  $\text{H}_2\text{O}$  (Rathke)

**Potassium** —  $\text{K}_2\text{SeS}_2\text{O}_6$

Sol in  $\text{H}_2\text{O}$  with gradual decomp (Rathke J pr 95 8, 97 56)

### Dyselenotrithionic acid, $\text{H}_2\text{SSe}_2\text{O}_6$

Exceedingly unstable (Schulze)

### Selenovanadic acid

**Lithium selenovanadate**,  $4\text{Li}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 30\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Prandtl and Lustig, Z anorg 1907, 53 401)

**Potassium selenovanadate**,  $2\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 12\text{SeO}_2 + 12\text{H}_2\text{O}$

(Prandtl and Lustig)

$3\text{K}_2\text{O}, 5\text{V}_2\text{O}_5, 16\text{SeO}_2 + 40\text{H}_2\text{O}$  (Prandtl and Lustig)

$4\text{K}_2\text{O}, 6\text{V}_2\text{O}_5, 21\text{SeO}_2 + 37\text{H}_2\text{O}$  (Prandtl and Lustig)

$5\text{K}_2\text{O}, 10\text{V}_2\text{O}_5, 26\text{SeO}_2 + 43\text{H}_2\text{O}$  (Prandtl and Lustig)

**Sodium selenovanadate**,  $4\text{Na}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 20\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Solution decomp gradually (Prandtl and Lustig)

$2\text{Na}_2\text{O}, 7\text{V}_2\text{O}_5, 10\text{SeO}_2 + 13\text{H}_2\text{O}$  (Prandtl and Lustig)

$2\text{Na}_2\text{O}, 7\text{V}_2\text{O}_5, 12\text{SeO}_2 + 45\text{H}_2\text{O}$ , and  $+90\text{H}_2\text{O}$  (Prandtl and Lustig)

### Selenoxyarsenic acid

**Ammonium selenoxyarsenate**,  $2(\text{NH}_4)_2\text{O}, 2\text{SeO}_3, \text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with decomp (Weinland, B 1903, 36 1403)

**Barium sodium selenoxyarsenate**,

$\text{BaNaAsO}_3\text{Se} + 9\text{H}_2\text{O}$

Ppt (Weinland, Z anorg 1897, 14 56)

**Potassium selenoxyarsenate**,  $2\text{K}_2\text{O}, 2\text{SeO}_3, \text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with decomp (Weinland and Bartlingck, B 1903, 36 1403)

$7\text{K}_2\text{O}, 10\text{SeO}_3, 2\text{As}_2\text{O}_5 + 11\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Weinland and Bartlingck)

$3\text{K}_2\text{O}, \text{As}_2\text{Se}_3 + 10\text{H}_2\text{O}$  Easily decomp by

sture Very sol in  $H_2O$  (Clever, Z  
ar rg 1895, 10 126)

Rubidium selenoxyarsenate,  $2Rb_2O, 2SeO_3,$   
 $As_2O_5+3H_2O$

sol in  $H_2O$  with decomp (Weinland and  
Böttlingek)

Sodium selenoxyarsenate,  $Na_2AsSeO_3$

fairly stable in air and in aq solution  
(Weinland, B 1896, 29 1010)

$As_2AsSeO_3+12H_2O$  Stable in the air  
when pure, sol in  $H_2O$  with decomp (Wein-  
land, Z anorg 1897, 14 50)

$As_2AsSeO_3+12H_2O$  Very sol in  $H_2O,$   
unstable (Szarvasy, B 1895, 28 2657)  
 $Na_2O, 3Na_2Se, As_2O_5+50H_2O$  Easily  
sol in  $H_2O$  Solution may be boiled for a  
long time without decomp (Clever, Z  
ar rg 1895, 10 136)

Selenoxyphosphoric acid

Ammonium triselenmonoxyphosphate,  
 $(NH_4)_3PSe_3O+10H_2O$   
pt (Ephraim, B 1910, 43 280)

Ammonium hydrogen triselenmonoxyphos-  
phate,  $(NH_4)_5H(PSe_3O)_2+18H_2O$   
pt (Ephraim)

Barium hydrogen diselenmonoxyphosphate,  
 $BaHPS_2O_2+14H_2O$   
decomp in moist air (Ephraim)

Potassium selenoxyphosphate,  $K_3PSe_3O_15$   
 $+H_2O$   
decomp by  $HNO_3$  Insol in alcohol and  
ether (Ephraim)

Sodium monoselenmonoxyphosphate,  
 $Na_4PSe_3O_1+20H_2O$   
decomp by  $H_2O$  (Ephraim)

Sodium triselenmonoxyphosphate,  $Na_3PSe_3O$   
 $+10H_2O$   
sol in  $H_2O$  Decomp in aq solution  
Easily sol in conc  $NaOH+aq$  (Muth-  
mann, Z anorg 1897, 13 199)

Selenyl bromide,  $SeOBr_2$  (?)  
chloride, Pogg 129 450)

Selenyl bromide sulphur dioxide,  $SeOBr_2,$   
 $SO_2$   
handtl, Z anorg 1909, 62 242)

Selenyl chloride,  $SeO_2Cl_2$   
easily decomp by  $H_2O$  (Weber, Pogg  
111 615)

Selenyl sulphur chloride  
e Sulphoselenyl chloride

Selenyl stannic chloride,  $2SeOCl_2, SnCl_4$

Extremely deliquescent Completely sol  
in  $H_2O$  (Weber, B A B 1865 154)

Selenyl titanium chloride,  $2SeOCl_2, TiCl_4$

Decomp by  $H_2O$  with separation of an  
insol residue Decomp by  $NH_4OH+aq$   
(Weber, B A B 1865 154)

Sesquauramine

See Sesquauramine

Sesquihydraurylamine,  $(HOAu)_3N, NH_3$

See Sesquihydraurylamine

Silicic acid,  $SiO_2, xH_2O$

See also Silicon dioxide

Silicic acid is sol in 1000 pts pure  $H_2O$   
(Kirwan)

When pptd from alkali silicates+aq by  
 $CO_2$ , 0.021 pt  $SiO_2$  remains dissolved in 100  
pts  $H_2O$  (Struckmann, A 94 341)

When pptd as above, 100 pts  $H_2O$  dissolve  
0.09 pt  $SiO_2$  in 3 days, 100 pts  $H_2CO_3+aq$   
dissolve 0.078 pt  $SiO_2$  in 3 days But if  
heated much more dissolves, the jelly itself  
becoming liquid, such jelly containing 2.49  
pts  $SiO_2$  to 100 pts  $H_2O$  This solution is  
not pptd by considerable quantities of al-  
cohol, but conc  $(NH_4)_2CO_3, NaCl$ , or  $CaCl_2+aq,$   
etc, cause gelatinization (Maschke, J  
pr 68 234)

Solubility in  $H_2O$  depends on the amt of  
 $H_2O$ , in presence of which the silicic acid  
is set free by dil acids,  $CO_2$ , or alkali salts+  
aq If  $H_2O$  is present in sufficient quantity  
to retain the silicic acid, much more will  
remain in solution than can be dissolved by  
digesting the gelatinous acid with  $H_2O$  after-  
wards 1 pt  $SiO_2$  can thus be held in solution  
by 500 pts  $H_2O$  Presence of  $NH_4OH,$   
 $(NH_4)CO_3$ , or  $NH_4Cl$  (in solutions of which  
 $SiO_2$  is remarkably insol) diminishes the  
power of  $H_2O$  to retain  $SiO_2$  in solution  $SiO_2$   
is always more sol in dil than conc  $NH_4OH$   
+aq (Liebig, A 94 373)

Silicic acid from the coagulation of the col-  
loid form (see p 802) is sol in about 5000  
pts  $H_2O$  when formed from a 1% solution,  
and 10,000 pts when formed from a 5% solu-  
tion, but is insol after being dried (Graham,  
A 121 36)

Silicic acid is more sol in dil acids than in  
 $H_2O$ , because, when acid is added in excess  
to moderately dil  $K_2SiO_3+aq$ , the solution  
remains clear, but if only enough acid is  
added to neutralize the base present, silicic  
acid will gradually separate out If acid is  
added to conc  $K_2SiO_3+aq$ , silicic acid sepa-  
rates out insol in excess of acid, but if  
20-30 pts  $H_2O$  are present to 1 pt  $K_2SiO_3$ ,  
and an excess of acid added at once, the silicic  
acid will remain in solution This result is  
obtained with  $HCl, HNO_3, H_2SO_4$ , or

$\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  These solutions may dissolve a neutral salt until saturated and no silicic acid will separate out. Therefore it is the acid that holds the  $\text{SiO}_2$  in solution, and not the  $\text{H}_2\text{O}$  (C J B Karsten, (1826) Pogg 3 353)

Even  $\text{CO}_2$  has the power of holding  $\text{SiO}_2$  in solution (Karsten, l c)

Solubility in acids of silicic acid of Struckmann (see above) 100 pts dil  $\text{HCl} + \text{Aq}$  of 1.088 sp gr dissolve 0.0172 g  $\text{SiO}_2$  in 11 days, 100 pts  $\text{H}_2\text{O}$  sat with  $\text{CO}_2$  dissolve 0.0136 g  $\text{SiO}_2$  in 7 days

Silicic acid obtained by passing  $\text{SiF}_4$  into  $\text{H}_2\text{O}$  is sol while still moist in 11,000 pts cold, and 5500 pts boiling  $\text{HCl} + \text{Aq}$  of 1.115 sp gr (Fuchs, A 82 119)

Silicic acid at the moment of separation (as in dissolving cast-iron, steel, etc) is abundantly sol in aqua regia (3 pts  $\text{HCl} + \text{Aq}$  of sp gr 1.13 and 1 pt  $\text{HNO}_3 + \text{Aq}$  of sp gr 1.33) (Wittstein, Z anal 7 433)

The aq solution obtained by the hydrolysis of ethyl silicate is more stable in acids +  $\text{Aq}$  or alkali than in pure  $\text{H}_2\text{O}$  (Jordis, Z anorg 1903, 35 16)

$\text{NH}_4\text{OH} + \text{Aq}$  dissolves considerable freshly precipitated silicic acid,  $(\text{NH}_4)_2\text{CO}_3$  only a very little (Karsten, Pogg 6 357)

Dry or ignited  $\text{SiO}_2$  is sol in  $\text{NH}_4\text{OH} + \text{Aq}$  100 pts  $\text{NH}_4\text{OH} + \text{Aq}$  containing 10%  $\text{NH}_3$  dissolve 0.714 pt  $\text{SiO}_2$  from gelatinous silicic acid, 0.303 pt from artificially dried silicic acid, 0.377 pt from amorphous  $\text{SiO}_2$ , 0.017 pt from quartz (Pribram, Z anal 6 119)

$\text{NH}_4\text{OH} + \text{Aq}$  dissolves 0.382 pt  $\text{SiO}_2$  from dry silicic acid 0.357 pt from ignited  $\text{SiO}_2$ , 0.00827 pt from quartz (Souhay, Z anal 11 182)

Silicic acid precipitated from alkali silicates +  $\text{Aq}$  with  $\text{CO}_2$  is sol as follows 100 pts pure  $\text{H}_2\text{O}$  dissolve 0.021 pt  $\text{SiO}_2$ , 100 pts  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  containing 5%  $(\text{NH}_4)_2\text{CO}_3$ , 0.020 pt, 100 pts containing 1%  $(\text{NH}_4)_2\text{CO}_3$ , 0.062 pt, 100 pts  $\text{NH}_4\text{OH} + \text{Aq}$  containing 19.2%  $\text{NH}_3$ , 0.071 pt, 100 pts containing 1.6%, 0.0986 pt (Struckmann, A 94 341)

100 pts  $\text{NH}_4\text{OH} + \text{Aq}$  (10%  $\text{NH}_3$ ) dissolve of crystallised  $\text{SiO}_2$ , 0.017 pt, amorphous  $\text{SiO}_2$ , ignited, 0.38 pt, amorphous  $3\text{SiO}_2 \cdot 4\text{H}_2\text{O}$ , 0.21 pt, amorphous silicic acid in form of jelly, 0.71 pt. Upon evaporation no ppt is formed, even when 80 mols  $\text{SiO}_2$  are present to 1 mol  $\text{NH}_3$  (Wittstein, J B 1866 192)

Sol in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ , especially if warm (Dumas)

Sol in  $\text{K}_2\text{SiO}_3$  or  $\text{Na}_2\text{SiO}_3 + \text{Aq}$  (Fuchs)

Easily sol in boiling  $\text{Na}_2\text{CO}_3 + \text{Aq}$ , separating as a jelly on cooling (Pfaff)

$\text{NH}_4\text{Cl}$  or other  $\text{NH}_4$  salts ppt  $\text{SiO}_2$  from solution in  $\text{Na}_2\text{CO}_3 + \text{Aq}$

100 pts  $\text{Ti}_2\text{O}$  in  $\text{H}_2\text{O}$  dissolve 4.17 pts amorphous  $\text{SiO}_2$  in 24 hours' boiling (Flemming, Jena Zeit 4 36)

Sol in butyl amine (Wurtz, A ch (3) 42 166)

Not more sol in  $\text{H}_2\text{O}$  containing sugar than in pure  $\text{H}_2\text{O}$  (Petzholdt, J pr 60 368)

#### *Soluble silicic acid*

*Colloidal form by dialysis* Solutions containing 4.9%  $\text{SiO}_2$  may be evaporated until they contain 14%  $\text{SiO}_2$ . The  $\text{SiO}_2$  is separated from its solution thus made in many ways—

(1) By standing. This happens the more easily the more conc the solution is, and is hastened by heat. A 10–12% solution gelatinizes at ordinary temp in a few hours, and immediately upon heating. A 5–6% solution may be kept 5–6 days, a 2% solution, 2–3 months, and a 1% solution may be kept 2 or more years without gelatinizing.

(2) When the solution is evaporated to dryness in vacuo at  $15^\circ$  a transparent glass is left which is insol in  $\text{H}_2\text{O}$ .

(3) The coagulation of colloidal silicic acid is accelerated by powdered graphite and other indifferent bodies, and it is brought about in a few minutes by a solution of the alkali carbonates, even when only  $\frac{1}{10,000}$  pt of the carbonate is present (Graham, A 121 36)

(4) Coagulation is also brought about by passing  $\text{CO}_2$  through the solution (Liebig)

$\text{CO}_2$  does not cause coagulation (Maschke)

Coagulation is not caused by  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{H}_2\text{C}_4\text{H}_6\text{O}_6$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ , or by neutral or acid salts +  $\text{Aq}$  (Graham)

$\text{NaCl}$  and  $\text{Na}_2\text{SO}_4 + \text{Aq}$  coagulate the solution (Maschke)

Alcohol, sugar, glycerine, or caramel do not coagulate

Soluble  $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ ,  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ , albumen, and casein precipitate soluble  $\text{SiO}_2$  (Graham, A 121 36)

The jelly from colloidal  $\text{SiO}_2$  is very sol in slightly alkaline  $\text{H}_2\text{O}$  1 pt  $\text{NaOH}$  in 10,000 pts  $\text{H}_2\text{O}$  dissolves in an hour at  $100^\circ$  an amt of the jelly corresponding to 200 pts  $\text{SiO}_2$  (Graham)

#### *Other colloidal forms*

Various solutions of silicic acid may be obtained as follows

The jelly formed when  $\text{SiF}_4$  is passed through  $\text{H}_2\text{O}$  dissolves in a large amt of  $\text{H}_2\text{O}$  and  $\text{SiO}_2$  separates out on evaporation. The is still sol in  $\text{H}_2\text{O}$ , but is made insol by evaporation with  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$  (Berzelius)

When  $\text{SiF}_4$  is absorbed by crystallized  $\text{H}_3\text{BO}_3$ , and the  $\text{HF}$  and  $\text{H}_3\text{BO}_3$  removed by a large excess of  $\text{NH}_4\text{OH} + \text{Aq}$ , a silicic acid is obtained which is very sol in  $\text{H}_2\text{O}$ . The solution is not decomp by boiling, but on evaporation an insol powder remains (Berzelius, A ch 14 366)

When  $\text{K}_2\text{SiO}_3 + \text{Aq}$  is precipitated by  $\text{CuCl}$  the precipitate washed and dissolved in  $\text{HCl} + \text{Aq}$ , the solution treated with  $\text{H}_2\text{S}$  filtered and boiled, a solution of silicic acid is obtained

which gelatinizes with KOH or  $\text{NH}_4\text{OH} + \text{Aq}$  (Dove, A ch (3) 21 40)  
 W n  $\text{Na}_2\text{SiO}_3 + \text{Aq}$  containing at most 3% SiO<sub>2</sub>, saturated with HCl + Aq of 1 10 sp gr, & d  $\text{Na}_2\text{SiO}_3$  added until the solution is slightly opalescent and carefully warmed to 30°, gelatinous mass is obtained which will dissolve in  $\text{H}_2\text{O}$  by 12-16 hours' boiling if before being exposed to the air. The solution is slightly opalescent. The solution can be evaporated by heat until it contains 6% SiO<sub>2</sub>. In a vacuum or over  $\text{H}_2\text{SO}_4$ , solution containing 10% may be obtained. The elect current, freezing, alcohol, or  $\text{H}_2\text{SO}_4$  precipitate or coagulate the solution (Kuhn, J pr 19 1)  
 Sif with  $\text{H}_2\text{O}$  gives off  $\text{H}_2\text{S}$ , and forms a solution of  $\text{SiO}_2$  which, after dilution, can be kept for months. But when boiled or evaporated or when a sol silicate is added, it becomes gelatinous. It leaves an insol residue when evaporated to dryness (Fremy, A ch (3) 38 314)  
 Various forms of silicic acid have been described as definite compounds of  $\text{SiO}_2$  with varying amounts of  $\text{H}_2\text{O}$ , but it is doubtful if any definite compounds exist, as the percentage of  $\text{H}_2\text{O}$  varies with the moisture of the air to which it is exposed (See Ebelmen, A ch (16) 129, Dover, A ch (3) 21 40, Fuchs, A 82 19, Merz, J pr 99 177, van Bemmelen, B 11 2232, etc.)

### Silicates

The silicates are insol in  $\text{H}_2\text{O}$  with the exception of the alkali salts, and these are soluble only when the ratio of the base to the acid is above a certain limit.

### Aluminum silicate, $2\text{Al}_2\text{O}_3, \text{SiO}_2 + 10\text{H}_2\text{O}$

Min *Collyrite*. Sol in acids, with formation of  $\text{SiO}_2$  &  $\text{H}_2\text{O}$ . Becomes transparent in  $\text{H}_2\text{O}$  and is decomp.  
 4A 1, 3SiO Min *Dillinite*  
 Al 1, SiO Min *Andalusite*, *Chastolite*, *Sillur*, *Disthen* or *Cyanite*. Insol in acids.  
 + 7  $\text{H}_2\text{O}$  Min *Allophane*. Completely soluble in acids, decomp by conc acids with separation of  $\text{SiO}_2$  &  $\text{H}_2\text{O}$ .  
 2A 3, 3SiO<sub>2</sub> + 4H<sub>2</sub>O Min *Pholerite*. Insol in  $\text{HNO}_3 + \text{Aq}$ .  
 + 12H<sub>2</sub>O Min *Glauberite*  
 Al 3, 2SiO + 2H<sub>2</sub>O Min *Kaolin*, *Clay*. Insol in dil HCl or  $\text{HNO}_3 + \text{Aq}$ , moderately soluble in  $\text{SO}_4 + \text{Aq}$  when heated to evaporation, extrudes  $\text{Al}_2\text{O}_3$  and some  $\text{SiO}_2$ , and leaves the rest of the  $\text{SiO}_2$  sol in boiling  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . All the  $\text{Al}_2\text{O}_3$  is dissolved by heating with 5-6 pts of  $\text{SO}_3 + 1$  pt  $\text{H}_2\text{O}$  until  $\text{H}_2\text{SO}_4$  evaporates, and then treating with  $\text{H}_2\text{O}$ .  
 Quickly attacked by  $\text{H}_2\text{SiF}_6 + \text{Aq}$ .  
 Decomposed by boiling KOH + Aq, with residue of  $\text{SiO}_2$  (Rammelsberg).  
 KC I + Aq extracts  $\frac{1}{4}$  of the  $\text{SiO}_2$  (Mala-

guti), is converted thereby into double silicates of K and Al, which are sol in HCl + Aq (Lemberg).

Solubility in KOH and HCl increased if first heated to a low glow (Glinka, C C 1899, II 1063).

*Colloidal clay* (Schlosing, C R 79 473)

+ 4H<sub>2</sub>O *Halloysite* Decomp by acids

4Al<sub>2</sub>O<sub>3</sub>, 9SiO<sub>2</sub> + 12H<sub>2</sub>O Min *Porcelain*

*clay* from Passau

Al<sub>2</sub>O<sub>3</sub>, 3SiO<sub>2</sub> + 3H<sub>2</sub>O Min *Razoumoffskine*

Al<sub>2</sub>O<sub>3</sub>, 4SiO<sub>2</sub> + 7H<sub>2</sub>O Min *Montmorillonite*

Not decomp by HCl + Aq, but by hot  $\text{H}_2\text{SO}_4$

+ H<sub>2</sub>O Min *Pyrophyllite* Not decomp by  $\text{H}_2\text{SO}_4$

+ 3H<sub>2</sub>O Min *Anauzite*

2Al<sub>2</sub>O<sub>3</sub>, 9SiO<sub>2</sub> + 6H<sub>2</sub>O Min *Cimolite*

"Aluminum silicate" is insol in acetone (Naumann, B 1904, 37 4328), ethyl acetate (Naumann, B 1910, 43 314)

**Aluminum barium silicate,  $\text{Al}_2\text{O}_3, \text{BaO}, 2\text{SiO}_2 + \text{H}_2\text{O}$  (?)**

Min *Edingtonite* Decomp by HCl + Aq with separation of  $\text{SiO}_2$ ,  $x\text{H}_2\text{O}$

5Al<sub>2</sub>O<sub>3</sub>, 4BaO, 10SiO<sub>2</sub> (Fremy and Feil, C R 85 1033)

2Al<sub>2</sub>O<sub>3</sub>, 4BaO, 7SiO<sub>2</sub> Min *Barylite* Very

sl decomp by alkali carbonates + Aq (Blomstrand)

**Aluminum barium potassium silicate,**

$\text{Al}_2\text{O}_3, (\text{Ba}, \text{K}_2)\text{O}, 5\text{SiO}_2 + 2\text{H}_2\text{O}$

Min *Harmotome* When finely powdered,

difficultly decomp by HCl + Aq with separation of pulverulent  $\text{SiO}_2$ ,  $x\text{H}_2\text{O}$

Al<sub>2</sub>O<sub>3</sub>, (Ba, K<sub>2</sub>)O, 4SiO<sub>2</sub> Min *Haglophane*

Scarcely attacked by acids

**Aluminum caesium silicate,  $\text{H}_2\text{Cs}_2\text{Al}_2\text{Si}_5\text{O}_{15}$  (?)**

Min *Pollucite* Very sl decomp by HCl + Aq

**Aluminum calcium silicate,  $\text{Al}_2\text{O}_3, \text{CaO}, 2\text{SiO}_2$**

Min *Anorthite* Completely decomp by HCl + Aq with separation of pulverulent  $\text{SiO}_2$ ,  $x\text{H}_2\text{O}$

Min *Barsowite* Instantaneously decomp by HCl + Aq, with separation of gelatinous  $\text{SiO}_2$ ,  $x\text{H}_2\text{O}$

+ 4H<sub>2</sub>O Min *Gismonite* Gelatinizes with HCl + Aq

Al<sub>2</sub>O<sub>3</sub>, CaO, 3SiO<sub>2</sub> + 3H<sub>2</sub>O Min *Scolezite*

Easily sol in HCl + Aq, without formation of gelatinous  $\text{SiO}_2$ . Sol in  $\text{H}_2\text{CO}_3 + \text{Aq}$  with pptn of  $\text{CaC}_2\text{O}_4$

Decomp by, and sol to a certain extent in  $\text{H}_2\text{CO}_3 + \text{Aq}$ , and decomp also even by pure  $\text{H}_2\text{O}$  (Rogers, Am J Sci (2) 5 408)

+ 5H<sub>2</sub>O Min *Levyite* Decomp by acids without gelatinizing

Al<sub>2</sub>O<sub>3</sub>, CaO, 4SiO<sub>2</sub> + 3H<sub>2</sub>O Min *Caporranite* *Leonhardtite* Efflorescent Easily

sol in acids, with pptn of gelatinous  $\text{SiO}_2$ ,  $x\text{H}_2\text{O}$

$\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ ,  $4\text{SiO}_2 + 4\text{H}_2\text{O}$  Min *Laumonite* Easily gelatinizes with  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ , but is not affected by  $\text{H}_2\text{SO}_4$  unless hot  
 $\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ ,  $6\text{SiO}_2 + 5\text{H}_2\text{O}$  Min *Epsilbite* Gelatinizes with conc  $\text{HCl} + \text{Aq}$  (Goldschmidt, Z anal 17 267)

Scarcely decomp by boiling conc  $\text{HCl} + \text{Aq}$  (Jannasch and Tenne, Miner Jahrb 1880, 1 43)

$+6\text{H}_2\text{O}$  *Silbite* *Heulandite* Slowly but completely gelatinized by  $\text{HCl} + \text{Aq}$

$\text{Al}_2\text{O}_3$ ,  $2\text{CaO}$ ,  $3\text{SiO}_2 + \text{H}_2\text{O}$  Min *Prehnite* Imperfectly decomp by acids before ignition, but easily afterwards

$\text{Al}_2\text{O}_3$ ,  $3\text{CaO}$ ,  $3\text{SiO}_2$  *Lime alumina garnet* *Grossularite* Partially decomp by acids before ignition, but easily afterwards

$2\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ ,  $2\text{SiO}_2 + \text{H}_2\text{O}$  *Margarite* Not attacked by acids

$3\text{Al}_2\text{O}_3$ ,  $4\text{CaO}$ ,  $6\text{SiO}_2 + \text{H}_2\text{O}$  *Zoisite* Partially decomp by  $\text{HCl} + \text{Aq}$

$4\text{Al}_2\text{O}_3$ ,  $6\text{CaO}$ ,  $9\text{SiO}_2$  Min *Meionite* Completely sol in  $\text{HCl} + \text{Aq}$

**Aluminum calcium ferric silicate**,  $2\text{Al}_2\text{O}_3$ ,  $4\text{CaO}$ ,  $\text{Fe}_2\text{O}_3$ ,  $6\text{SiO}_2 + \text{H}_2\text{O}$

Min *Epidote* Only sl attacked by  $\text{HCl} + \text{Aq}$  before ignition

**Aluminum calcium ferric magnesium silicate**,  $\text{H}_{14}(\text{Ca}, \text{Mg})_{10}(\text{Al}_2, \text{Fe}_2)_{10}\text{Si}_{35}\text{O}_{147}$

Min *Vesuvianite* *Idocrase* Only partially decomp by  $\text{HCl} + \text{Aq}$  before ignition

**Aluminum calcium iron, etc, silicate borate**,  $\text{H}_2\text{R}^+(\text{Al}_2, \text{B}_2)_3\text{Si}_8\text{O}_{32}$

Min *Aznite* Not attacked by  $\text{HCl} + \text{Aq}$  before ignition

**Aluminum calcium magnesium silicate**,  $4\text{H}_4\text{Ca Mg}_3\text{Si}_6\text{O}_{24}$ ,  $5\text{H}_2\text{CaMgAl}_5\text{O}_{12} = 15\text{Al}_2\text{O}_3$ ,  $13\text{CaO}$ ,  $37\text{MgO}$ ,  $24\text{SiO}_2 + 13\text{H}_2\text{O}$

Min *Clintonite* Completely decomp by  $\text{HCl} + \text{Aq}$  without gelatinization

$3\text{H}_4\text{Ca}_2\text{Mg}_3\text{Si}_6\text{O}_{24}$ ,  $4\text{H}_2\text{CaMgAl}_5\text{O}_{12}$  Min *Brandisite* Not attacked by  $\text{HCl} + \text{Aq}$  Slowly decomp by boiling conc  $\text{H}_2\text{SO}_4$

$5\text{H}_4\text{Ca}_2\text{Mg}_3\text{Si}_6\text{O}_{24}$ ,  $8\text{H CaMgAl}_5\text{O}_{12}$  Min *Xanthophyllite* Very sl decomp by hot  $\text{HCl} + \text{Aq}$

$3(\text{Ca}, \text{Mg})\text{O}$ ,  $\text{Al}_2\text{O}_3$ ,  $2\text{SiO}_2$  Min *Gehlenite* Easily decomp by acids

**Aluminum calcium potassium silicate**,  $(\text{H}, \text{K})_2\text{CaAl}_3\text{Si}_5\text{O}_{15} + 6\text{H}_2\text{O}$

Min *Chabasite* Decomp by  $\text{HCl} + \text{Aq}$   
 $(\text{K}_2, \text{Ca})\text{Al}_2\text{Si}_3\text{O}_{10} + 4\text{H}_2\text{O}$  Min *Zeagonite* Completely sol in  $\text{HCl} + \text{Aq}$

**Aluminum calcium sodium silicate**,  $3\text{Al}_2\text{O}_3$ ,  $8\text{CaO}$ ,  $\text{Na}_2\text{O}$ ,  $9\text{SiO}_2$

Min *Sarcosite* Decomp by acids

$2\text{Al}_2\text{O}_3$ ,  $12(\text{Ca}, \text{Na}_2)\text{O}$ ,  $9\text{SiO}_2$  (?) Min *Mellilite* Gelatinized by acids

$\text{Na}_2\text{CaAl}_4\text{Si}_2\text{O}_{12}$  (?) Min *Margarite*  
 $\text{Na}_2\text{CaAl}_3\text{Si}_{10}\text{O}_{28}$  Min *Faujasite* Decomp by  $\text{HCl} + \text{Aq}$

$(\text{Na}_2, \text{Ca})\text{Al}_2\text{Si}_4\text{O}_{12}$  Min *Gmelinite* Decomp by  $\text{HCl} + \text{Aq}$

$(\text{Ca}, \text{Na}_2)\text{Al}_2\text{Si}_4\text{O}_{19} + 6\text{H}_2\text{O}$  Min *Foersite* Difficultly decomp by  $\text{HCl} + \text{Aq}$

$(\text{Ca}, \text{Na}_2)\text{Al}_2\text{Si}_3\text{O}_8 + 2\frac{1}{2}\text{H}_2\text{O}$  Min *Thomsonite* Gelatinizes with  $\text{HCl} + \text{Aq}$

$x\text{Na}_2\text{Al}_2\text{Si}_6\text{O}_{16}$ ,  $y\text{CaAl}_2\text{Si}_2\text{O}_8$  Min *Oligoclase*, *Labradorite* Sl decomp by acids, more easily the larger the amt of Ca present

**Aluminum calcium sodium silicate sulphate**,  $2(\text{Na}_2, \text{Ca})\text{Al}_2(\text{SiO}_4)_2$ ,  $(\text{Na}_2, \text{Ca})\text{SO}_4$

Min *Hawyn* Gelatinizes with  $\text{HCl} + \text{Aq}$

**Aluminum glucinum silicate**,  $\text{Al}_2\text{O}_3$ ,  $3\text{GfO}$ ,  $6\text{SiO}_2$

Min *Beryl* *Emerald* Not decomp by acids, excepting partially by  $\text{H}_2\text{SO}_4$  after being ignited

$\text{Al}_2\text{O}_3$ ,  $2\text{GfO}$ ,  $2\text{SiO}_2 + \text{H}_2\text{O}$  Min *Euclase* Not attacked by acids

**Aluminum ferrous silicate**,  $\text{Al}_2\text{Fe}(\text{SO}_4)_3$

Min *Garnet* Sl decomp by  $\text{HCl} + \text{Aq}$   
 $\text{H}_2\text{FeAl}_2\text{SiO}_7$  Min *Chloritoid* Not attacked by  $\text{HCl} + \text{Aq}$  Completely decomp by  $\text{H}_2\text{SO}_4$

$\text{Al}_2\text{O}_3$ ,  $3\text{FeO}$ ,  $3\text{SiO}_2 + 3\text{H}_2\text{O}$  Min *Voirite*

**Aluminum iron lithium potassium silicate**,  $\text{K}_3\text{Li}_3\text{FeAl}_{12}\text{Si}_{20}\text{O}_{65}$

Min *Zinnwaldite* Sl decomp by acids

**Aluminum ferrous magnesium silicate**,  $6\text{Al}_2\text{O}_3$ ,  $3(\text{Mg}, \text{Fe})\text{O}$ ,  $6\text{SiO}_2 + \text{H}_2\text{O}$

Min *Staurolite* Not attacked by acids

**Aluminum ferric magnesium silicate**,  $2(\text{Al}_2, \text{Fe}_2)\text{O}_3$ ,  $2\text{MgO}$ ,  $5\text{SiO}_2$

Min *Cordierite* Sl attacked by acids  
 $+2\text{H}_2\text{O}$  Min *Fsmarkite*, *Chlorophyllite*

**Aluminum ferrous manganous silicate**,  $\text{Al O}_3$ ,  $\text{FeO}$ ,  $2\text{MnO}$ ,  $3\text{SiO}_2$

Min *Partschmitze*

**Aluminum ferrous sodium, etc, silicate borate**,  $\text{R}^+(\text{Al}_2)(\text{B}_2)\text{Si}_4\text{O}_{20} + \text{R}^+(\text{Al}_2)(\text{B}_2)\text{Si}_4\text{O}_{20}$ , etc

Min *Tourmaline* Not decomp by  $\text{HCl} + \text{Aq}$ , very sl decomp by  $\text{H}_2\text{SO}_4$

**Aluminum lithium silicate**,  $\text{Al}_2\text{O}_3$ ,  $\text{Li O}$ ,  $5\text{SiO}_2$   
 Not attacked by acids (*Hautfeuille*, C R 90 541)

$\text{Al}_2\text{O}_3$ ,  $\text{Li}_2\text{O}$ ,  $6\text{SiO}_2$   
 $\text{Al}_2\text{O}_3$ ,  $\text{Li}_2\text{O}$ ,  $4\text{SiO}_2$  [Min *Spodumene* Not attacked by acids]

4Al<sub>2</sub>C  
attaque 3Li<sub>2</sub>O, 30SiO<sub>2</sub> Min *Petalite* Not  
by acids

Alumin n lithium potassium silicate,  
(L) K<sub>1</sub>Al<sub>10</sub>Si<sub>16</sub>O<sub>52</sub>  
Min *epidohite* SI decomp by acids

Alumin n magnesium silicate, 5Al<sub>2</sub>O<sub>3</sub>, 4MgO,  
2Si<sub>2</sub>  
Min *apphurine*

Alumin n magnesium potassium silicate,  
xH  $\zeta_2$ Al<sub>6</sub>Si<sub>6</sub>O<sub>24</sub>, yMg<sub>12</sub>Si<sub>6</sub>O<sub>21</sub>  
Min *Lepidomelane* Easily decomp by  
HCl or NO<sub>3</sub>+Aq, with residue of a skeleton  
of SiO<sub>2</sub>  
3Al<sub>2</sub>C, 12MgO, 2K<sub>2</sub>O, 12SiO<sub>2</sub>+H<sub>2</sub>O Min  
*Anomist*  
7Al<sub>2</sub>C, 35MgO, 7K<sub>2</sub>O, 36SiO<sub>2</sub> Min  
*Phlogoj* e

Alumin n manganous silicate, 2Al<sub>2</sub>O<sub>3</sub>, 6MnO,  
6S  
Not comp by very dil HCl+Aq (Gor-  
geu, C 97 1303)

Alumin m potassium silicate, Al<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O,  
Si

Very lowly decomp by cold H<sub>2</sub>O, 12% is  
dissolv by hot H<sub>2</sub>O Sol in alkali hydrox-  
ides+Aq, but insol in carbonates+Aq  
K<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 2SiO<sub>2</sub> Insol in cold H<sub>2</sub>O, but  
6% di solves on boiling Sol in dil acids  
Insol 1 alkali hydroxides or carbonates+Aq  
(Gorge A ch (6) 10 45)

K<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 3SiO<sub>2</sub>+3H<sub>2</sub>O Easily sol in  
Aq (Deville, A ch (3) 61 313)

K<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 4SiO<sub>2</sub> Min *Leucite* De-  
comp HCl+Aq with separation of pul-  
veruler SiO<sub>2</sub>

+4I O Ppt (Deville, C R 54 324)  
H<sub>4</sub>K d, Si<sub>4</sub>O<sub>4</sub> Min *Muscovite*, "Mica"

Not at ck'd by HCl or H<sub>2</sub>SO<sub>4</sub>+Aq

K<sub>2</sub>Al Si<sub>2</sub>O<sub>7</sub>+3H<sub>2</sub>O Min *Pinite* Partly  
decom by HCl+Aq

K<sub>2</sub>Al Si<sub>2</sub>O<sub>11</sub> Min *Orthoclase Feldspar*  
Scarcl attacked by acids Slowly sol in  
H<sub>2</sub>SO<sub>4</sub> n HCl+Aq when finely powdered  
(Rogier)

Alumin m potassium sodium silicate,  
K L<sub>2</sub>(SiO<sub>3</sub>)<sub>4</sub>, 5N<sub>2</sub>Al<sub>2</sub>(SiO<sub>4</sub>)<sub>2</sub> (?)  
Min *Nepheline* Decomp by HCl+Aq

Alumin m silver silicate, Al<sub>2</sub>Ag<sub>2</sub>Si<sub>2</sub>O<sub>7</sub>,  
Inso in NH<sub>4</sub>OH+Aq (Silber, B 14 941)  
Al<sub>6</sub>A N<sub>14</sub>Si<sub>16</sub>O<sub>4</sub> As above (Silber)

Alumin m sodium silicate, Al<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>O, SiO<sub>2</sub>  
Inso in cold H<sub>2</sub>O, but 38-40% dissolves in  
hot H<sub>2</sub> (Gorgeu)  
Al<sub>2</sub>C N<sub>1</sub>O, 2SiO<sub>2</sub> Insol in cold H<sub>2</sub>O,  
boiling H<sub>2</sub>O dissolves 1-2% Sol in HCl or  
HNO<sub>3</sub> diluted with 10-20 vols H<sub>2</sub>O Insol

in alkali hydroxides or carbonates+Aq  
(Gorgeu, A ch (6) 10 145)

Not attacked by H<sub>2</sub>O (Silber, B 14 941)  
+3H<sub>2</sub>O Easily sol in HCl+Aq (v  
Ammon)

Al<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>O, 3SiO<sub>2</sub>+3H<sub>2</sub>O Decomp by  
acids (Deville, A ch (3) 61 326)

Al<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>O, 4SiO<sub>2</sub>+3H<sub>2</sub>O Easily sol in  
HCl+Aq (v Ammon)

2Al<sub>2</sub>O<sub>3</sub>, 3Na<sub>2</sub>O, 3SiO<sub>2</sub> Insol in cold H<sub>2</sub>O,  
but 27-30% dissolves on boiling (Gorgeu)

H<sub>4</sub>Na<sub>2</sub>Al<sub>6</sub>Si<sub>6</sub>O<sub>24</sub> Min *Paragonite* De-  
comp by conc H<sub>2</sub>SO<sub>4</sub>

Na<sub>2</sub>Al<sub>2</sub>Si<sub>4</sub>O<sub>12</sub>+2H<sub>2</sub>O Min *Anachite*  
Readily decomp by HCl+Aq

Na<sub>2</sub>Al<sub>2</sub>Si<sub>2</sub>O<sub>10</sub>+2H<sub>2</sub>O Min *Natrohite* Sol  
in H<sub>2</sub>O with separation of SiO<sub>2</sub> Also sol in  
H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>+Aq

Na<sub>2</sub>Al<sub>2</sub>Si<sub>6</sub>O<sub>18</sub> Min *Albite* Not attacked  
by acids

Aluminum sodium silicate chloride,  
3Na<sub>2</sub>Al<sub>2</sub>(SiO<sub>4</sub>)<sub>2</sub>, 2NaCl

Min *Sodalite* Easily decomp by HCl,  
and HNO<sub>3</sub>+Aq

Aluminum sodium silicate sulphate,  
3Na<sub>2</sub>Al<sub>2</sub>(SiO<sub>4</sub>)<sub>2</sub>, Na<sub>2</sub>SO<sub>4</sub>

Min *Nosean* Easily decomp by HCl+  
Aq

Aluminum sodium silicate sulphide  
See Ultramarine

Barium silicate, BaSiO<sub>3</sub>

Somewhat sol in boiling H<sub>2</sub>O Completely  
sol in dil HCl+Aq (v Ammon)

+6H<sub>2</sub>O, or 7H<sub>2</sub>O Boiling H<sub>2</sub>O decomp-  
poses, and dissolves about 1/2 the weight of  
this substance (le Chatelier, C R 92 931)

2BaO, SiO<sub>2</sub> Decomp by H<sub>2</sub>O into BaSiO<sub>3</sub>  
+6H<sub>2</sub>O (I audrin)

Bismuth silicate, 2Bi<sub>2</sub>O<sub>3</sub>, 3SiO<sub>2</sub>

Min *Eulytite* Decomp by HCl+Aq

Bismuth ferric silicate, Bi<sub>2</sub>Fe<sub>4</sub>Si<sub>4</sub>O<sub>17</sub>

Min *Bismuthoferrite*

Boron calcium silicate

See Borate silicate, calcium, and Silicate  
borate, calcium

Cadmium silicate, CdSiO<sub>3</sub>+1 1/2 H<sub>2</sub>O

Sol in HCl+Aq with deposition of pul-  
verulent SiO<sub>2</sub>, xH<sub>2</sub>O (Roussieu and Tite,  
C R 114 1262)

Cæsium silicate, Cs<sub>2</sub>SiO<sub>3</sub>

(Kahlenberg, J phys Chem 1898, 2  
82)

**Calcium silicate,  $\text{CaSiO}_3$** 

Slowly sol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$   
Sol in about 100,000 pts  $\text{H}_2\text{O}$  (Gorgeu, A ch 1885, (6) 4 550)

100 cc sat aq solution of air dried calcium silicate contains 0.0046 g  $\text{CaO} = 0.0095$  g  $\text{CaSiO}_3$  at  $17^\circ$  (Weisberg, Bull Soc 1896, (3) 15 1097)

100 cc sat solution of air dried calcium silicate in 10% sugar solution at  $17^\circ$  contains 0.0065 g  $\text{CaO} = 0.0135$  g  $\text{CaSiO}_3$ , 20% sugar solution, 0.0076 g  $\text{CaO} = 0.0175$  g  $\text{CaSiO}_3$

After boiling and filtering hot, 10% sugar solution contains 0.0094 g  $\text{CaO} = 0.0195$  g  $\text{CaSiO}_3$ , 20% sugar solution, 0.0120 g  $\text{CaO} = 0.0249$  g  $\text{CaSiO}_3$  (Weisberg)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

$4\text{CaO}, 3\text{SiO}_2$  (Laudrin)  
 $5\text{CaO}, 3\text{SiO}_2 + 5\text{H}_2\text{O}$  When freshly precipitated is somewhat sol in  $\text{H}_2\text{O}$  and easily decomp by  $\text{HCl} + \text{Aq}$  (v Ammon)

$\text{CaO}, 3\text{SiO}_2 + 2\text{H}_2\text{O}$  (Hjeldt, J pr 94 129)

$2\text{CaO}, 9\text{SiO}_2 + 3\text{H}_2\text{O}$  Ppt  
 $\text{CaSiO}_3$  Min *Wollastonite* Gelatinizes with  $\text{HCl} + \text{Aq}$

$\text{CaSi}_2\text{O}_5 + 2\text{H}_2\text{O}$  Min *Okenite* Easily decomp by cold  $\text{HCl} + \text{Aq}$  when powdered

**Calcium glucinum silicate sodium fluoride,**  
 $(\text{Ca}, \text{Gl})_{15}\text{Si}_{14}\text{O}_{48}, 6\text{NaF}$

Min *Leucophane*  
 $7(\text{Ca}, \text{Gl})_3\text{Si}_2\text{O}_7, 6\text{NaF}$  Min *Melnophane*

**Calcium ferrous silicate,  $\text{CaSiO}_3, \text{FeSiO}_3$**

Min *Hedenbergite*, *Pyroxene* Sl decomp by acids

**Calcium ferric silicate,  $\text{Ca}_3\text{Fe}_2(\text{SiO}_4)_3$**

Min *Garnet* Sl decomp by  $\text{HCl} + \text{Aq}$   
 $2\text{CaSiO}_3, 11 \text{Fe}_2(\text{SiO}_3)_3$  Min *Szabotite*  
Sl attacked by  $\text{HCl} + \text{Aq}$ , and still less by  $\text{H}_2\text{SO}_4 + \text{Aq}$

**Calcium ferroferric silicate,  $2\text{CaO}, 4\text{FeO}, \text{Fe}_2\text{O}_3, 4\text{SiO}_2 + \text{H}_2\text{O} = \text{H}_2\text{Ca}_2\text{Fe}_4\text{Fe}_2\text{Si}_4\text{O}_{18}$**

Min *Luevite* *Ilwite* Easily gelatinizes with  $\text{HCl} + \text{Aq}$

**Calcium ferrous magnesium silicate,**  
 $(\text{Ca}, \text{Fe}, \text{Mg})\text{SiO}_3$

Min *Amphibole*, *Hornblende*, *Asbestos*, *Actinolite*, *Tremolite* Only sl attacked by acids

**Calcium ferroferric sodium silicate,  $\text{CaSiO}_3, \text{FeSiO}_3, \text{Fe}_2(\text{SiO}_3)_3, \text{Na}_2\text{SiO}_3$**

Min *Aegirite*

**Calcium magnesium silicate,  $\text{CaO}, \text{MgO}, 4\text{SiO}_2$**

(Mutschler, A 176 86)  
 $\text{Ca}_2\text{SiO}_4, \text{Mg}_2\text{SiO}_4$  Min *Monticellite*  
Completely sol in dil  $\text{HCl} + \text{Aq}$

$(\text{Ca}, \text{Mg})\text{SiO}_3$  Min *Dropside*, *Pyroxene*  
Very sl attacked by acids

**Calcium manganous silicate,  $\text{CaSiO}_3, 2\text{MnSiO}_3$**

Min *Bustamite*

**Calcium potassium silicate**

See under Glass

**Calcium sodium silicate,  $(\text{Ca}, \text{Na}_2, \text{H}_2)\text{SiO}_3$**

Min *Pectolite* Decomp by  $\text{HCl} + \text{Aq}$   
See under glass

**Calcium sodium silicate zirconate,**

$\text{Na}_4\text{Ca}(\text{Si}, \text{Zr})_2\text{O}_{21} + 9\text{H}_2\text{O}$

Min *Wohlerite* Decomp by  $\text{HCl} + \text{Aq}$

**Calcium uranyl silicate,  $3\text{CaO}, 5\text{UO}_3, 6\text{SiO}_2 + 18\text{H}_2\text{O}$**

Min *Uranophane* Gelatinizes with acids  
 $\text{CaO}, 3\text{UO}_3, 3\text{SiO}_2 + 9\text{H}_2\text{O}$  Min *Uranotile*

**Calcium silicate chloride,  $2\text{CaO}, \text{SiO}_2, \text{CaCl}_2$**

Insol in  $\text{H}_2\text{O}$  or alcohol Sol in  $\text{HCl} + \text{Aq}$   
(le Chatelier, C R 97 1510)

**Calcium silicate fluoride,  $2\text{CaO}, 3\text{SiO}_2, 6\text{CaF}_2$**

(Deville, C R 52 110)

**Calcium silicate potassium fluoride,**

$4\text{H}_2\text{CaSi}_2\text{O}_8, \text{KF} + 4\text{H}_2\text{O}$

Min *Apophyllite* Decomp by  $\text{HCl} + \text{Aq}$

**Calcium silicate stannate**

See Silicostannate, calcium

**Calcium silicate titanate,  $\text{CaO}, \text{SiO}_2, \text{TiO}_2$**

(Hautefeuille, A ch (4) 4 154)  
Min *Titanite* Incompletely decomp by  $\text{HCl} + \text{Aq}$ , wholly by  $\text{H}_2\text{SO}_4 + \text{Aq}$

**Cerous silicate,  $\text{Ce}_2(\text{SiO}_3)_3$**

More or less attacked by  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , according to the concentration (Didier, C R 101 882)

**Cerium didymium lanthanum silicate,**

$2(\text{Ce}, \text{La}, \text{Di})_2\text{O}_3, 3\text{SiO}_2$

Min *Cerite* Gelatinizes with  $\text{HCl} + \text{Aq}$

**Cerium glucinum yttrium silicate,**

$(\text{Y}, \text{Ce}, \text{Gl})_2\text{SiO}_3$

Min *Gadolinite* Easily gelatinized by  $\text{HCl} + \text{Aq}$

**Cerous silicate chloride,  $2\text{Ce}_2\text{O}_3, 3\text{SiO}_2,$**

$4\text{CeCl}_2 = \text{Ce}_4(\text{SiO}_4)_3, 4\text{CeCl}_3$

Insol in  $\text{H}_2\text{O}$ , but slowly decomp thereby (Didier, C R 101 882)

<b>Cobaltous silicate</b> , $\text{Co}_2\text{SiO}_4$ Gelatinizes with $\text{HCl} + \text{Aq}$ (Bourgeois, C R 108 177)	<b>Iron (ferrous) manganous silicate chloride</b> , $7(\text{Fe}, \text{Mn})\text{SiO}_3, (\text{Fe}, \text{Mn})\text{Cl}_2 + 5\text{H}_2\text{O}$ Min <i>Pyroxmalite</i> Completely decomp by conc $\text{HNO}_3 + \text{Aq}$
<b>Cupric silicate</b> , $\text{CuH}_2\text{SiO}_4$ Min <i>loptase</i> Sol in $\text{HCl}$ , $\text{HNO}_3$ , or $\text{Aq}$ with separation of $\text{SiO}_2$ Not attacked by $\text{KOH} + \text{Aq}$ $\text{CuSiO}_3 \cdot 2\text{H}_2\text{O}$ Min <i>Chrysocolla</i> Decomp by $\text{HCl} + \text{Aq}$ $+ 3\text{H}_2\text{O}$ Min <i>Asperolite</i> Easily decomp by $\text{HCl} + \text{Aq}$ "Cupric silicate" is insol in methyl acetate (Naummar, B 1909, 42 3790)	<b>Iron (ferric) potassium silicate</b> , $\text{Fe}(\text{SiO}_3)_3, \text{K}_2\text{SiO}_3$ (Hautefeuille and Perrey, C R 107 1150)
<b>Cupric silicate ammonia</b> , $\text{CuSi}_2\text{O}_6, 2\text{NH}_3$ Ppt <i>schuff</i> , A 123 38)	<b>Iron (ferric) sodium silicate</b> , $\text{Na}_2\text{Fe}_2\text{Si}_4\text{O}_{12}$ Min <i>Crokydolite</i> Not attacked by acids
<b>Glucinum silicate</b> , $\text{Gl}_2\text{SiO}_4$ Min <i>phenacite</i> Not attacked by acids	<b>Lead silicate</b> Insol in acetone (Naumann, B 1904, 37 4329), methyl acetate (Naumann, B 1909, 42 3790) <i>See under Glass</i>
<b>Glucinum ferrous manganous silicate ferrous manganous sulphide</b> , $3(\text{Gl}, \text{Fe}, \text{Mn})_2\text{SiO}_4, (\text{Mn}, \text{Fe})\text{S}$ Min <i>Ielwne</i> Decomp by $\text{HCl} + \text{Aq}$	<b>Lithium silicate</b> , $\text{Li}_2\text{Si}_5\text{O}_{11}$ $\text{Li}_4\text{SiO}_4$ $\text{Li}_2\text{SiO}_3$ More stable towards $\text{H}_2\text{O}$ than the other alkali metasilicates (Rieke and Endell, C C 1911, I 7) Decomp by boiling $\text{H}_2\text{O}$ and acids (Friedel, C C 1901, II 89) Scarcely attacked by cold $\text{H}_2\text{O}$ (Friedel, Bull Soc Min 1901, 24 141) Insol in ethyl acetate (Naumann, B 1904, 37 3601), methyl acetate (Naumann, B 1909, 42 3790)
<b>Iron (ferrous) silicate</b> , $\text{Fe}_2\text{SiO}_4$ Min <i>Fayalite</i> Gelatinizes with $\text{HCl} + \text{Aq}$ $\text{FeSiO}_3$ Min <i>Grunerite</i> $+ 6\text{H}_2\text{O}$ Min <i>Chlorophane</i> $4\text{FeO} \cdot \text{SiO}_2$ (Zobel, Dingl 154 111)	<b>Magnesium silicate</b> , $\text{Mg}_3\text{Si}_2\text{O}_7 + 2\text{H}_2\text{O}$ Min <i>Serpentine</i> Decomp by $\text{HCl} + \text{Aq}$ , more easily by $\text{H}_2\text{SO}_4$ Min <i>Chrysotile</i> $\text{Mg}_4\text{Si}_3\text{O}_{10} + 6\text{H}_2\text{O}$ Min <i>Gymnolite</i> , <i>Soapstone</i> Decomp by $\text{H}_2\text{SO}_4$ $\text{MgSiO}_3$ Not completely decomp by $\text{HCl} + \text{Aq}$
<b>Iron (ferric) silicate</b> , $\text{Fe}_2\text{Si}_2\text{O}_7 + 5\text{H}_2\text{O}$ Min <i>Vontromite</i> Gelatinizes with hot acids $4\text{Fe}_2\text{O}_3 \cdot 9\text{SiO}_2 + 18\text{H}_2\text{O}$ Min <i>Hisingerite</i> $2\text{Fe}_2\text{O}_3 \cdot 9\text{SiO}_2 + 2\text{H}_2\text{O}$ Min <i>Anthosiderite</i>	$+ \frac{1}{4}\text{H}_2\text{O}$ Min <i>Aphrodite</i> Decomp by hot acids $+ \frac{1}{2}\text{H}_2\text{O}$ Min <i>Picrosmine</i> $+ 1\frac{1}{3}\text{H}_2\text{O}$ Sol in dil acids (v Ammon) Min <i>Forsterite</i> $3\text{MgO}, 4\text{SiO}_2 + \text{H}_2\text{O}$ or $4\text{MgO}, 5\text{SiO}_2 + \frac{3}{4}\text{H}_2\text{O}$ Min <i>Talc</i> or <i>Steatite</i> Not attacked by $\text{HCl}$ or $\text{H}_2\text{SO}_4 + \text{Aq}$ $\text{Mg}_5\text{Si}_4\text{O}_{17} + 4\text{H}_2\text{O}$ Min <i>Spadarte</i> Decomp by conc $\text{HCl} + \text{Aq}$ $\text{Mg}_2\text{Si}_3\text{O}_8 + 4\text{H}_2\text{O}$ Min <i>Meerschaum</i>
<b>Iron (ferroferric) magnesium silicate</b> , $(\text{Fe}, \text{Mg})_3\text{Fe}_2\text{Si}_2\text{O}_{10} + 4\text{H}_2\text{O}$ Min <i>Cronstadite</i> Gelatinizes with acids	Decomp by $\text{HCl} + \text{Aq}$ <b>Iron (ferroferric) sodium silicate</b> , $5\text{Na}_2\text{SiO}_3, 2\text{Fe}_2\text{SiO}_3, 4\text{Fe}_2(\text{SiO}_3)_3$ Min <i>Akntite</i> Sl decomp by acids
<b>Iron (ferrous) magnesium silicate</b> , $\text{Fe}_2\text{SiO}_4, \text{M SiO}_4$ Min <i>Olivene</i> , <i>Chrysotile</i> , <i>Peridot</i> Gelatinizes with $\text{HCl}$ or $\text{H}_2\text{SO}_4 + \text{Aq}$ $(\text{Fe}, \text{Mg})\text{SiO}_3 + \frac{3}{2}\text{H}_2\text{O}$ Min <i>Picrophyllite</i> $+ \frac{1}{2}\text{H}_2\text{O}$ Min <i>Monradite</i> $(\text{Fe}, \text{Mg})\text{SiO}_3$ Min <i>Bronzite</i> , <i>Hypersthene</i> Not attacked by acids $x\text{MgSiO}_3, y\text{FeSiO}_3$ Min <i>Anthophyllite</i> Not attacked by acids	<b>Magnesium potassium silicate</b> , $\text{MgO}, \text{K}_2\text{O}, 3\text{SiO}_2$ Easily sol in acids with decomp (Duboin, C R 1895, 120 681)
<b>Iron (ferrous) manganous silicate</b> , $\text{Fe}_2\text{SiO}_4, \text{M SiO}_4$ Min <i>Knebelite</i> Gelatinizes with $\text{HCl} + \text{Aq}$	<b>Magnesium silicate fluosilicate</b> , $\text{Mg}_6\text{Si}_2\text{O}_9, \text{Mg}_8\text{Si}_2\text{F}_{18}$ Min <i>Humite</i> , <i>Chondrodite</i> Gelatinizes with $\text{HCl}$ or $\text{H}_2\text{SO}_4 + \text{Aq}$



**Manganous silicate,  $Mn_2SiO_4$** 

Min *Tephroite* Decomp by  $HCl + Aq$  with formation of a stiff jelly

$MnSiO_3$  Min *Rhodomite*, *Hermannite*

Not attacked by  $HCl + Aq$

$Mn_2Si_4O_{10} + 2H_2O$  Min *Friedelite*

Easily gelatinized by  $HCl + Aq$

"Manganous silicate" is insol in ethyl acetate (Naumann, B 1910, 43 314)

**Manganous zinc silicate,  $(Mn,Zn)_2SiO_4$** 

Min *Troostite*

**Manganous silicate chloride,  $MnSiO_3$ ,  $MnO$ ,  $MnCl_2$** 

Decomp by  $H_2O$  (Gorgeu)

**Nickel silicate,  $Ni_2SiO_4$** 

Easily decomp by acids (Bourgeois, C R 108 1077)

**Potassium silicate,  $K_2SiO_3$** 

Completely sol in  $H_2O$  (Ordway, Sill Am J (2) 33 34)

Insol in methyl acetate (Naumann, B 1909 42 3790)

$K_2Si_2O_5$  Sol in  $H_2O$  Conc  $K_2Si_2O_5 + Aq$  contains 28% of the salt, and has sp gr 1.25 (Luchs)

**Hydroscopic** Decomp at once by  $H_2O$  (Morey, J Am Chem Soc 1914, 36 222)

$K_2Si_2O_5$  Partially sol in  $H_2O$  as  $K_2SiO_3$   $K_2Si_4O_{10} + 16H_2O$  Insol in  $H_2O$  (Forchhammer)

The  $K$  silicates are pptd from their aqueous solution by alcohol with partial decomp, but less readily than  $Na$  silicates

More sol in  $H_2O$  than the corresponding  $Na$  silts (Ordway, Sill Am J (2) 32 155)

Solution can be obtained which is perfectly clear when  $H_2SiO_3$  are present to  $H_2O$  if there are no impurities present (Ordway)

The  $K$  silicates resemble the  $Na$  silts which see for further data

**Potassium hydrogen silicate,  $KHSiO_3$** 

Not readily affected by  $H_2O$ , even by treatment at 100 for several hours

Decomp by heating with dil  $HCl$  (Morey, J Am Chem Soc 1914, 36 222)

**Potassium zinc silicate**

Sol in  $KOH + Aq$  (Schmidler)

$K_4O$ ,  $6ZnO$ ,  $4SiO_2$  Sol in  $HCl + Aq$  (Duboin, C R 1905, 141 255)

$8K_2O$ ,  $9ZnO$ ,  $17SiO_2$  Sol in  $HCl + Aq$  (Duboin)

**Potassium zirconium silicate,  $K_2O$ ,  $ZrO_2$ ,  $2SiO_2$** 

Decomp by  $HCl + Aq$  (Melliss)

**Rubidium silicate,  $Rb_2SiO_3$** 

(Kahlenberg, J phys Chem 1898, 2 82)

**Silver silicate,  $Ag_2SiO_3$** 

Decomp by all acids, sol in  $NH_4OH + Aq$  (Hawkins, Sill Am J 139 311)

**Sodium silicate,  $Na_2SiO_3$** 

Rapidly decomp by  $H_2O$  (Morey, J Am Chem Soc 1914, 36 224)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

+5, 6, and  $8H_2O$  Easily sol in  $H_2O$  +  $9H_2O$  Solubility in  $\frac{1}{2}$ -N  $NaOH + Aq$

100 ccm of the solution contain 25.56 g  $Na_2SiO_3 + 9H_2O$  at  $17.5^\circ$

Sp gr of the solution = 1.129 (Vesterberg, C C 1913 777)

100 ccm of a sat solution of sodium silicate in  $\frac{1}{2}$ -N  $NaCl + Aq$  contain 3.83 g  $Na_2SiO_3 + 9H_2O$  at  $17.5^\circ$  Sp gr of solution = 1.15

100 ccm of a sat solution of sodium silicate in sat  $NaCl + Aq$  contain 20.64 g  $Na_2SiO_3 + 9H_2O$  at  $17.5^\circ$  (Vesterberg)

$Na_2Si_2O_5$  Sol in  $H_2O$

Slowly decomp by cold  $H_2O$  (Morey J Am Chem Soc 1914, 36 223)

$Na_4Si_6O_{12}$

$Na_4Si_3O_8$

$Na_2Si_4O_9$  Slowly sol in  $H_2O$

+  $12H_2O$

Above compounds are all more or less indefinite

**Water glass**  $xNa_2O$ ,  $ySiO_2 + zH_2O$  Sol in  $H_2O$ , but solution is decomposed by all weak acids, even  $CO_2$

Fused water glass is but little acted on by cold  $H_2O$ , but when pure, easily dissolves in  $H_2O$  by long boiling (Ordway, Am J Sci (2) 32 337)

When the  $SiO_2$  is present in greater proportion than in  $Na_2O$ ,  $3SiO_2$ , it is very difficult to dissolve in  $H_2O$

$Na$  silicate is less easily sol in  $H_2O$  than the corresponding  $K$  compound

Solubility of water glass in  $H_2O$  is much impaired by earthy impurities, so that traces have great effect in preventing the solubility

$NH_4$  silts decomp water glass solutions. A solution containing  $\frac{1}{2}\%$   $Na_2SiO_3$  is scarcely precipitated by  $NH_4Cl$ , but easily by  $NH_4NO_3$  (Flückiger)

Precipitated by  $NH_4OH + Aq$  as  $Na_2SiO_3$

Many sodium and potassium silts (especially the chlorides and acetates) form precipitates in solutions of water glass; these precipitates are larger the more concentrated the solution is, and the greater amount of  $SiO_2$  it contains. Heating hastens the precipitation by chlorides, nitrates, and sulphates, but delays that by acetates.  $KOH + Aq$  does not precipitate

Cold sat  $Na_2SO_4 + Aq$  does not precipitate even on heating, but 1 pt anhydrous  $Na_2SO_4$  dissolved in 2 pts  $H_2O$  precipitates a hot solution of  $Na_2SiO_3$

$\text{NaNO}_3$  dissolved in 1 pt  $\text{H}_2\text{O}$  precipitate  $\text{Na}_2\text{SiO}_3$  Aq of 1392 sp gr,  $\text{NaNO}_3$  in 2 pts  $\text{H}_2\text{O}$  when mixed with a solution of  $\text{Na}_2\text{SiO}_3$  as above, if the two are present in equal vol, causes no ppt in the cold, but when warmed to  $54^\circ$ , and redissolving rapidly, but if 2 vols  $\text{NaNO}_3$  present to 1 vol  $\text{Na}_2\text{SiO}_3$  + Aq, the ppt does not disappear on cooling

If 1 pt  $\text{NH}_4\text{OH}$  + Aq (0.921 sp gr) is added to but by 1 pt  $\text{Na}_2\text{SiO}_3$  + Aq, no ppt forms, increasing the amt of  $\text{NH}_4\text{OH}$  + Aq to 2 pts the greater pt of the  $\text{Na}_2\text{SiO}_3$  is redissolved on heating to  $90^\circ$ , separation on cooling. When 1 pt  $\text{NH}_4\text{OH}$  + Aq is added to 6-8 pts  $\text{Na}_2\text{SiO}_3$  + Aq and to  $30^\circ$ , a clear liquid is formed which separates into two layers at ordinary temp

The most sol K, Na, Li, and  $\text{NH}_4$  salts separate  $\text{SiO}_2$  from conc  $\text{Na}_2\text{SiO}_3$  + Aq. These salts lose this power by dilution, but the  $\text{NH}_4$  salts and KSON keep this power unless the solution is very dil. This is the case with  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{NO}_3$ , especially

Bromine, chloroform, propylamine, cresote, phenol, dissolved in glycerine, chloral hydrate, chloroform, and glue solution.  $\text{SiO}_2$  from  $\text{Na}_2\text{SiO}_3$  + Aq, but sugar, glycerine, urea, sl alkaline solution of urea, nitrate, conine, nicotine, saponine, me, jalapine, and colophonium dissolve in  $\text{KOH}$  + Aq do not ppt  $\text{SiO}_2$  (Fluckiger, Arch Pharm (2) 144 97)

Alcohol ppt water glass as such from its solution, even when this is very dil. is some decomposition, the alcohol holds in solution a portion of a more alkaline than that previously in  $\text{H}_2\text{O}$ , while the ppt formed contains  $\text{SiO}_2$  than the original silicate

Neutral K or Na salts ppt water glass as silicate when added to aqueous solutions of alcohol, these solutions exert a decomposition, the ppt being always more siliceous than the original silicate. Na silicate gives a larger deposit than K silicate, when a silicate of one base is pptd by a salt of the other, both bases enter into the composition of the ppt, and the relative proportion of Na and K is very nearly the same as in the average of the liquids mixed

Difficult salts have very unequal pptg power, especially acetates and chlorides being particularly efficient. Heat increases the pptg of the chlorides, sulphates, and nitrides diminishes that of the acetates. The efficiency of acetates are somewhat more than the chlorides, but  $\text{NaC}_2\text{H}_3\text{O}_2$  gives a slight ppt with  $\text{Na}_2\text{O}$ ,  $2\frac{1}{2}\text{SiO}_2$ , even after some time

$\text{Na}_2\text{O}$  has but little effect on the more alkaline silicates

$\text{Na}_2\text{O}$  has still less power than  $\text{NaNO}_3$

$\text{Na}_2\text{O}$  has no pptg power, and  $\text{Na}_2\text{AsO}_4$  or  $\text{Na}_2\text{O}_4$  have very little effect

$\text{MHSO}_4$ ,  $\text{MHCO}_3$ ,  $\text{MHPbO}_4$ ,  $\text{M}_2\text{HAsO}_4$  ppt  $\text{SiO}_2$ .  $\text{NH}_4$  salts also have that effect

Pptd water glass, as mentioned above, is much more sol in  $\text{H}_2\text{O}$  than ordinary water glass, and dissolves in  $\text{H}_2\text{O}$  without decomposition. For numerous further details, see articles by Orday in Sill Am J Sci vols 32 and 33, also Storer's Dict

Sp gr of water glass solution containing 14-15%  $\text{SiO}_2$ , 13-14%  $\text{Na}_2\text{O}$ , and 70-72%  $\text{H}_2\text{O}$  is 1.30-1.35 (Hager, Comm 1883)

Sp gr of sat  $\text{Na}_2\text{SiO}_3$  + Aq freshly prepared at  $18^\circ$  is 1.2600, and 1 litre contains 4.5 gramme-equivalents  $\frac{1}{2}\text{Na}_2\text{SiO}_3$

Sp gr of sat solution of  $\text{Na}_2\text{O}$ , 3.4  $\text{SiO}_2$  is 1.366, and 1 litre contains 3.7 gramme-equivalents  $\frac{1}{2}(\text{Na}_2\text{O}, 3.4\text{SiO}_2)$  (Kohlrausch, Z phys Ch 12 773)

**Sodium zirconium silicate**,  $\text{Na}_2\text{O}$ ,  $\text{ZrO}_2$ ,  $\text{SiO}_2$

Decomp by hot  $\text{H}_2\text{O}$  or  $\text{HCl}$  + Aq (Gibbs, Pogg 71 559)

$\text{Na}_2\text{O}$ , 8  $\text{ZrO}_2$ ,  $\text{SiO}_2$  + 11  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{SO}_4$  (Melliss)

**Strontium silicate**,  $\text{SrSiO}_3$

(Stein, Z anorg 1907, 55 164)

+  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Jordis and Kanter, Z anorg 1903, 35 90)

$\text{Sr}_2\text{SiO}_4$  (Stein, Z anorg 1907, 55 167)

3  $\text{SrO}$ ,  $\text{SiO}_2$ . Sl sol in  $\text{H}_2\text{O}$ . Sol in acids (Vauquelin)

**Thallous silicate**, 3  $\text{Tl}_2\text{O}$ , 10  $\text{SiO}_2$

100 pts of a solution of  $\text{Tl}_2\text{O}$  dissolve 4-17 pts  $\text{SiO}_2$  by 24 hours' boiling. Sol in  $\text{H}_2\text{O}$  (Flemming, J B 1868 251)

**Thorium silicate**,  $\text{ThO}_2$ ,  $\text{SiO}_2$

Insol in acids. Attacked by  $\text{KHSO}_4$  (Troost and Ouvrard, C R 105 255)

+  $1\frac{1}{2}\text{H}_2\text{O}$  Min *Thorite* Decomp by  $\text{HCl}$  + Aq

$\text{ThO}_2$ , 2  $\text{SiO}_2$  Insol in acids or  $\text{KHSO}_4$  (T and O)

**Yttrium silicate**,  $\text{Y}_2\text{O}_3$ ,  $\text{SiO}_2$

Attacked by  $\text{HCl}$ ,  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$  + Aq (Duboué, C R 107 99)

**Zinc silicate**,  $\text{ZnSiO}_3$

(Stein, Z anorg 1907, 55 160)

$\text{Zn}_2\text{SiO}_4$  Min *Willemite* Gelatinizes with  $\text{HCl}$  + Aq, sol in  $\text{KOH}$  + Aq

Decomp by cold sat citric acid + Aq (Bolton C N 1881 43 34)

+  $\text{H}_2\text{O}$  Min *Calamine* Sol in  $\text{HCl}$  + Aq with separation of gelatinous  $\text{SiO}_2$ ,  $\text{rH}_2\text{O}$

Sol in  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq, and  $\text{KOH}$  + Aq

Insol in  $\text{NH}_4\text{OH}$  +  $(\text{NH}_4)_2\text{CO}_3$  + Aq (Brandhorst, Zeit angew Ch 1904, 17 513)

$\text{ZnO}$ , 3  $\text{SiO}_2$  (Bornträger, Ch Z 1893, 8 186)

**Zirconium silicate**,  $\text{SiO}_2$ ,  $\text{ZrO}_2$ 

Min *Zircon* Insol in acids, except  $\text{H}_2\text{SO}_4$ , in which it is very slowly and sl sol  
 $3\text{SiO}_2$ ,  $2\text{ZrO}_2$  Min *Auerbachite*

**"Silicium oxide,"**  $\text{Si}_2\text{H}_2\text{O}_5$ 

(Geuther, J pr 95 430) This substance is identical with silicoformic anhydride according to Otto-Graham's Handb anorgan Chem 7te Aufl 2 953

**Siliciuretted hydrogen**

See Silicon hydride

**Silicobromoform**,  $\text{HSiBr}_3$ 

Fumes on air, decomp by  $\text{H}_2\text{O}$

**Silicochloroform**,  $\text{HSiCl}_3$ 

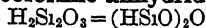
Decomp by  $\text{H}_2\text{O}$  and alcohol  
 Completely miscible with  $\text{CS}_2$ ,  $\text{CCl}_4$ ,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$ ,  $\text{SiCl}_4$ ,  $\text{SnCl}_4$ ,  $\text{TiCl}_4$ , and  $\text{AsCl}_3$  (Ruff, B 1905, 38 2230)

**Silicoethane**

See Silicon hydride

**Silicofluoroform**,  $\text{SiHF}_3$ 

Decomp by  $\text{H}_2\text{O}$  Decomp by  $\text{NaOH}$  and abs alcohol with evolution of hydrogen  
 Decomp by abs ether Sol in toluene (Ruff, B 1905, 38 63)

**Silicoformic anhydride**,

Somewhat sol in  $\text{H}_2\text{O}$  Acids, even conc  $\text{HNO}_3 + \text{Aq}$ , have no action, except  $\text{HF}$ , which dissolves it easily with evolution of hydrogen  
 Solutions of alkali hydrates, ammonium hydrate, and alkali carbonates +  $\text{Aq}$  also dissolve with evolution of hydrogen (Ruff and Wohler, A 104 101)

**Silicoiodoform**,  $\text{HSiI}_3$ 

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{CS}_2$  (Friedel, A 149 96)  
 Miscible with  $\text{C}_6\text{H}_6$  and  $\text{CS}_2$  (Ruff, B 1908, 41 3739)

**Silicomethane**,  $\text{SiH}_4$ 

See Silicon hydride

**Silicomethyl chloride**,  $\text{SiH}_3\text{Cl}$ 

Decomp by  $\text{H}_2\text{O}$  and by alkalis (Besson and Fournier, C R 1909, 148 556)

**Silicomethylene chloride**,  $\text{SiH}_2\text{Cl}_2$ 

Decomp by  $\text{H}_2\text{O}$  and by alkalis (Besson and Fournier, C R 1909, 148 556)

**Silicomolybdic acid**,  $\text{SiO}_2$ ,  $12\text{MoO}_3 + 26\text{H}_2\text{O}$ 

Very easily sol in  $\text{H}_2\text{O}$  and dil acids (Parmentier, C R 94 213)

Forms a solution with a little ether, which separates into two layers by addition of  $\text{H}_2\text{O}$  or more ether (Parmentier, C R 104 686) (Copaux, Bull Soc Min 1906, 29 79)  
 $+32\text{H}_2\text{O}$  Decomp by alkali (Asch, Z anorg 1901, 28 293)  
 $+33\text{H}_2\text{O}$  (Copaux, Bull Soc Min 1906, 29 79)

**Aluminum silicomolybdate**,  $2\text{Al}_2\text{O}_3$ ,  $3(\text{SiO}_2, 12\text{MoO}_3) + 93\text{H}_2\text{O}$   
 (Copaux, A ch 1906, (8) 7 118)

**Aluminum sodium silicomolybdate**,  $4(\text{Na}_2\text{O}, \text{Al}_2\text{O}_3, 2\text{SiO}_2)$ ,  $\text{Na}_2\text{MoO}_4 + 7\text{H}_2\text{O}$   
 Sol in  $\text{HCl} + \text{Aq}$  (Thugutt, Z anorg 1892, 2 87)

**Ammonium silicomolybdate**

Sol in  $\text{H}_2\text{O}$  (Parmentier, C R 94 213)

**Barium silicomolybdate**,  $2\text{BaO}$ ,  $\text{SiO}_2$ ,  $12\text{MoO}_3 + 16\text{H}_2\text{O}$   
 (Copaux, A ch 1906, (8) 7 118)  
 $+22\text{H}_2\text{O}$  Sol in 4 pts  $\text{H}_2\text{O}$  (Copaux, Bull Soc Min 1906, 29 80)  
 $+24\text{H}_2\text{O}$  Efflorescent Very sol in  $\text{H}_2\text{O}$  (Asch, Z anorg 1901, 28 282)  
 $+29\text{H}_2\text{O}$  Efflorescent (Copaux, A ch 1906, (8) 7 118)

**Cadmium silicomolybdate**,  $2\text{CdO}$ ,  $\text{SiO}_2$ ,  $12\text{MoO}_3 + 22\text{H}_2\text{O}$

Very unusually sol in  $\text{H}_2\text{O}$  (Copaux, A ch 1906, (8) 7 140)

**Cesium silicomolybdate**

Sl sol in  $\text{H}_2\text{O}$ , insol in silicomolybdic acid +  $\text{Aq}$

**Calcium silicomolybdate**,  $2\text{CaO}$ ,  $\text{SiO}_2$ ,  $12\text{MoO}_3 + 24\text{H}_2\text{O}$

Efflorescent Very sol in  $\text{H}_2\text{O}$  (Asch, Z anorg 1901, 28 282)  
 $+26\text{H}_2\text{O}$  (Copaux, A ch 1906, (8) 7 118)  
 $+31\text{H}_2\text{O}$  (Copaux)

**Chromium silicomolybdate**,  $2\text{Cr}_2\text{O}_3$ ,  $3(\text{SiO}_2, 12\text{MoO}_3) + 93\text{H}_2\text{O}$   
 (Copaux)

**Cupric silicomolybdate**,  $2\text{CuO}$ ,  $\text{SiO}_2$ ,  $12\text{MoO}_3 + 31\text{H}_2\text{O}$   
 Very sol in  $\text{H}_2\text{O}$  (Copaux)

**Lithium silicomolybdate**,  $2\text{Li}_2\text{O}$ ,  $\text{SiO}_2$ ,  $12\text{MoO}_3 + 29\text{H}_2\text{O}$   
 Very sol in  $\text{H}_2\text{O}$  (Copaux)

**Magnesium silicomolybdate**,  $2\text{MgO}$ ,  $\text{SiO}_2$ ,  $12\text{MoO}_3 + 30\text{H}_2\text{O}$   
 (Asch, Z anorg 1901, 28 282)  
 $+31\text{H}_2\text{O}$  Very efflorescent and sol in  $\text{H}_2\text{O}$  (Copaux)

**Potassium silicomolybdate**,  $2K_2O, SiO_2, 12MoO_3 + 16H_2O$   
 Effloresces Very sol in  $H_2O$  (Asch, Z anorg 1901, 8 282)  
 $1.5K_2O, SiO_2, 12MoO_3 + 14H_2O$  (Asch)  
 Sol in  $H_2O$  with decomp (Copaux)

**Potassium silver silicomolybdate**,  $K_2O, 3Ag_2O, 2(SiO_2, 12MoO_3) + 14H_2O, + 22H_2O, + 30H_2O$   
 Sol in  $H_2O$  with decomp Sol unchanged in dil mol r liquor (Copaux, Bull Soc Min 1907, 293)

**Rubidium silicomolybdate**  
 Sol in  $H_2O$

**Silver silicomolybdate**,  $1.5Ag_2O, SiO_2, 12MoO_3 + 11H_2O$   
 Sol in  $H_2O$  (Asch)  
 $2Ag_2O, SiO_2, 12MoO_3 + 12H_2O$  Decomp by boiling  
 $4Ag_2O, SiO_2, 12MoO_3 + 15H_2O$  (Asch)

**Sodium silicomolybdate**,  $2Na_2O, SiO_2, 12MoO_3 + 14H_2O$   
 (Copaux)  
 $Na_2O, SiO_2, 12MoO_3 + 21H_2O$  Very sol in  $H_2O$  Efflorescent (Asch)  
 $+ 22H_2O$  (Copaux)  
 $1.5Na_2O, SiO_2, 12MoO_3 + 17H_2O$  (Asch)  
 $3Na_2O, SiO_2, 12MoO_3 + 17H_2O$  (Copaux)

**Strontium silicomolybdate**,  $2SrO, SiO_2, 12MoO_3 + 26H_2O$   
 (Copaux)

**Zinc silicomolybdate**,  $2ZnO, SiO_2, 12MoO_3 + 31H_2O$   
 Extreme sol in  $H_2O$  (Copaux)

### Silicon, S

**Amorphous** Insol in  $H_2O$  Sol before igniting in old HF Insol in other mineral acids and uregia Sol in conc KOH + Aq When amorphous Si is ignited, it becomes insol in  $H_2O$  and KOH + Aq

**Amorphous** Si is sol in aqua regia and in a mixture of  $HNO_3$  and HF (Vigouroux-Moissan, C R 1895, 120 367)

Insol in liquid  $CO_2$  (Buchner, Z phys Ch 1906, 1 674)

Insol in liquid  $NH_3$  (Gore, Am Ch J 1898 20 0)

**Graphite** Sol in  $HNO_3 + HF$  (Berzelius, A 247)

**Crystalline** Insol in all acids, except a mixture of conc KO + Aq even when cold (Deville)

Although it has been generally understood that crystallized Si is not attacked by HF, and that this applies only to HF +

Aq Gaseous HF readily attacks cryst Si (Newth, C N 1896, 72 287)

Si cryst from Ag is incompletely sol in HF According to the temp to which the Ag Si mixture has been heated, the following percentages of Si are dissolved in HF 970°, 58.02%, 1150°, 27.66%, 1250°, 19%, 1470°, 16% (Moissan and Siemens, C R 1904, 138 657, 1300)

Insol in liquid  $NH_3$  (Gore, Am Ch J 1898, 20 830)

### Silicon amide, $Si(NH_2)_4$

Unstable, decomp by  $H_2O$  and partially decomp by  $HNO_3$ , sol in most organic solvents (Lengfeld, Am Ch J 1899, 21 531)

Decomp by  $H_2O$ , insol in liquid  $NH_3$  (Vigouroux, C R 1903, 136 1670)

### Silicon triboride, $SiB_3$

Slowly attacked by  $HNO_3$  Decomp by hot conc  $H_2SO_4$  or fused KOH (Moissan, C R 1900, 131 142)

### Silicon hexaboride, $SiB_6$

Readily attacked by  $HNO_3$  Slowly decomp by hot conc  $H_2SO_4$  Not attacked by fused KOH (Moissan, C R 1900, 131 142)

### Silicon tribromide $Si_2Br_6$

Decomp by KOH + Aq (Friedel and Ladenburg, A 203 253)

$HSiBr_3$  See Silicobromoform

### Silicon tetrabromide, $SiBr_4$

Rapidly decomp by  $H_2O$ , decomp in several days by  $H_2SO_4$  (Friedel and Ladenburg, A 147 362)

### Silicon bromide, $Si_3Br_8$

(Besson, C R 1910, 151 1056)

$Si_4Br_{10}$  (Besson)

### Disilicon hydrogen pentabromide, $HSiBr_5$ or $Si_2Br_5$ (?)

Decomp by  $H_2O$  (Mahn, Zeit Chem (2) 5 279)

### Silicon tetrabromide ammonia, $SiBr_4, 6NH_3$

Decomp by  $H_2O$  (Lav, Dissert 1910)  
 $SiBr_4, 7NH_3$  Decomp by  $H_2O$  (Besson C R 110 240)

### Silicon bromiodide, $SiBr_3I$

Decomp by  $H_2O$  Sol in CS (Friedel, B 2 60)

$SiBr_2I_2$  As above (F)

$SiBrI_3$  As above (F)

### Silicon bromosulphide, $SiSBr_2$

Decomp in moist air Violently decomp by  $H_2O$  Sol in CS and other organic solvents (Blx, B 1903, 36 4218)

**Silicon carbide,  $\text{SiC}$** 

Very stable, insol in  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ , sol in fused  $\text{KOH}$  at red heat (Moissan, Bull Soc 1894, (3) 11 997)

Cryst modification Insol in acids, sol in fused alkalis (Moissan, C R 1893, 117 427)

Insol in all acids, sol in molten alkalis (Muhlhauser, Z anorg 1894, 5 116)

See *Silundum*

**Silicon subchloride,  $\text{SiCl}_2$  (?)**

Decomp by  $\text{H}_2\text{O}$  (Troost and Hautefeuille, A ch (5) 7 463)

**Silicon trichloride,  $\text{Si}_2\text{Cl}_6$** 

Decomp by  $\text{H}_2\text{O}$  and alkalis (Troost and Hautefeuille A ch (5) 7 459)

$\text{SiHCl}_3$  See *Silicochloroform*

**Silicon tetrachloride,  $\text{SiCl}_4$** 

Decomp by  $\text{H}_2\text{O}$  and alcohol

**Silicon octochloride,  $\text{Si}_8\text{Cl}_{18}$** 

"Perchlorsilicopropane" Decomp by  $\text{H}_2\text{O}$  (Gattermann, B 1894, 27 1947)

, 36)

cobutane" Decomp  
air (Besson)

cohexane" Decomp  
1909, 148 841)

**Silicon trichloride ammonia,  $\text{Si}_2\text{Cl}_6, 5\text{NH}_3$** 

Slowly decomp by  $\text{H}_2\text{O}$  (Besson, C R 110 516)

**Silicon tetrachloride ammonia,  $\text{SiCl}_4, 6\text{NH}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Persoz, A ch 44 319)

**Silicon tetrachloride hydrazine,  $\text{SiCl}_4, 4\text{N}_2\text{H}_4$** 

Extremely hygroscopic and quickly decomp by  $\text{H}_2\text{O}$  (Lay, Dissert 1910)

**Silicon chlorobromide,  $\text{SiCl}_3\text{Br}$** 

Decomp by  $\text{H}_2\text{O}$  (Friedel and Ladenburg, A 145 187)

$\text{SiCl}_2\text{Br}_2$  As above (Friedel and Ladenburg)

$\text{SiBr}_3\text{Cl}$  Decomp by  $\text{H}_2\text{O}$  (Reynolds, Chem Soc 51 590)

**Silicon chlorobromide ammonia,  $2\text{SiCl}_3\text{Br}, 11\text{NH}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Besson, C R 112 788)

$\text{SiCl}_2\text{Br}_2, 5\text{NH}_3$  As above (B)

$2\text{SiClBr}_3, 11\text{NH}_3$  As above (B)

**Silicon chlorohydrosulphide,  $\text{SiCl}_3\text{SH}$** 

Decomp by  $\text{H}_2\text{O}$  or alcohol (Pierre, A ch (3) 24 286)

**Silicon chloriodide,  $\text{SiCl}_2\text{I}$** 

Decomp by  $\text{H}_2\text{O}$  (Besson, C R 112 611)

$\text{SiCl}_2\text{I}_2$  As above (B)

$\text{SiClI}_3$  As above (B)

**Silver chloriodide ammonia,  $2\text{SiCl}_2\text{I}, 11\text{NH}_3$  (Besson)**

$\text{SiCl}_2\text{I}_2, 5\text{NH}_3$

**Silicon chloronitride,  $\text{Si}_3\text{N}_2\text{Cl}_2$** 

(Schutzenberger, C R 92 1508)

**Silicon chlorosulphide,  $\text{Si}_2\text{Cl}_2\text{S}_2$** 

Decomp violently by  $\text{H}_2\text{O}$  Sol in  $\text{CCl}_4$  (Besson, C R 113 1040)

$\text{SiSiCl}_2$  Violently decomp by  $\text{H}_2\text{O}$ , sol in  $\text{CS}_2$  (Blax, B 1903, 36 4223)

**Silicon difluoride,  $\text{SiF}_2$ (?)**

Decomp by  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  (Troost and Hautefeuille, A ch (5) 7 464)

**Silicon tetrafluoride,  $\text{SiF}_4$** 

Abundantly absorbed by  $\text{H}_2\text{O}$  with decomp 100 pts  $\text{H}_2\text{O}$  absorb 140 6 pts  $\text{SiF}_4$  in 24 hours (Berzelius), 124 1 pts  $\text{SiF}_4$  in 24 hours (Davy)

Absorbed abundantly by  $\text{HNO}_3 + \text{Aq}$  (Kuhlmann, A 39 319)

Absorbed abundantly by alcohol, without separation of silicic acid, if the alcohol contains less than 8% of water

Sol in conc  $\text{HF} + \text{Aq}$  Absorbed by ether Sl sol in naptha, and oil of turpentine

**Silicon hydrogen fluoride,  $\text{H}_2\text{SiF}_6$** 

See *Fluosilicic acid*

**Silicon fluoride with MF**

See *Fluosilicate, M*

**Silicon fluoride ammonia,  $\text{SiF}_4, 2\text{NH}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Davy)

**Silicon hydride,  $\text{SiH}_4$** 

Insol in  $\text{H}_2\text{O}$  Decomp by  $\text{KOH} + \text{Aq}$  Not changed by  $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{H}_2\text{SO}_4 + \text{Aq}$ , or  $\text{HCl} + \text{Aq}$

$\text{Si}_2\text{H}_2$  "Silicoacetylene"

Sol in 20%  $\text{NaOH} + \text{Aq}$  with evolution of  $\text{H}_2$  (Bradlev, C N 1900, 82 149)

$\text{Si}_2\text{H}_6$  "Silicoethane" (Lcbrau, C R 1909, 148 44)

Sl sol in  $\text{H}_2\text{O}$  Best solvent is ethyl orthosilicate (Moissan, Bull Soc 1903, (2) 29 443)

**Silicon nitrogen hydride,  $\text{Si}_3\text{HN}$** 

Decomp by  $\text{H}_2\text{O}$  and  $\text{NaOH}$  (Ruff, B 1905, 38 2241)

<b>Silicon hydride</b> , $\text{SiH}_4$ , $\text{SiO}_2$ , $x\text{H}_2\text{O}$	Not decomposed by $\text{H}_2\text{O}$ Sol in hot alkalis + Aq with decomp (Blx, B 1903, 36 4227)
<i>See Silicic acid</i>	
$\text{Si}_2\text{H}_2\text{O}_4$ <i>See Silicooxalic acid</i>	
$\text{Si}_2\text{H}_2\text{O}_3$ <i>See Silicoformic anhydride</i>	
$\text{Si}_4\text{H}_4\text{O}_3$ <i>See Silicene</i>	
<b>Silicon imide</b> , $(\text{Si}(\text{NH})_2)_x$	<b>Silicon suboxide</b> , $\text{Si}_3\text{O}_2$ (Honigschmid, M 1909, 30 509)
Decomp by $\text{H}_2\text{O}$ (Vigouroux, C R 1903, 136 571)	<b>Silicon monoxide</b> , $\text{SiO}$ Much less easily sol in $\text{HF} + \text{Aq}$ but more easily sol in alkalis + Aq than $\text{SiO}_2$ (Potter, C C 1907, II 1952)
<b>Silicon diamide</b> , $\text{Si}(\text{NH})_2$	
Decomp by $\text{H}_2\text{O}$ with evolution of much heat (Blx B 1903, 36 4224)	<b>Silicon dioxide</b> , $\text{SiO}_2$ <i>See also Silicic acid</i> (a) <i>Crystalline</i> Min <i>Quartz</i> , <i>Tridymite</i> Insol in $\text{H}_2\text{O}$ , and acids, except $\text{HF}$ Sl sol in boiling $\text{K CO}_3 + \text{Aq}$ , and $\text{KOH} + \text{Aq}$ , see below Insol in cold $\text{KOH} + \text{Aq}$ , extremely slowly sol in boiling $\text{KOH} + \text{Aq}$ (Fuchs) Sol in $\text{HF}$ with formation of $\text{SiF}_4$ and $\text{H}_2\text{O}$ Insol in sugar + Aq, contrary to assertion of Verdel and Rissler (Petzholdt, J pr 60 368) (b) <i>Amorphous</i> Min <i>Opal</i> , etc Insol in $\text{H}_2\text{O}$ , and acids except $\text{HF}$ 100 pts $\text{H}_2\text{O}$ containing $\text{CO}$ dissolve 0 078 pt amorphous $\text{SiO}_2$ (Maschke), 0 0136 pt (Struckmann) 100 pts cold $\text{HCl} + \text{Aq}$ of 1 088 sp gr dissolve 0 017 pt $\text{SiO}$ (Struckmann) 100 pts $\text{HCl} + \text{Aq}$ of 1 115 sp gr dissolve in the cold 0 009 pt $\text{SiO}$ , and 0 018 pt on boiling 100 pts $\text{NH}_4\text{OH} + \text{Aq}$ (containing 10% $\text{NH}_3$ ) dissolve 0 017 pt quartz and 0 38 pt ignited $\text{SiO}_2$ (Pribram, Z anal 6 119) Sol in boiling $\text{K CO}_3$ or $\text{Na CO}_3 + \text{Aq}$ , separating out on cooling as a gelatinous mass (Pfaff, Schw J 29 383) The different forms of $\text{SiO}$ have different degrees of solubility in $\text{K}_2\text{CO}_3 + \text{Aq}$ Unignited amorphous $\text{SiO}$ from $\text{SiF}_4$ dissolves most readily, then come opal, ignited amorphous $\text{SiO}$ , fused $\text{SiO}$ , and tridymite, quartz powder is the most difficultly soluble (Rose) A similar behaviour is shown to $\text{KOH} + \text{Aq}$ Opal is much more sol in $\text{KOH} + \text{Aq}$ than quartz, and hyalite is the least sol of the varieties of opal (Fuchs) Opal is easily sol in $\text{KOH} + \text{Aq}$ even after ignition (Schaffgotsch, Pogg 68 147) Rammelsberg (Pogg 112 177) made the following experiments on the solubility of $\text{SiO}$ in $\text{KOH} + \text{Aq}$ The $\text{KOH} + \text{Aq}$ used contained 1 pt $\text{KOH}$ to 5 pts $\text{H}_2\text{O}$ 1 pt of the powdered mineral was boiled half an hour in a silver dish with such an amount of the $\text{KOH} + \text{Aq}$ that 20 pts $\text{KOH}$ were present 7 75% of milky white quartz was dissolved by repeating the above process three times 12 8-15% of gray hornstone was dissolved by twice boiling, 2 43% of moderately finely powdered agate of 2 661 sp gr was dissolved by once boiling, 9 7% of unignited hyalite remained undissolved after thrice boiling,
<b>Silicon imide</b> , $\text{Si}(\text{NH})_2$	
Decomp by $\text{H}_2\text{O}$ (Vigouroux, C R 1903, 136 571)	
<b>Silicon diamide</b> , $\text{Si}(\text{NH})_2$	
Decomp by $\text{H}_2\text{O}$ with evolution of much heat (Blx B 1903, 36 4224)	
<b>Silicon imide hydrochloride</b> , $\text{Si}(\text{NH}_2)_2 \cdot 2\text{HCl}$	
Rather stable in air (Blx, B 1903, 36 4225)	
<b>Silicon diiodide</b> , $\text{SiI}_2$	
Insol in $\text{CS}_2$ , $\text{CHCl}_3$ , $\text{C}_6\text{H}_6$ , and $\text{SiCl}_4$ (Friedel and Ladenburg, A 203 247)	
<b>Silicon triiodide</b> , $\text{SiI}_3$	
Decomp with $\text{H}_2\text{O}$ even at $0^\circ$ 100 pts $\text{SiI}_3$ dissolve 19 pts $\text{SiI}_2$ at $19^\circ$ , 26 pts $\text{SiI}_2$ at $27^\circ$ (Friedel and Ladenburg, Bull Soc 12 92) $\text{HSiI}_3$ <i>See Silicoiodideform</i>	
<b>Silicon tetraiodide</b> , $\text{SiI}_4$	
Decomp by $\text{H}_2\text{O}$ Acts on alcohol and ether 1 pt $\text{C}_2$ dissolves 2 2 pts $\text{SiI}_4$ at $27^\circ$ (Friedel, Z 149 96)	
<b>Silicon nitride</b> , $\text{Si}_3\text{N}_4$	
Partial decomp by boiling with conc $\text{H}_2\text{SO}_4$ Not attacked by dil acids with the exception of $\text{HCl}$ Decomp by $\text{HF}$ Partial decomp by boiling with alkalis + Aq (Weiss, Z anorg 1910, 65 89) $\text{Si}_2\text{N}_2$ Partially decomp by boiling with conc $\text{H}_2\text{SO}_4$ Not attacked by dil acids with the exception of $\text{HCl}$ Decomp by $\text{HF}$ Partial decomp by boiling with alkalis + Aq (Weiss, Z anorg 1910, 65 89) $\text{Si}_3\text{N}_4$ Not attacked by $\text{H}_2\text{O}$ Partial decomp by boiling with conc $\text{H}_2\text{SO}_4$ Not attacked by dil acids with the exception of $\text{HCl}$ Decomp by $\text{HF}$ Partial decomp by boiling with alkalis + Aq (Weiss, Z anorg 1910, 65 89)	
<b>Silicon nitride</b> , $\text{Si}_3\text{N}_4$	
"Silicic acid" Sol in $\text{HF}$ , and rapidly in $\text{KOH} + \text{Aq}$ (Schulze, C R 92 1508) Decomp by cold, more rapidly by hot $\text{H}_2\text{O}$ and more rapidly by alkalis Sol in $\text{HF} + \text{Aq}$ Not attacked by $\text{HNO}_3$ Decomp by conc $\text{H}_2\text{SO}_4$ (Lay, Dissert 1910)	

21% of ignited hyalite remained undissolved after thrice boiling, 7.21% of semi-opal of 2101 sp gr remained undissolved after thrice boiling, 18.5-19.2% of impure semi-opal of 2101 sp gr remained undissolved after thrice boiling, 79.9% of chalcedony of 2624 sp gr remained undissolved after thrice boiling, 6.12% of chalcedony of 2567 sp gr remained undissolved after fourth boiling, 14.4% chrysoprase of 2623 sp gr remained undissolved after once boiling, 49.41% of chrysoprase of 2635 sp gr remained undissolved after thrice boiling, 6.62% of flint of 2606 sp gr remained undissolved after twice boiling, 38.1% of fire-opal of 2625 sp gr remained undissolved after fourth boiling, 26.6% of fire-opal of 2625 sp gr remained undissolved after fifth boiling

Insol in liquid  $\text{CO}_2$  (Buchner, Z phys Ch 1906, 54 674)

Insol in acetone (Naumann, B 1904, 37 4329)

The solubility of crystals of quartz on different faces in HF has been determined by Lebrun (Belg Acad Bull 1913, 953)

#### Silicon thorium oxide

See Silicate, thorium

#### Silicon zirconium oxide

See Silicate, zirconium

#### Silicon oxychloride, $\text{Si}_2\text{OCl}_6$

Decomp by  $\text{H}_2\text{O}$  and alcohol Miscible with  $\text{CS}_2$ ,  $\text{SiCl}_4$ ,  $\text{CCl}_4$ ,  $\text{CHCl}_3$ , or ether (Friedel and Ladenburg, A 147 355)

$\text{Si}_4\text{O}_3\text{Cl}_{10}$ ,  $\text{Si}_4\text{O}_4\text{Cl}_8$ ,  $\text{Si}_5\text{O}_{10}\text{Cl}_{12}$ ,  $(\text{Si}_2\text{O}_3\text{Cl}_2)_n$ ,  $\text{Si}_4\text{O}_7\text{Cl}_2$  Sol in above oxychlorides (Troost and Hautefeuille, Bull Soc (2) 35 360)

#### Silicon oxyfluorhydride, $\text{Si}_2\text{O}_3\text{F}^{\text{OH}}$

(Landolt, A Suppl 4 27)

#### Silicon selenide, $\text{SiSe}_2$

Decomp by  $\text{H}_2\text{O}$  or  $\text{KOH} + \text{Aq}$  (Sabatier, C R 113 132)

#### Silicon sulphide, $\text{SiS}_2$

Sol in  $\text{H}_2\text{O}$  with decomp Acts on alcohol or ether in the cold (Fremy, A ch (3) 38 314)

$\text{SiS}$  Decomp by  $\text{H}_2\text{O}$ , easily sol in dil alkalis (Schutzenberger, Bull Soc (2) 38 56)

#### Silicon sulphodiamide, $\text{SiS}(\text{NH}_2)_2$

Slowly decomp in the air Insol in cold liquid  $\text{NH}_3$  (Blix, B 1903, 36 4219)

#### Silicon sulphobromide

See Silicon bromosulphide

#### Silicon sulphochloride

See Silicon chlorosulphide

#### Silicon sulphourea, $\text{SiS}(\text{NH}_2)_2$

Slowly decomp in air

Decomp by  $\text{H}_2\text{O}$

Insol in cold liquid  $\text{NH}_3$  (Blix, B 1903, 36 4219)

#### Silicone, $\text{Si}_4\text{H}_4\text{O}_3$

Insol in  $\text{H}_2\text{O}$ , but gives off hydrogen when warmed therewith Not attacked by chlorine or nitric or sulphuric acids even on heating, but is gradually sol in HF Decomp by alkalis, even by the most dil  $\text{NH}_4\text{OH} + \text{Aq}$ , with greatest violence and evolution of heat and hydrogen gas Insol in alcohol,  $\text{SiCl}_4$ ,  $\text{PCl}_3$ , or  $\text{CS}_2$  (Wohler, A 127 257)

$\text{H}_2\text{Si}_2\text{O}_2$  Decomp by  $\text{H}_2\text{O}$  and by dil acids Violently decomp by fuming  $\text{HNO}_3$  Not attacked by conc  $\text{H}_2\text{SO}_4$  Very slowly decomp by conc  $\text{HCl}$ , rapidly by alkalis +  $\text{Aq}$  and by pyridine (Hofschmidt, M 1909, 30 509)

Insol in  $\text{H}_2\text{O}$ , alcohol  $\text{SiCl}_4$ ,  $\text{PCl}_3$ , and  $\text{CS}_2$  Not attacked by acids except HF (Donath and Liesner, C C 1909, II 1707)

$\text{H}_{12}\text{Si}_{10}\text{O}_8$  Scarcely attacked by acids, but easily decomp by hot  $\text{H}_2\text{O}$ ,  $\text{NaOH} + \text{Aq}$  etc but not by  $\text{NH}_4\text{OH} + \text{Aq}$  (Kolb, Z anorg 1909, 64, 353)

$\text{H}_{10}\text{Si}_{10}\text{O}_8$  (Kolb)

$\text{H}_8\text{Si}_8\text{O}_{13}$  As  $\text{H}_{12}\text{Si}_{10}\text{O}_8$  (Kolb)

#### Silicomesoxalic acid, $\text{Si}(\text{OH})_2(\text{SiO OH})_2$

Insol in cold  $\text{H}_2\text{O}$ , decomp by hot  $\text{H}_2\text{O}$  (Gattermann, B 1899, 32 1116)

#### Silicooxalic acid, $\text{Si}_2\text{H}_2\text{O}_4 = \text{Si}_2\text{O}_2(\text{OH})_2$

Decomp by bases with evolution of hydrogen Takes up  $\text{HNO}_3$  to form compound, but not  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$  (Troost and Hautefeuille, A ch (5) 7 463)

#### Silicophosphoric acid, $\text{SiO}_2, \text{P}_2\text{O}_5$

Slowly decomp by  $\text{H}_2\text{O}$  Unchanged by alcohol Exists also in two modifications which are not attacked by  $\text{H}_2\text{O}$  (Hautefeuille and Margottet, C R 99 789)

$\text{SiO}_2, 2\text{P}_2\text{O}_5 + 4\text{H}_2\text{O}$  Decomp by moist air Sol in  $\text{H}_2\text{O}$  at  $0^\circ$ , but decomp by warming to ordinary temp (Hautefeuille and Margottet, C R 104 56)

#### Calcium silicophosphate

See Phosphate silicate, calcium

#### Silicostannic acid

#### Calcium silicostannate, $\text{Ca}(\text{Si}, \text{Sn})\text{O}_3$

Not attacked by acids,  $\text{KHSO}_4$ , or alkalis +  $\text{Aq}$  (Bourgeois, Bull Soc (2) 47 297)

**Silicodectungstic acid**,  $\text{H}_5\text{W}_{10}\text{SiO}_{36} + 3\text{H}_2\text{O}$   
 Somewhat sol in  $\text{H}_2\text{O}$ , but usually separates out as a siliceous silica (Marignac, A ch (4) 3 5)  
 See also **silicododecungstic acid**

**Ammonium silicodectungstate**,  $(\text{NH}_4)_5\text{W}_{10}\text{SiO}_{36} + 8\text{H}_2\text{O}$   
 Sol in 5 pts  $\text{H}_2\text{O}$  at  $18^\circ$  Very sol in hot  $\text{H}_2\text{O}$  (Marignac, A ch (4) 3 5a)  
 $(\text{NH}_4)_5\text{W}_{10}\text{SiO}_{36} + 9\text{H}_2\text{O}$  (Marignac)

**Ammonium potassium** —,  $(\text{NH}_4)_4\text{KHSiW}_{10}\text{O}_{36} + 15\text{H}_2\text{O}$   
 (Marignac)

**Barium** —,  $\text{Ba}_4\text{SiW}_{10}\text{O}_{36} + 22\text{H}_2\text{O}$   
 Precipitate Insol in  $\text{H}_2\text{O}$  (Marignac)

**Potassium** —,  $\text{K}_8\text{SiW}_{10}\text{O}_{36} + 17\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Marignac)  
 $\text{K}_4\text{H}_4\text{Si}_{10}\text{O}_{36} + 8\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Marignac)

**Potassium** — **silicotungstate** (?),  $\text{K}_8\text{Si}_{11}\text{O}_{36} + 14\text{H}_2\text{O}$   
 $\text{K}_4\text{H}_4\text{Si}_{11}\text{O}_{36} + 10\text{H}_2\text{O}$  (Marignac)

**Silver** —,  $\text{Ag}_5\text{W}_{10}\text{SiO}_{36} + 3\text{H}_2\text{O}$   
 Not appreciably sol in cold  $\text{H}_2\text{O}$  (Marignac, A ch (4) 3 65)

**Silicotungstic acid or Silicododecungstic acid**,  $\text{H}_8\text{SiW}_{12}\text{O}_{42}$   
 $(\text{H}_4\text{SiW}_{12}\text{O}_{40})_2$ , according to Copaux (Bull Soc 1906 (4) 3 101)  
 +20H<sub>2</sub>O Sol in  $\text{H}_2\text{O}$ , very sol in alcohol, behaves with ether as the acid with  $22\text{H}_2\text{O}$  (Marignac, A ch (4) 3 10)  
 +22H<sub>2</sub>O Solubility as acid with  $29\text{H}_2\text{O}$  100 pt deliquesces with 13 pts ether. To this mixture 20–25 pts of ether can be added, but a further quantity no longer mixes with, but floats above the mixture. The etheral solution is miscible with  $\text{H}_2\text{O}$ . Ether is taken up by a saturated aqueous solution with evolution of heat, until the volume has become doubled, whereafter the ether floats on the mixture. By warming the latter a liquid separates out which forms a layer between the two original layers. A alcoholic solution of the acid mixes with an equal vol of ether, but on adding more ether a conc etheral solution separates as a syrupy layer (Marignac, A ch (4) 3 10)  
 +29H<sub>2</sub>O Efflorescent Sol in  $\text{H}_2\text{O}$  Saturated solution at  $18^\circ$  contains 1 pt crystallized acid to 0.104 pt  $\text{H}_2\text{O}$ , and has 2.843 sp gr. Melts in crystal  $\text{H}_2\text{O}$ . Easily sol in absolute alcohol and anhydrous ether  
 +xH<sub>2</sub>O (Drechsel, B 1887, 20 1452)

**Aluminum silicotungstate**,  $\text{Al}_4\text{H}_{12}(\text{SiW}_{12}\text{O}_{42})_3 + 75\text{H}_2\text{O}$   
 Not deliquescent, very sol in  $\text{H}_2\text{O}$  (Marignac)  
 $\text{Al}_4(\text{SiW}_{12}\text{O}_{40})_3 + 60\text{H}_2\text{O}$  (Wyruboff)  
 Chem Soc 1897, 72, (2) 174)  
 +87H<sub>2</sub>O (Wyruboff)  
 +93H<sub>2</sub>O Very efflorescent (Wyruboff)

**Aluminum ammonium** —,  $\text{Al}_4(\text{NH}_4)_{18}(\text{SiW}_{12}\text{O}_{42})_3 + 75\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Marignac)

**Ammonium** —, basic,  $(\text{NH}_4)_4\text{SiW}_{12}\text{O}_{40} + 4\text{NH}_4\text{OH} + 14\text{H}_2\text{O}$   
 (Wyruboff, Chem Soc 1897, 72 (2) 174)

**Ammonium** —,  $(\text{NH}_4)_8\text{SiW}_{12}\text{O}_{42} + 16\text{H}_2\text{O}$   
 Very sol in hot  $\text{H}_2\text{O}$  (Marignac, A ch (4) 3 17)  
 $(\text{NH}_4)_4\text{H}_4\text{SiW}_{12}\text{O}_{42} + 6\text{H}_2\text{O}$  Less soluble in  $\text{H}_2\text{O}$  than the preceding salt (Marignac)  
 $(\text{NH}_4)_4\text{SiW}_{12}\text{O}_{40} + 8\text{H}_2\text{O}$  (Wyruboff, Chem Soc 1897, 72 (2) 174)

**Barium** —,  $\text{Ba}_2\text{H}_4\text{SiW}_{12}\text{O}_{42} + 14\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$   
 +22H<sub>2</sub>O Gradually efflorescent (Marignac)  
 Sol in cold  $\text{H}_2\text{O}$ , 1.07 pts (Copaux, Bull Soc Min 1906, 29 80)  
 Sol in 4 pts cold  $\text{H}_2\text{O}$  (Wyruboff, Bull Soc Min 1896, 19 278)  
 $\text{Ba}_4\text{SiW}_{12}\text{O}_{42} + 27\text{H}_2\text{O}$  Nearly insol in cold, sl sol in hot  $\text{H}_2\text{O}$  (Marignac)  
 $\text{Ba}_2\text{SiW}_{12}\text{O}_{40} + 16\text{H}_2\text{O}$  (Wyruboff)

**Barium potassium** —,  $\text{Ba}_2\text{K}_2\text{SiW}_{12}\text{O}_{40} + 17\text{H}_2\text{O}$   
 (Wyruboff, Chem Soc 1897, 72 (2) 176)

**Barium sodium** —,  $\text{Na}_2\text{Ba}_2\text{SiW}_{12}\text{O}_{40} + 28\text{H}_2\text{O}$   
 $\text{H}_2\text{O}$  gradually dissolves out sodium silicotungstate

**Cadmium** —,  $\text{Cd}_2\text{SiW}_{12}\text{O}_{40} + 23\text{H}_2\text{O}$ , and +27H<sub>2</sub>O  
 (Wyruboff)  
 $4\text{CdO}$ ,  $3(\text{SiO}_2, 12\text{WO}_3) + 4\text{H}_2\text{O}$  (Wyruboff)

**Cæsium** —,  $\text{Cs}_8\text{SiW}_{12}\text{O}_{42}$   
 100 pts  $\text{H}_2\text{O}$  dissolve only 0.005 pt at  $20^\circ$ , 0.52 pt at  $100^\circ$   
 Completely insol in alcohol, and  $\text{HCl} + \text{Aq}$   
 Somewhat sol in dil  $\text{NH}_4\text{OH} + \text{Aq}$  (Godefroy, B 9 1363)

**Cadmium hydrogen** —,  $2\text{Cd}_2\text{SiW}_{12}\text{O}_{40} + \text{H}_4\text{SiW}_{12}\text{O}_{40} + 42\text{H}_2\text{O}$   
 (Wyruboff)



**Calcium silicotungstate**,  $\text{Ca}_2\text{H}_4\text{SiW}_{12}\text{O}_{42} + 20\text{H}_2\text{O}$

Not deliquescent Extremely easily sol in  $\text{H}_2\text{O}$  (Marignac)  
 $\text{Ca}_2\text{SiW}_{12}\text{O}_{40} + 18, 24 \text{ and } 27\text{H}_2\text{O}$  (Wyruboff)

**Calcium silicotungstate nitrate**,  $\text{Ca}_2\text{SiW}_{12}\text{O}_{40}, \text{Ca}(\text{NO}_3)_2 + 15\text{H}_2\text{O}$   
 (Wyruboff)

**Cerous** —,  $\text{Ce}_2\text{SiW}_{12}\text{O}_{40} + 27\text{H}_2\text{O}$   
 (Wyruboff)  
 $\text{Ce}_2\text{SiW}_{12}\text{O}_{40}, \text{CeH}_2\text{SiW}_{12}\text{O}_{40} + 34\text{H}_2\text{O}$   
 (Wyruboff)

**Chromium** —,  $\text{Cr}_4(\text{SiW}_{12}\text{O}_{40})_3 + 60, 87 \text{ and } 93\text{H}_2\text{O}$   
 (Wyruboff)

**Cupric** —,  $\text{Cu}_2\text{SiW}_{12}\text{O}_{40} + 18, 27 \text{ and } 29\text{H}_2\text{O}$   
 Very efflorescent (Wyruboff)

**Didymium** —,  $\text{D}_{12}\text{SiW}_{12}\text{O}_{40} + 26 \text{ and } 27\text{H}_2\text{O}$   
 (Wyruboff)  
 $\text{D}_{12}\text{SiW}_{12}\text{O}_{40}, \text{D}_1\text{H}_2\text{SiW}_{12}\text{O}_{40} + 34\text{H}_2\text{O}$   
 (Wyruboff)

**Gallium** —,  $\text{Ga}_4(\text{SiW}_{12}\text{O}_{40})_3 + 60, 87, \text{ and } 93\text{H}_2\text{O}$   
 (Wyruboff)  
 $\text{Ga}_4(\text{SiW}_{12}\text{O}_{40})_3 + 45, 87 \text{ and } 93\text{H}_2\text{O}$   
 (Wyruboff)

**Indium** —,  $\text{In}_2\text{O}_3, \text{H}_2\text{O}, 2(\text{SiO}_2, 12\text{WO}_3) + 40\text{H}_2\text{O}$   
 (Wyruboff)  
 $2\text{In}_2\text{O}_3, 3(\text{SiO}_2, 12\text{WO}_3) + 63 \text{ and } 93\text{H}_2\text{O}$   
 (Wyruboff)

**Iron (ferric)** —,  $\text{Fe}_4(\text{SiW}_{12}\text{O}_{40})_3 + 60 \text{ and } 93\text{H}_2\text{O}$   
 (Wyruboff)

**Lanthanum** —,  $\text{La}_2\text{SiW}_{12}\text{O}_{40} + 27\text{H}_2\text{O}$   
 Efflorescent (Wyruboff)  
 $\text{La}_2\text{SiW}_{12}\text{O}_{40}, \text{LaH}_2\text{SiW}_{12}\text{O}_{40} + 34\text{H}_2\text{O}$   
 (Wyruboff)

**Lead** —, **basic**,  $\text{Pb}_2\text{SiW}_{12}\text{O}_{40}, 2\text{PbO} + 20\text{H}_2\text{O}$   
 Sl sol in  $\text{H}_2\text{O}$  (Wyruboff)

**Lead** —,  $\text{Pb}_2\text{SiW}_{12}\text{O}_{40} + 21\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Wyruboff)

**Lithium** —,  $\text{Li}_2\text{O}, \text{SiO}_2, 12\text{WO}_3 + 14 \text{ and } 24\text{H}_2\text{O}$   
 (Wyruboff)

**Magnesium** —,  $\text{Mg}_2\text{H}_4\text{SiW}_{12}\text{O}_{42} + 16\text{H}_2\text{O}$   
 Stable on the air (Marignac)

**Mercurous silicotungstate, basic**,  $\text{Hg}_4\text{SiW}_{12}\text{O}_{40}, 2\text{Hg}_2\text{O} + 5\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Insol in dil  $\text{HNO}_3$  Slowly sol in conc warm  $\text{HNO}_3$  (Wyruboff)

**Mercurous** —,  $\text{Hg}_2\text{SiW}_{12}\text{O}_{42}$

Insol in  $\text{H}_2\text{O}$  Scarcely sol in dil  $\text{HNO}_3 + \text{Aq}$  (Marignac, A ch (4) 3 43)

**Mercuric** —,  $\text{Hg}_2\text{SiW}_{12}\text{O}_{40} + 15\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Solution decomp on boiling (Wyruboff)

**Potassium** —, **basic**,  $\text{K}_4\text{SiW}_{12}\text{O}_{40}, 4\text{KOH} + 12\text{H}_2\text{O}$   
 1 pt is sol in 10 pts  $\text{H}_2\text{O}$  at  $18^\circ$  (Wyruboff)

**Potassium** —,  $\text{K}_3\text{SiW}_{12}\text{O}_{42} + 14\text{H}_2\text{O}$

Sol in 10 pts  $\text{H}_2\text{O}$  at  $18^\circ$ , and less than 3 pts at  $100^\circ$  (Marignac)  
 $+ 20\text{H}_2\text{O}$  Much less sol in cold than hot  $\text{H}_2\text{O}$  Extremely sol in hot  $\text{H}_2\text{O}$  More sol than above comp (Marignac)

$\text{K}_4\text{H}_2\text{SiW}_{12}\text{O}_{42} + 7\text{H}_2\text{O}$  Solubility as preceding salt  
 $\text{K}_4\text{H}_4\text{SiW}_{12}\text{O}_{42} + 16\text{H}_2\text{O}$  Sol in 3 pts  $\text{H}_2\text{O}$  at  $20^\circ$

$\text{K}_6\text{H}_{10}(\text{SiW}_{12}\text{O}_{12})_2 + 25\text{H}_2\text{O}$  Decomp by dissolving in  $\text{H}_2\text{O}$  (Marignac)

$\text{K}_4\text{SiW}_{12}\text{O}_{40} + 6 \text{ and } 15\text{H}_2\text{O}$  (Wyruboff)  
 $\text{K}_4\text{SiW}_{12}\text{O}_{40}, \text{K}_2\text{H}_2\text{SiW}_{12}\text{O}_{40} + 29\text{H}_2\text{O}$   
 (Wyruboff)

**Rubidium** —,  $\text{Rb}_3\text{SiW}_{12}\text{O}_{42}$

Sol in 145–150 pts  $\text{H}_2\text{O}$  at  $20^\circ$  and in 19–20 pts at  $100^\circ$  Insol in alcohol, difficultly sol in acidified, but extremely easily in ammoniacal  $\text{H}_2\text{O}$  (Godeffroy, B 9 1363)

$\text{Rb}_2\text{H}_2\text{SiW}_{12}\text{O}_{40} + 5\text{H}_2\text{O}$  (Wyruboff)  
 $\text{Rb}_4\text{SiW}_{12}\text{O}_{40}, \text{Rb}_2\text{H}_2\text{SiW}_{10}\text{O}_{40} + 22\text{H}_2\text{O}$   
 (Wyruboff)

**Silver** —,  $\text{Ag}_4\text{H}_4\text{SiW}_{12}\text{O}_{42} + 7\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$ , sol in dil  $\text{HNO}_3 + \text{Aq}$  (Marignac)  
 Sl sol in  $\text{H}_2\text{O}$  (Wyruboff)

**Sodium** —, **basic**,  $\text{Na}_4\text{SiW}_{12}\text{O}_{40}, 4\text{NaOH} + 5\text{H}_2\text{O}$   
 (Wyruboff)

**Sodium** —,  $\text{Na}_3\text{SiW}_{12}\text{O}_{42} + 7\text{H}_2\text{O}$

The saturated solution at  $19^\circ$  contains 0.21 pt  $\text{H}_2\text{O}$  to 1 pt of the salt dried at  $100^\circ$ , and has sp gr = 3.05 (Marignac)

$\text{Na}_4\text{H}_2\text{SiW}_{12}\text{O}_{42} + 11\text{H}_2\text{O}$  Stable on air  
 $+ 18\text{H}_2\text{O}$  Efflorescent (Marignac)  
 $\text{Na}_2\text{H}_6\text{SiW}_{12}\text{O}_{42} + 14\text{H}_2\text{O}$  Decomp by dissolving in  $\text{H}_2\text{O}$  (Marignac)  
 $\text{Na}_4\text{SiW}_{12}\text{O}_{40} + 14, 16 \text{ and } 20\text{H}_2\text{O}$  (Wyruboff)

- Sodium silicotungstate nitrate**,  
 $3\text{Na}_2\text{SiW}_{12}\text{O}_{42} \cdot 4\text{NaNO}_3 + 39\text{H}_2\text{O}$   
 Slightly liquescent (Marignac)
- Strontium** —,  $\text{Sr}_2\text{SiW}_{12}\text{O}_{40} + 16, 17, 23$  and  $27\text{H}_2\text{O}$   
 (Wyrout ff)
- Thallium** —,  $\text{Tl}_2\text{H}_2\text{SiW}_{12}\text{O}_{40} + 9\text{H}_2\text{O}$   
 (Wyrout ff)
- Thorium** —, basic  
 Insol in  $\text{I}_2\text{O}$  (Wyroutboff)
- Thorium** —,  $\text{Th}_2\text{SiW}_{12}\text{O}_{40} + 27\text{H}_2\text{O}$   
 Very sol in  $\text{H}_2\text{O}$  (Wyroutboff)  
 $\text{Th}_2\text{SiW}_{12}\text{O}_{40} \cdot 2\text{H}_4\text{SiW}_{10}\text{O}_{40} + 45\text{H}_2\text{O}$   
 (Wyroutboff)
- Uranium** —  
 Thirteen salts are described by Wyroutboff
- Uranyl** —  
 Seven salts are described by Wyroutboff
- Zinc** —,  $\text{Zn}_2\text{SiW}_{12}\text{O}_{40} + 18, 27$  and  $29\text{H}_2\text{O}$   
 (Wyroutboff)

### Silicovanadomolybdic acid

- Ammonium silicovanadomolybdate**,  
 $3(\text{NH}_4)_2\text{O} \cdot \text{SiO}_2 \cdot \text{V}_2\text{O}_5 \cdot 9\text{MoO}_3 + 20\text{H}_2\text{O}$   
 Sp gr of sat solution containing 0.32016 g salt in 1 cc at  $18^\circ = 1.21322$  (Friedheim, B 1900, 3 1624)  
 $3(\text{NH}_4)_2\text{O} \cdot \text{SiO}_2 \cdot \text{V}_2\text{O}_5 \cdot 10\text{MoO}_3 + 21\text{H}_2\text{O}$   
 Sp gr of sat solution containing 0.35026 g of salt in 1 cc at  $18^\circ = 1.25275$  (Friedheim)  
 $3(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot \text{SiO}_2 \cdot 11\text{MoO}_3 + 27\text{H}_2\text{O}$   
 Sp gr of sat solution containing 0.38086 g salt in 1 cc at  $18^\circ = 1.29266$  (Friedheim)  
 $3(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_5 \cdot \text{SiO}_2 \cdot 15\text{MoO}_3 + 24\text{H}_2\text{O}$   
 Sp gr of sat solution containing 0.48997 g salt in 1 cc at  $18^\circ = 1.43761$  (Friedheim)

- Ammonium potassium** —,  $(\text{NH}_4)_2\text{O} \cdot 2\text{K}_2\text{O} \cdot \text{SiO}_2 \cdot 9\text{MoO}_3 + 20\text{H}_2\text{O}$   
 Sp gr of sat solution containing 0.24021 g salt in 1 cc at  $18^\circ = 1.17031$  (Friedheim)  
 $(\text{NH}_4)_2\text{O} \cdot 2\text{K}_2\text{O} \cdot \text{SiO}_2 \cdot \text{V}_2\text{O}_5 \cdot 10\text{MoO}_3 + 21\text{H}_2\text{O}$   
 Sp gr of sat solution containing 0.2591 g salt in 1 cc at  $18^\circ = 1.19184$  (Friedheim)  
 $(\text{NH}_4)_2\text{O} \cdot 2\text{K}_2\text{O} \cdot \text{SiO}_2 \cdot \text{V}_2\text{O}_5 \cdot 11\text{MoO}_3 + 12\text{H}_2\text{O}$   
 Sp gr of sat solution containing 0.2791 g salt in 1 cc at  $18^\circ = 1.21378$  (Friedheim)

- Ammonium zinc** —,  $4(\text{NH}_4)_2\text{O} \cdot 2\text{ZnO} \cdot 2\text{SiO}_2 \cdot 3\text{V}_2\text{O}_5 \cdot 18\text{MoO}_3 + 15\text{H}_2\text{O}$   
 Sl sol in  $\text{H}_2\text{O}$  (Blum, Dissert 1904)

### Silicovanadotungstic acid

- Ammonium silicovanadotungstate**,  $3(\text{NH}_4)_2\text{O} \cdot \text{SiO}_2 \cdot \text{V}_2\text{O}_5 \cdot 9\text{WO}_3 + 24\text{H}_2\text{O}$   
 Can be cryst from  $\text{H}_2\text{O}$  (Friedheim, B 1902, 35 3244)  
 $(\text{NH}_4)_2\text{SiV}_2\text{W}_{10}\text{O}_{40} + 21\text{H}_2\text{O}$  1 cc of sat solution in  $\text{H}_2\text{O}$  at  $17.5^\circ$  contains 0.6652 g of the hydrated salt Sp gr of this solution = 1.4505 Decomp by conc acid and alkali (Friedheim)

- Ammonium barium potassium** —,  $(\text{NH}_4)_2\text{K}_2\text{BaSiV}_2\text{W}_{10}\text{O}_{40} + 25\text{H}_2\text{O}$   
 Sl sol in  $\text{H}_2\text{O}$  Decomp by conc acids and alkalis (Friedheim)

- Ammonium potassium** —,  $(\text{NH}_4)_2\text{K}_2\text{SiV}_2\text{W}_{10}\text{O}_{40} + 23\text{H}_2\text{O}$   
 1 ccm of sat solution at  $17.5^\circ$  contains 0.5072 g of the salt Sp gr of the solution at  $20^\circ = 1.3462$  Can be cryst from  $\text{H}_2\text{O}$  Decomp by conc acids and alkalis (Friedheim)

- Barium** —,  $\text{Ba}_3\text{SiV}_2\text{W}_{10}\text{O}_{40} + 28\text{H}_2\text{O}$   
 1 ccm of the sat solution in  $\text{H}_2\text{O}$  at  $17.5^\circ$  contains 0.0384 g of the salt Sp gr of the solution = 1.0307 Decomp by conc acids and alkalis (Friedheim, B 1902, 35 3245)  
 $6\text{BaO} \cdot 2\text{SiO}_2 \cdot 3\text{V}_2\text{O}_5 \cdot 18\text{WO}_3 + 50\text{H}_2\text{O}$   
 Sl sol in  $\text{H}_2\text{O}$  (Friedheim)  
 $7\text{BaO} \cdot 2\text{SiO}_2 \cdot 3\text{V}_2\text{O}_5 \cdot 18\text{WO}_3 + 83\text{H}_2\text{O}$   
 Sl sol in  $\text{H}_2\text{O}$  (Friedheim)

- Potassium** —,  $\text{K}_8\text{SiV}_2\text{W}_{10}\text{O}_{40} + 22\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  Can be cryst from  $\text{H}_2\text{O}$  without decomp Decomp by conc acids and alkalis (Friedheim)  
 $6\text{K}_2\text{O} \cdot 2\text{SiO}_2 \cdot 3\text{V}_2\text{O}_5 \cdot 18\text{WO}_3 + 31\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Friedheim)  
 $7\text{K}_2\text{O} \cdot 2\text{SiO}_2 \cdot 3\text{V}_2\text{O}_5 \cdot 18\text{WO}_3 + 42\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Friedheim)

- Sodium** —,  $\text{Na}_6\text{SiV}_2\text{W}_{10}\text{O}_{40} + 29\text{H}_2\text{O}$   
 Very sol in  $\text{H}_2\text{O}$  Decomp by conc acids and alkalis (Friedheim)

### Silundum, $\text{Si}_2\text{C}_y$

- Not attacked by hot Cl or conc acids (Amborg, Z Elektrochem 1909, 15 725)

### Silver, Ag

- Not attacked by  $\text{H}_2\text{O}$  Absolutely insol in HCl or  $\text{HClO}_2 + \text{Aq}$  (Lea, Sil Am J 144 444) Easily sol in  $\text{HNO}_3 + \text{Aq}$  on warming, if not too conc Only a minute trace is dissolved in an hour by cold dil  $\text{HNO}_3 + \text{Aq}$  (1 pt  $\text{HNO}_3 + \text{Aq}$  of sp gr 1.40 10 pts  $\text{H}_2\text{O}$ ) (Lea) Sol in hot conc  $\text{H}_2\text{SO}_4$  with evolution of  $\text{SO}_2$  Sl sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (1 4), but with more dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  the different forms of Ag behave differently (Lea)  
 Sol in HI + Aq at ordinary temperature

Sol in KI+Aq with access of air Sol in hot KCN+Aq (Christomanos, Z anal 7 301)

Sol in chromic, iodic, chloric and bromic acids Dil  $\text{H}_2\text{SO}_4$  alone is incapable of dissolving finely divided Ag, and the seeming solvent action is due to the oxygen of the air, oxygen dissolved in the acid, or derived from some external source (Hendrixson, J Am Chem Soc 1903, 25 637)

Boiling  $\text{H}_2\text{SO}_4$  dissolves pure Ag only when concentration equals 60° B More dil acid dissolves only the impure metal (Pannan, Gazz ch it 1909, 39 (2) 234)

Slowly decomp into AgCl by alkali chlorides+Aq, also by  $\text{CuCl}_2$ , etc +Aq

Somewhat sol in  $\text{NH}_4\text{OH}$ +Aq in presence of O (Lea, Sill Am J 144 444)

Sol in  $\text{KMnO}_4$ +dil  $\text{H}_2\text{SO}_4$ +Aq (Friedheim, B 20 2554)

Sol in  $\text{Fe}_2(\text{SO}_4)_3$ +Aq, especially on heating, but completely insol in  $\text{FeSO}_4$ +Aq (Vogel)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 829)

**Allotropic forms**—(a) Very sol in  $\text{H}_2\text{O}$  Solution is pptd by saline solutions or almost any neutral substance Alkali sulphates, nitrates, and citrates ppt it in a sol form, while  $\text{MgSO}_4$ ,  $\text{CuSO}_4$ ,  $\text{FeSO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ,  $\text{K}_4\text{Fe}(\text{CN})_6$ ,  $\text{Ba}(\text{NO}_3)_2$ , and even  $\text{AgNO}_3$ +Aq ppt it in an insol form, which, however, may be made sol again by treatment with many substances, as  $\text{Na}_2\text{B}_4\text{O}_7$ ,  $\text{K}_2\text{SO}_4$ , or  $\text{Na}_2\text{SO}_4$ +Aq  $\text{NaNO}_2$ +Aq ppts the Ag from its solution in a perfectly insol form

(b) The ppt from aqueous solution by salts is sol in  $\text{NH}_4\text{OH}$ +Aq (Lea, Sill Am J 137 476)

Many other allotropic forms exist (Lea) Pure colloidal silver is also sol in alcohol (Schneider, B 25 1164)

Entirely sol in  $\text{H}_2\text{O}$ , even when dry (Schneider, Z anorg 1894, 7 339)

### Silver acetylde, $\text{Ag}_2\text{C}_2$

Sol in KCN+Aq with evolution of  $\text{C}_2\text{H}_2$  Decomp by  $\text{HCl}$ +Aq (Arth, C R 1897, 124 1535)

### Silver amide, $\text{AgNH}_2$

Ppt, sol in ammonium salts+Aq and in excess of potassium amide Sol in liquid  $\text{NH}_3$  Insol in Ag salts+Aq (Franklin, J Am Chem Soc 1905, 27 833)

Sol in excess of  $\text{KNH}_2$  (Franklin, Z anorg 1905, 46 16)

### Silver antimonide, $\text{Ag}_3\text{Sb}$ or $\text{Ag}_3\text{Sb}$

Min *Discrasite* Sol in  $\text{HNO}_3$ +Aq  $\text{Ag}_3\text{Sb}$  Insol in  $\text{HCl}$ +Aq, decomp by  $\text{HNO}_3$ +Aq (Christoffe)

### Silver azoumide, $\text{AgN}_3$

Insol in hot or cold  $\text{H}_2\text{O}$  or dil acids, sol in conc mineral acids Sol in  $\text{NH}_4\text{OH}$ +Aq (Curtaus, B 23 3023)

### Silver bromide, $\text{AgBr}$

Insol in  $\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$  acidulated with  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HC}_2\text{H}_3\text{O}_2$  between 0° and 33° If flocculent or pulverulent, it is sensibly sol thereon above 33°, but if granular only above 50°, and then very slightly (Stas, A ch (5) 3 289) Ag can be detected as AgBr in 10,000,000 pts  $\text{H}_2\text{O}$  (Stas)

Calculated from the electrical conductivity of  $\text{AgBr}$ +Aq, AgBr is sol in 1,971,658 pts  $\text{H}_2\text{O}$  at 26°, and 775,400 pts at 38° (Holleman, Z phys Ch 12 133)

By same method Kohlrausch and Rose calculate that 1 l  $\text{H}_2\text{O}$  dissolves 0.4 mg AgBr at 18° (Z phys Ch 12 240)

Solubility in  $\text{H}_2\text{O}$ =0.109 mg per l (Prudhomme, J chim Phys 9 519)

Solubility in  $\text{H}_2\text{O}$ = $6.6 \times 10^{-7}$  at 25° (Goodwin, Z phys Ch 1894, 13 645)

Solubility of AgBr in  $\text{H}_2\text{O}$  at 25° equals  $8.1 \times 10^{-7}$  g mols per l (Thiel, Z anorg 1900 24 57)

Aq solution sat at 21.1° contains 0.57  $\times 10^{-6}$  gr equiv per litre (Kohlrausch, C C 1901, II 1299)

1 l  $\text{H}_2\text{O}$  dissolves 0.000137 g AgBr at 25° (Abegg and Cox, Z phys Ch 1903, 46 11)

$0.84 \times 10^{-4}$  g are dissolved per liter of sat solution at 20° (Böttger, Z phys Ch 1903, 46 603)

1 l  $\text{H}_2\text{O}$  dissolves 0.107 mg AgBr at 21° (Kohlrausch, Z phys Ch 1904, 50 356)

3.7 mg AgBr are contained in 1 liter of sat solution at 100° (Böttger, Z phys Ch 1906, 56 93)

1 mg in 1 l of sat solution at 21° (Kohlrausch, Z phys Ch 1908, 64 168)

Solubility in  $\text{H}_2\text{O}$ = $8.8 \times 10^{-7}$  g mol per litre at 25° (A E Hill, J Am Chem Soc 1908, 30 74)

Boiling  $\text{H}_2\text{O}$  dissolves 0.000003502 of its weight of AgBr  $\text{HNO}_3$ +Aq (1%  $\text{HNO}_3$ ) dissolves 0.00000543 of its weight of AgBr at 100° with sl decomposition The solution is pptd by  $\text{AgNO}_3$ +Aq or  $\text{HBr}$  (or  $\text{MBr}$ ) +Aq, but not completely 1 pt of AgBr in solution requires 3 pts of Br as  $\text{MBr}$  (or  $\text{HBr}$ ), or of Ag as  $\text{AgNO}_3$  in order to be wholly precipitated (Stas)

Not attacked by boiling  $\text{HNO}_3$ +Aq, sl sol in conc  $\text{HBr}$  or  $\text{HCl}$ +Aq (Lowig) Boiling conc  $\text{H}_2\text{SO}_4$  decomposes it (Balard), hardly acts on it (Dumas), dissolves a small quantity, which is reprecipitated by  $\text{H}_2\text{O}$  (Berzelius)

Very sl sol in dil, easily in conc  $\text{NH}_4\text{OH}$ +Aq 100 pts  $\text{NH}_4\text{OH}$ +Aq (0.986 sp gr) dissolve 0.51 pt AgBr (dried at 100°) at 80°, and about double that amount of freshly pptd AgBr (Pohl, W A B 41 267)

1 g freshly pptd AgBr is sol in 250 ccm 10%  $\text{NH}_4\text{OH}$ +Aq, but insol in an ammoniacal solution of AgCl (Seiner, Pharm J Trans (3) 14 1)

1 g AgBr dissolves in 8779.4 g 5%  $\text{NH}_4\text{OH}$ +Aq (sp gr=0.998) at 12°, and in 288.5 g

10%  $\text{NH}_4\text{Cl}$  (Long, Ga) + Aq (sp gr = 0.96) at 12° ch it 13 87)

Solubility of  $\text{AgBr}$  in  $\text{NH}_4\text{OH}$  + Aq at 15°  
G mols per l

$\text{NH}_3$	$\text{AgBr}$	Sp gr 15.5°
1 085	0 0011	0 9932
2 365	0 0031	0 9853
3 410	0 0050	0 9793
4 590	0 0074	0 9720
5 725	0 0101	0 9655

(Bodlan, x, Z phys Ch 1892, 9 734)

Solubility in  $\text{NH}_4\text{OH}$  + Aq at 0°  
10 ccm of the solution contain g  $\text{NH}_3$  and mg  $\text{AgBr}$

g $\text{NH}_3$	Mg $\text{AgBr}$	g $\text{NH}_3$	Mg $\text{AgBr}$
0 307	8 0	2 627	106 7
0 488	9 6	3 126	156 8
0 669	17 2	3 389	198 7
0 829	21 2	3 652	266 9
1 151	34 9	3 722	288 8
1 532	55 7	3 770	293 0
1 809	72 2	3 926	289 2
1 953	74 1	3 995	285 0

(Jarvis, A ch 1899, (7) 17 364)

Solubility of  $\text{AgBr}$  in  $\text{NH}_4\text{OH}$  + Aq at 25°  
G mols per l

$\text{NH}_3$	$\text{AgBr}$	$\text{NH}_3$	$\text{AgBr}$
0 1932	0 00060	1 965	0 00692
0 3849	0 00120	3 024	0 01163
0 7573	0 00223	5 244	0 02443

(Bodlander and Fittig, 1902, Z phys Ch 39 597)

Solubility in  $\text{NH}_4\text{OH}$  + Aq at 25°

g at 15°	per l	Mols $\text{NH}_3$ per l
0 00	70	0 450
0 00	59	0 497
0 00	341	0 268
0 00	17	0 273
0 00	391	0 115
0 00	386	0 118
0 00	276	0 0764
0 00	264	0 0777

(Whitney and Melcher, J Am Chem Soc 1903, 25 79)

Sol in 1 t  $\text{NH}_4\text{Cl}$  + Aq Very sl sol in  
 $\text{NH}_4$  carb, sulphate, or succinate + Aq,  
and still l s in nitrate (Wittstein) Not  
very easily sol in  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq when sus-  
pended in much  $\text{H}_2\text{O}$ , and is separated out  
again by Br + Aq (Field, C N 3 17)  
Sol in 1 CN + Aq Sl sol in conc  $\text{KCl}$ ,

$\text{KBr}$ ,  $\text{NaCl}$ ,  $\text{NaBr}$ ,  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{Br}$  + Aq,  
but insol when dilute

Traces only dissolve in alkali nitrates + Aq  
(Fresenius, Quant Anal)

Abundantly sol in  $\text{Hg}(\text{NO}_3)_2$  + Aq 100  
ccm  $\text{H}_2\text{O}$  containing 10 ccm normal  
 $\text{Hg}(\text{NO}_3)_2$  + Aq dissolve 0.0383 g  $\text{AgBr}$   
(Stas)

Solubility of  $\text{AgBr}$  in  $\text{Hg}(\text{NO}_3)_2$  + Aq at 25°  
G mols per l

$\text{Hg}(\text{NO}_3)_2$ $\text{HNO}_3$	$\text{AgBr}$	$\text{Hg}(\text{NO}_3)_2$ $\text{HNO}_3$	$\text{AgBr}$
1	0 03660	0 025	0 00459
0 10	0 00873	0 0125	0 00329
0 05	0 00639	0 0100	0 00306

$\text{HNO}_3$  was present in all cases, and it was  
found that there was no difference in solubili-  
ty of  $\text{AgBr}$  with concentrations between  
0.1N and 2N  $\text{HNO}_3$ . Cryst and amorphous  
 $\text{AgBr}$  showed the same solubility (Morse,  
Z phys Ch 1902, 45 708)

Difficultly sol in hot conc  $\text{AgNO}_3$  + Aq  
(Rasse, A 111 39)

100 ccm of a 3-N solution of  $\text{AgNO}_3$  dis-  
solve 0.04 g  $\text{AgBr}$  at 25°. Much less sol  
in  $\text{AgNO}_3$  + Aq than  $\text{AgI}$  (Hellwig, Z,  
anorg 1900, 25 176)

Solubility in  $\text{AgNO}_3$  + Aq

Volumetric measurements

$\text{AgNO}_3$	N/10 $\text{KBr}$ ccm	Opal escent at	G $\text{AgBr}$ retained per 100 g $\text{AgNO}_3$
10 g made up to 32 g per 100 g of solution	0 65	22°	0 129
	0 72	35	0 144
	0 8	44	0 159
	0 9	62	0 178
	1 0	67	0 188
	1 1	77	0 207
10 g made up to 70 g per 100 g of solution	1 2	79	0 226
	6 0	37	1 13
	8 0	53	1 50
	10 0	67	1 88
	11 25	72	2 12
	12 0	74	2 26
	12 75	79	2 40
	13 5	82	2 54
	15 5	85 5	2 92
	17 5	90	3 29

Gravimetric measurements at 14.5

G $\text{AgNO}_3$	ccm $\text{H}_2\text{O}$	Strength of $\text{AgNO}_3$ %	G $\text{AgBr}$ re- tained per 100 g $\text{AgNO}_3$
7 326	9 32	44	0 144
8 290	7 65	52	0 185
7 255	4 84	60	0 283
7 35	3 95	65	0 365

(Lowry, Roy Soc Proc 1914, 91 A, 65)

100 g KBr in conc KBr+*Aq* dissolve 3019 mg AgBr at 15°, 95 g NaCl+10 g KBr dissolve only 75 mg AgBr at 15° (Schierholz, W A B 101, 2b 4)

### Solubility in KBr+*Aq* at 25°

Mol KBr in 1 litre	G AgBr in 1 litre
4 864	26 44
4 44	17 95
4 18	13 50
3 68	7 50
2 81	2 34
2 76	2 20

(Hellwig, Z anorg 1900, 25 183)

Sol in conc KBr or NaBr+*Aq* (Lowig), but less than AgI in KI+*Aq* (Field)

100 g NaCl in conc NaCl+*Aq* dissolve 474 mg AgBr at 15°, 100 g NaCl in 21% NaCl+*Aq* dissolve 188 mg AgBr at 15° (Schierholz, W A B 101, 2b 4)

### Solubility of AgBr in Na<sub>2</sub>SO<sub>3</sub>+*Aq* at 25° G formula weights per l

So <sub>3</sub>	Ag	So <sub>3</sub>	Ag
0 232	0 0025	0 466	0 0053
0 406	0 0023	0 474	0 0055
0 448	0 0023	0 675	0 0084

(Luther and Leubner, Z anorg 1912, 74 393)

### Solubility of AgBr in Na<sub>2</sub>SO<sub>3</sub> at (?)° (g salts per l of solution)

Na <sub>2</sub> SO <sub>3</sub>	AgBr	Na <sub>2</sub> SO <sub>3</sub>	AgBr
83 75	0 790	2 08	0 0159
70 75	0 570	1 13	0 0086
38 2	0 265	0 59	0 0045
17 65	0 116	0 3	0 0039
9 47	0 0526	0 17	0 0022
4 85	0 0329	0 08	0 00075

(Mees and Piper, Photog J 1912, 36 234)

### Solubility in Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>+*Aq* at 35°

g Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> in 1 liter	g AgBr corresponding to each g Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>
100	0 376
200	0 390
300	0 397
500	0 427

(Richards and Faber, Am Ch J 1899, 21 169)

(NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>3</sub>+*Aq* dissolves AgBr more rapidly than does Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>+*Aq* (Lumière and Seyewitz, C C 1908, II 1138)

### Solubility in salts+*Aq*

Solvent	% Conc	Grams AgBr sol in 100 grams solvent
Sodium thiosulphate	1	0 35
" " "	5	1 90
" " "	10	3 50
" " "	15	4 20
" " "	20	5 80
Sodium sulphite	10	0 04
" " "	20	0 08
Ammonium sulphite	10	Traces
Potassium cyanide	5	6 55
Ammonium sulphocyanide	5	0 21
" " "	10	2 04
" " "	15	5 30
Potassium " "	10	0 73
Calcium " "	10	0 53
Barium " "	10	0 35
Aluminum " "	10	4 50
Thiocarbamide	10	1 87
Thiosinamine	1	0 08
" "	5	0 35
" "	10	0 72

(Valenti, M 1894, 15 250)

Solubility of AgBr in salts+*Aq* at (?)°  
(G AgBr sol in 1 l of 1% solution of salts)

NaSCN	2 06
NH <sub>4</sub> SCN	0 03
(NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub>	0 004
Na <sub>2</sub> SO <sub>4</sub>	0 055

(Mees and Piper, Photog J, 1912, 36 234)

In a solution of NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+*Aq*, containing 10 ccm of sat NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+*Aq* at 15° and 20 ccm normal HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+*Aq* mixed with 970 ccm H<sub>2</sub>O, about double the amt of flocculent AgBr is dissolved in the cold that dissolved by boiling H<sub>2</sub>O from granular AgBr. This solution required 3 pts of Ag or Br to ppt the AgBr in solution. Pulverulent or granular AgBr are wholly insol in dil conc acetates+*Aq* (Stas)

Sol in Hg(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>+*Aq*  
100 ccm H<sub>2</sub>O containing 10% of norm Hg(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>+*Aq* dissolves 0 0122 g AgI at 20° (Schierholz)

Very sol in liquid NH<sub>4</sub> (Linklin, Am Ch J 1898, 20 829)

Solubility in 10 cc methylamine+*Aq* at different concentrations at 11 5°

g NH <sub>2</sub> CH <sub>3</sub>	4 844	4 311	3 562	3 22
mg AgBr	289	127	73	56

g NH <sub>2</sub> CH <sub>3</sub>	1 797	1 513	1 317	1 10
mg AgBr	28	16	12	7

(Jarry, A ch 1899, (7) 17 378)

Solubility in methylamine + Aq at 25°	
G mol per l	
CH <sub>3</sub> NH <sub>2</sub>	AgBr
0 0	0 00026
0 0	0 00034
0 0 4	0 000395
0 0 47	0 00041
0 1 50	0 00045

(V uth, B 1902, **35** 2416)

Solubility of AgBr in methylamine + Aq at 25°			
G mol per l			
CH <sub>3</sub> NH <sub>2</sub>	AgBr	CH <sub>3</sub> NH <sub>2</sub>	AgBr
1 017	0 0025	0 102	0 00026
0 508	0 0013	0 051	0 00012
0 203	0 00049		

(Bodlander and Eberlein, B 1903, **36** 3948)

Solubility in ethylamine + Aq at 25°	
G mol per l	
C <sub>2</sub> H <sub>5</sub> NH <sub>2</sub>	AgBr
0 0 72	0 0000867
0 0 42	0 000137
0 0 12	0 000193
0 0 72	0 000258
0 1 300	0 000711

(V uth, B 1902, **35** 2416)

At 25°, 1 l ethylamine + Aq containing 0 483 g n 1 C<sub>2</sub>H<sub>5</sub>NH<sub>2</sub> dissolves 0 00231 g mol AgBr 0 200 g mol C<sub>2</sub>H<sub>5</sub>NH<sub>2</sub>, 0 0097 g mol AgBr (Bodlander and Eberlein, B 1903, **36** 48)

Insol benzonitrile (Naumann, B 1914, **47** 70)  
 Insol acetone (Eidmann, C C 1899, II, 1014) (Naumann, B 1904, **37** 4329)  
 Sol in alcoholic thionin (Reynolds, Chem Soc 1892, **61** 251)  
 Insol in methyl acetate (B 1901, Dissert 1906), (Naumann, B 1909, **42** 57) ethyl acetate (Naumann, B 1910, **4** 314)  
 1 49 g glBr is dissolved in 1 l of 1% thiocarbamide -Aq (Meis and Piper, Photog J 1912, **3** 239)  
 Insol in warm pyridine  
 Mol w determined in piperidine (Werner, Z an 1897, **15** 16)  
 Min F myrite, Bromate

Silver bromide ammonia, AgBr, NH<sub>3</sub> (Joannis and Crozier, C R 894, **118** 1150)

AgBr, 1½NH<sub>3</sub> (Jarry, A ch 1899, (7) 17 356)  
 2AgBr, 3NH<sub>3</sub> (Joannis and Crozier)  
 AgBr, 3NH<sub>3</sub> Decomposed by H<sub>2</sub>O Sl sol in liquid NH<sub>3</sub> (Jarry)  
 AgBr, 5NH<sub>3</sub> (Jarry, C R 1898, **126** 1141)

### Silver carbide, Ag<sub>2</sub>C

(Gay-Lussac)  
 Ag<sub>2</sub>C(?) Sol in HNO<sub>3</sub> + Aq with residue of C (Laebig, A 38 129)  
 Ag<sub>2</sub>C<sub>2</sub> Sol in HNO<sub>3</sub> + Aq with residue of C (Regnault, A 19 153)

### Silver subchloride, Ag<sub>2</sub>Cl<sub>2</sub>

NH<sub>4</sub>OH + Aq dissolves the greater part, the residue (20%) being sol in HNO<sub>3</sub> + Aq  
 KCN dissolves the greater part, H<sub>2</sub>SO<sub>4</sub> dissolves about 2%, acetic acid and KOH are without action (Bibra, J pr 1875, (2) 12 52)

### Argentous chloride, Ag<sub>2</sub>Cl

Obtained in a pure state by Guntz (C R 112 861) Dil HNO<sub>3</sub> + Aq does not attack but warm conc HNO<sub>3</sub> + Aq decomposes Easily sol in KCN + Aq (Guntz, C R 112 1212)  
 The following data are for a more or less impure Ag<sub>2</sub>Cl

Boiling conc HCl + Aq NaCl + Aq or NH<sub>4</sub>OH + Aq dissolve out AgCl and leave Ag (Scheele Wetzlar Dulk Wohler)

According to Berthollet wholly sol in NH<sub>4</sub>OH + Aq  
 Sol for the most part in NH<sub>4</sub>OH + Aq and the residue is sol in HNO<sub>3</sub> + Aq (= Ag + AgCl) (V Bibra B 7 741)

### Silver chloride, AgCl

Nearly insol in H<sub>2</sub>O  
 When AgCl is left in contact for some hours with pure H<sub>2</sub>O at 20-22°, and especially at 75°, traces go into solution, more Cl is dissolved than Ag When 1 pt Ag is pptd as AgCl in presence of 1 million pts H<sub>2</sub>O a slight bluish milkiness is observed, but in order to have a distinct ppt 4 pts Ag should be present

Dil HNO<sub>3</sub> + Aq does not increase the solubility of AgCl, but AgCl is not absolutely insol in stronger HNO<sub>3</sub> + Aq (Mulder)

1 pt AgNO<sub>3</sub>, when mixed with HCl + Aq in presence of 120 000 (Pfaff), 240,000 (Harting), pts H<sub>2</sub>O, causes an opalescence

1 pt Ag gives a slight turbidity with HCl + Aq in presence of 200 000 pts H<sub>2</sub>O, a scarcely opalescent cloudiness with 400,000 pts H<sub>2</sub>O, and the same after the lapse of 15 minutes in presence of 800,000 pts H<sub>2</sub>O (Lassaigne)

1 pt Ag can be detected as AgCl in 1 million parts H<sub>2</sub>O at ordinary temp, but not in 2 million parts In NaNO<sub>3</sub> + Aq containing 0 79 pt NaNO<sub>3</sub> in 200,000 pts H<sub>2</sub>O, 1 pt Ag can be detected as AgCl This dissolves at 75°, and is visible again on cooling

If the same liquid contains 1574 pts NaNO<sub>3</sub>, the AgCl remains in solution after cooling

In 100 ccm  $H_2O$  containing 0.787 g  $NaNO_3$ , 13 drops of  $NaCl$  and silver solution, each drop of which contains 0.05 mg  $Ag$ , cause a precipitate at  $5^\circ$ , 20 drops at  $15-17^\circ$ , 60 drops at  $45-55^\circ$ .

$AgCl$  is somewhat less sol in  $HNO_3 + Aq$  than in  $NaNO_3 + Aq$  when the amount of  $H_2O$  remains the same.

Therefore, if  $HCl$  is used instead of  $NaCl$ , about  $\frac{1}{2}$  less  $AgCl$  remains in solution.

In 100,000 pts of  $H_2O$ , which contain  $HNO_3$  and an amount of  $HCl$  corresponding to the amount of  $Ag$  salt, 1.596 pts  $AgCl$  dissolve at  $25^\circ$ . The solution is precipitated by either  $AgNO_3$  or  $HCl$  (Mulder, Silber Probir-methode, Leipzig, 1859 62).

(For further older data, see Storer's Dictionary.)

White flaky  $AgCl$  is appreciably sol in hot  $H_2O$ , 1000 ccm boiling  $H_2O$  dissolving about 2 mg  $AgCl$ . Far less sol in  $H_2O$  containing  $AgNO_3$ , being practically insol in  $H_2O$  containing 0.1 g  $AgNO_3$  in a litre. Solubility is also diminished one-half by addition of  $HCl$  (Cooke, Sill Am J (3) 21 220).

Solubility in  $H_2O$  rapidly diminishes as the temp falls (Cooke, *l c*).

Not completely insol in  $H_2O$ . According to Stas (C R 73 998) there are four modifications (1) gelatinous, (2) cheesy-flocculent, (3) pulverulent, (4) granular, crystalline, or fused (4) is almost absolutely insol in  $H_2O$  at the ordinary temp, but the solubility increases with the temp, and is considerable at  $100^\circ$ , (2), which is formed by the precipitation of a cold dilute  $Ag$  solution, has the greatest solubility in pure  $H_2O$ , and it changes its solubility by standing, or if made pulverulent by shaking with  $H_2O$ , (3) is also sol in  $H_2O$ , the solution of (2) or (3) in pure  $H_2O$ , or  $H_2O$  acidified with  $HNO_3$ , is precipitated by  $AgNO_3$ , or  $NaCl + Aq$ .

In order to ppt 1 pt  $AgCl$  in above solution 3 pts of  $Cl$  as chloride or  $Ag$  as nitrate are necessary, the pptn is then complete.

Solubility of granular variety in boiling  $H_2O$  is proportionately large, and pptn is brought about by 3 pts  $Cl$  or  $Ag$  as above, but the pptn in this case is not complete.

The salts formed simultaneously with the  $AgCl$  have no influence on the solubility of the  $AgCl$ . Presence of  $HNO_3$  does not increase the solubility of (2), but has that effect on (3) in proportion to the amt of  $HNO_3$  present (Stas, C R 73 998).

Further determination by Stas are as follows—

Between  $0^\circ$  and  $30^\circ$  granular  $AgCl$  is insol in pure  $H_2O$ , or  $H_2O$  acidulated with  $HNO_3$ .

Between  $0^\circ$  and  $30^\circ$  the flocculent and pulverulent forms of  $AgCl$  dissolve without alteration in pure  $H_2O$ , in acidulated  $H_2O$ , in alkali acetates +  $Aq$ , and in  $Hg(C_2H_3O_2)_2 + Aq$  containing an alkali acetate. Their degree of solubility is a function of the state of the chloride, of the temp, and of the nature

and quantity of the solvent within these limits of temp ( $0^\circ-30^\circ$ ). These solvents, if they contain either  $Ag$  in the state of an  $Ag$  salt, or  $Cl$  as chloride or  $HCl$  in an amount three times that which they can dissolve as  $AgCl$ , exercise no solvent action on any of the modifications of  $AgCl$ . And reciprocally sat  $AgCl + Aq$  is pptd instantly by a decinormal solution of  $AgNO_3$  or  $MCl$  (or  $HCl$ ). The  $AgCl$  is wholly pptd when the quantity of the  $Ag$  or  $Cl$  thus added is equal to three times the quantity of the  $Ag$  or  $Cl$  dissolved as  $AgCl$ .

Between  $50^\circ$  and  $100^\circ$ , however, decinormal solutions of  $Ag$  or chlorides, which cause instant pts in solutions sat with any of the modifications of  $AgCl$ , do not eliminate all the dissolved  $AgCl$ . At  $100^\circ$ , they only ppt 60% of the amt dissolved (Stas, A ch (5) 3 323).

Calculated from electrical conductivity of  $AgCl + Aq$ ,  $AgCl$  is sol in 715,800 pts  $H_2O$  at  $13.8^\circ$ , and 384,100 pts at  $26.5^\circ$  (Holleman, Z phys Ch 12 132).

Calculated in the same way, 1 l  $H_2O$  dissolves 0.76 mg at  $2^\circ$ , 0.97 mg at  $10^\circ$ , 1.52 mg at  $18^\circ$ , 2.24 mg at  $26^\circ$ , 3.03 mg at  $34^\circ$ , 4.05 mg at  $42^\circ$  (Kohlrausch and Rose, Z phys Ch 12 242).

Solubility in  $H_2O = 1.25 \times 10^{-5}$  mol/l at  $25^\circ$  (Goodwin, Z phys Ch 1894, 13 645).

Solubility of  $AgCl$  in  $H_2O$  at  $25^\circ$  is  $1.41 \times 10^{-5}$  (in normality) (Thiel, Z anorg 1900, 24 57).

$2.16 \times 10^{-5}$  moles are sol in 1 liter  $H_2O$  at  $25^\circ$  (Noyes and Kohr, Z phys Ch 1903, 42 341).

$1.53 \times 10^{-3}$  g per liter are dissolved in sat aq solution at  $20^\circ$  (Böttger, Z phys Ch 1903, 46 603).

1 l  $H_2O$  dissolves 1.6 mg  $AgCl$  at  $18^\circ$  (Kohlrausch, Z phys Ch 1904, 50 356).

21.8 milligrams are dissolved in 1 liter of sat solution at  $100^\circ$  (Eöttger, Z phys Ch 1906, 56 93).

1.34 mg are contained in 1 l of sat solution at  $18^\circ$  (Kohlrausch, Z phys Ch 1908, 64 168).

1 l sat solution at  $t^\circ$  contains mg  $AgCl$

t	mg $AgCl$	t	mg $AgCl$
1 55	0 56	17 51	1 31
4 68	0 66	25 86	1 935
9 97	0 89	34 12	2 74

(Kohlrausch, Z phys Ch 1908 64 168)

Solubility in  $H_2O = 1.6 \times 10^{-5}$  g-mol per litre at  $25^\circ$  (A E Hill, J Am Chem Soc 1903, 30 74).

1 l  $H_2O$  dissolves 0.00154 g  $AgCl$  at  $21^\circ$  0.0217 g at  $100^\circ$  (Whitby, Z anorg 1910 67 108).

Calculated from electrical conductivity of  
 AgCl + Aq 1 l H<sub>2</sub>O dissolves  
 0 0105 mill-equivalents AgCl at 18°  
 0 0365 " " " " 50°  
 0 147 " " " " 100°  
 (Melcher, J Am Chem Soc 1910, **32** 55)

1 l H<sub>2</sub>O dissolves  $1.02 \times 10^{-5}$  g equiv at  
 18°, 1 429  $10^{-5}$  g equiv at 25° (van Rossen,  
 C C 1915; I 1539)

The most probable average value for solubility of AgCl in H<sub>2</sub>O is  $1.04 \times 10^{-5}$  g equiv per l at 25°, and  $1.43 \times 10^{-5}$  g equiv per l at 18° (van Rossen, C C 1912, II 1807)  
 $1.20 \times 10^{-5}$  g AgCl are sol in 1 l H<sub>2</sub>O at 18° (Główny, C A 1915, 741)

More soluble in H<sub>2</sub>O than AgSCN (Normand, Chem Soc 1912, 101 1853)

Soluble in conc HCl + Aq, and also when not very conc thus the solution of 1 pt AgNO<sub>3</sub> + 10 pts H<sub>2</sub>O is clouded by a little but clears up by the addition of HCl (Pierre, J Pharm (3) 12 237)

1 pt AgCl dissolves in 200 pts conc HCl + 600 pts HCl + Aq diluted with 2 pts H<sub>2</sub>O (Pierre, J Pharm (3) 12 237)

Somewhat sol in hot alcohol, to which HCl has been added, but is precipitated on cooling (Erdmann, J pr 19 341)

100 pt sat HCl + Aq (sp gr 1 165) dissolve 0 2 g AgCl, or AgCl is sol in 336 Aq at ord temp, 100 pts HCl + Aq (sp gr 1 165) at b-pt dissolve 0 56 g AgCl, or AgCl is sol in 178 pts HCl + Aq

Solubility of AgCl in dil HCl + Aq 100 ccm HC - Aq (sp gr 1 165), to which the given am H<sub>2</sub>O has been added, dissolve g AgCl

ccm HCl	ccm H <sub>2</sub> O	g AgCl	Pts HCl which dissolve 1 pt AgCl
100	10	0 056	1,785
100	20	0 018	5,555
100	30	0 0089	11,235
100	50	0 0035	18,571

(Vogel, N Pcp Pharm **23** 335)

If HCl is added to a solution in which Ag is suspended, the milkiness disappears. Solubility in HCl + Aq increases with the temp, the AgCl separating out on cooling (Mulder)

The amounts of AgCl which dissolve in HCl + Aq are directly proportional to the volumes of acid (of fixed concentration) used (Barlow, Am Chem Soc 1906, **28** 1448)

1 l 1% Cl dissolves 0 0002 g AgCl at 21°  
 1 l 5% Cl dissolves 0 0033 g AgCl at 21°  
 1 l 10% Cl dissolves 0 0555 g AgCl at 21°  
 (Witby, Z anorg 1910, **67** 108)

## Solubility in HCl + Aq at 25°

HCl g equivalents per l	Ag $\times 10^{-3}$ g -equivalents per l
0 649	0 032
1 300	0 126
1 911	0 266
2 149	0 374
2 569	0 610
2 975	0 814
3 576	1 358
4 182	2 147
4 735	3 168
5 508	4 126

(Forbes, J Am Chem Soc 1911, **33** 1941)

## Solubility in 20% HCl + Aq

HCl	N/10 AgNO <sub>3</sub> ccm	Opalescent at t°	G AgCl to 100 g anhydrous HCl
20 g of 20% acid	1 0		
	1 1	0 0	0 39
	2 0	29 5	0 72
	3 0	51 5	1 076
	3 75	70 0	1 346
	4 25	82 0	1 525
	4 75	90 0	1 74
	5 80	107 0	2 08

(Lowry, Roy, Soc Proc 1914, **91** A 62)

Soluble in conc HBr + Aq (Lowry)

Insoluble in HNO<sub>3</sub> + Aq (Wackenroder)  
 Entirely unacted upon by HNO<sub>3</sub> of 1 43 sp gr (Wurtz, Am J Sci (2) **25** 382)

Solubility in dil HNO<sub>3</sub> + Aq is the same as solubility in H<sub>2</sub>O, i.e.  $1/2,000,000$  pt of Ag cannot be detected in H<sub>2</sub>O with or without HNO<sub>3</sub>, but  $1/1,000,000$  pt can be detected in both cases (Mulder)

1 pt Ag in the form of AgCl dissolves at 25° in 83,000 pts H<sub>2</sub>O containing free HNO<sub>3</sub> and 0 33 pt of HCl (Mulder)

100,000 pts conc HNO<sub>3</sub> + Aq dissolve about 2 pts AgCl, and solubility is not sensibly affected by lower nitrogen oxides (Thorpe, Chem Soc (2) **10** 453)

Solubility of AgCl in HNO<sub>3</sub> + Aq at 25°

G per liter			
HNO <sub>3</sub>	AgCl	HNO <sub>3</sub>	AgCl
0 0315	0 001647	18 9	0 00225
0 063	0 001705	94 5	0 0245
0 630	0 00176		

(Głowczyński, Kolloidchem Beih 1914, **6** 147)



Insol in cold conc  $H_2SO_4$ , but on boiling is in part decomp and in part dissolved, and does not separate on cooling

$AgCl$  is not more sol in dil  $H_2SO_4 + Aq$  than in dil  $HNO_3 + Aq$

Unacted upon by cold  $H_2SO_4 + Aq$ , and but slightly decomp on heating (Vogel)

Abundantly sol in  $H_2PtCl_4 + Aq$  without decomp (Burnbaum, Z Ch 1867 520)

Insol in cold dil caustic alkalis +  $Aq$  but decomp by hot conc solutions (Gregory)

Decomp by  $K_2CO_3 + Aq$

Sl sol in cold  $K_2CO_3 + Aq$

Easily sol even in dil  $NH_4OH + Aq$

1 pt  $AgCl$  dissolves in 1288 pts  $NH_4OH + Aq$  of 0.89 sp gr (Wallace and Lamont, Chem Gaz 1893 137)

100 pts  $NH_4OH + Aq$  of 0.986 sp gr dissolve at  $80^\circ$  1.492 pts  $AgCl$ , dried at  $100^\circ$  (Pohl, W A B 41 627)

1 l  $NH_4OH + Aq$  of 0.949 sp gr dissolves 51.6 g  $Ag$  as freshly precipitated  $AgCl$ , and 47.6 g when diluted with 1 l  $H_2O$

1 l  $NH_4OH + Aq$  of 0.924 sp gr dissolves 58 g  $Ag$  as freshly precipitated  $AgCl$ , 1 l  $NH_4OH + Aq$  of 0.899 sp gr dissolves 49.6 g, 0.5 l  $NH_4OH + Aq$  (of 0.049 sp gr) + 0.5 l saturated  $NaCl + Aq$  dissolves 20.8 g, 0.5 l  $NH_4OH + Aq$  (of 0.949 sp gr) + 0.5 l saturated  $KCl + Aq$  dissolves 20.4 g, 0.5 l  $NH_4OH + Aq$  (of 0.949 sp gr) + 0.5 l saturated  $NH_4Cl + Aq$  dissolves 22.4 g  $Ag$  as freshly pptd  $AgCl$  (Millon and Commaile, C R 56 309)

1 g  $AgCl$  dissolves in 428.64 g 5%  $NH_4OH + Aq$  (sp gr 0.998) at  $12^\circ$ , 1 g  $AgCl$  dissolves in 12.76 g 10%  $NH_4OH + Aq$  (sp gr 0.96) at  $18^\circ$  (Longi, Gazz ch it 13 87)

1 g freshly pptd  $AgCl$  is sol in 17 cc 10%  $NH_4OH + Aq$ . Solubility is diminished by presence of  $AgBr$  (Semier, Pharm J Trans (3) 14 1)

#### Solubility in $NH_4OH + Aq$ at $0^\circ$

G per 100 g solution

$NH_3$	$AgCl$	$NH_3$	$AgCl$
1.45	0.49	28.16	5.69
1.94	1.36	29.80	7.09
5.60	3.44	30.19	7.25
6.24	4.00	32.43	5.87
11.77	4.68	34.56	4.77
16.36	5.18	37.48	3.90

(Jarrry, A ch 1899, (7) 17 342)

Solubility in  $NH_4OH + Aq$  increases with the temp (Jarrry)

#### Solubility in $NH_4OH + Aq$ at $25^\circ$

g at $Ag$ per l	Mols $NH_3$ per l	g at $Ag$ per l	Mols $NH_3$ per l
0.151	2.042	0.0140	0.253
0.149	2.017	0.0140	0.253
0.149	2.013	0.0140	0.252
0.147	1.991	0.0139	0.252
0.0616	0.961	0.00621	0.118
0.0583	0.916	0.00621	0.118
0.0584	0.909	0.00619	0.118
0.0572	0.903	0.00625	0.118
0.0569	0.896	0.00304	0.0590
0.0555	0.873	0.00297	0.0589
0.0541	0.863	0.00300	0.0585
0.0514	0.818	0.00149	0.0288
0.0249	0.428	0.00143	0.0287
0.0240	0.416	0.00142	0.0285
0.0235	0.411	0.00141	0.0282
0.0227	0.397		

(Whitney and Melcher, J Am Chem Soc 1903, 25 78)

#### Solubility of $AgCl$ in $NH_4OH + Aq$ at $25^\circ$

$Ag = g$  at  $Ag$  in 1000 g  $H_2O$

$NH_3 = g$  mol  $NH_3$  in 1000 g  $H_2O$

Conc = Molecular concentration of free  $NH_3$

$Ag$	$NH_3$	Conc	Solid phase
0.023	0.437	0.391	$AgCl$
0.025	0.428	0.378	"
0.1197	1.700	1.461	"
0.1308	1.688	1.426	"
0.372	3.782	3.038	"
0.378	3.945	3.181	"
0.574	5.10	3.95	"
0.609	5.33	4.11	"
0.633	5.545	4.279	"
0.745	6.26	4.77	$AgCl + 2AgCl, 3NH_3$
0.754	6.27	4.76	"
0.757	6.25	4.74	"
0.760	6.25	4.73	"
0.775	6.52	4.97	$2AgCl, 3NH_3$
0.848	8.28	6.58	"
0.968	11.19	9.25	"
0.980	11.78	9.82	"
0.978	12.23	10.27	"
0.965	12.26	10.33	"
1.03	12.68	10.62	"
1.09	12.96	10.78	"
1.049	14.34	12.24	"
1.039	14.47	12.39	"

(Straub, Z phys Ch 1911, 77 332)

Easily (Brett), difficultly (Wittstein), so in  $NH_4Cl + Aq$ , but not in other  $NH_4$  salts

Solubility in $\text{NH}_4\text{Cl} + \text{Aq}$ at $15^\circ$	
% $\text{NH}_4\text{Cl}$	% $\text{AgCl}$
10	0 0050
14	0 0143
17	0 0354
19	0 0577
21	0 110
25	0 228
28	0 340*
Sat	0 177

\*24  $5^\circ$ 

(Schierholz, W A B, 1890, 101 2b 8)

Solubility in $\text{NH}_4\text{Cl} + \text{Aq}$ (26 31%) at $t^\circ$	
t	% $\text{AgCl}$
1	0 276
2	0 329
6	0 421
8	0 592
9	0 711
10	0 856
11	1 053

(Schierholz)

At  $25^\circ$ , 1  $\text{NH}_4\text{Cl} + \text{Aq}$  containing 0 00053 g  $\text{NH}_4\text{Cl}$  dissolves 0 001604 g  $\text{AgCl}$ , 0 00530 g  $\text{NH}_4\text{Cl}$  dissolves 0 002379 g  $\text{AgCl}$  (Glowczynski, Kolloidchem Beih 1914, 6 147)

See also orbes, page 826  
1 l  $\text{KCl} + \text{Aq}$  dissolves 1 8 mg (Guye, J Chim Phys 10 145)  
Sl sol 1 conc  $\text{KCl} + \text{Aq}$ ,  $\text{NaCl} + \text{Aq}$ , and certain other chlorides

$\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{CaCl}_2$ ,  $\text{ZnCl}_2 + \text{Aq}$ , etc., dissolve appreciable quantities of  $\text{AgCl}$ , especially if hot and concentrated, but it separates out the most part on cooling

Sol in solutions of all the metallic chlorides which are soluble in  $\text{H}_2\text{O}$ , thus  $\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{CaCl}_2$ ,  $\text{SrCl}_2$ , and  $\text{BaCl}_2 + \text{Aq}$  all dissolve  $\text{AgCl}$ , especially if hot (Mulder)

(least) also dissolve  $\text{AgCl}$  (Wetzelar)

Sol in conc  $\text{CaCl}_2 + \text{Aq}$  (Wetzelar)

Sol in cobaltic chloride +  $\text{Aq}$  (Gibbs and Guntz)

Insol in  $\text{SnCl}_4$ ,  $\text{HgCl}_2$ ,  $\text{CuCl}_2$ ,  $\text{ZnCl}_2$ ,  $\text{CdCl}_2$ ,  $\text{NiCl}_2$ , or  $\text{CoCl}_2 + \text{Aq}$  (Vogel)

Solubility of  $\text{AgCl}$  in sat solutions of chlorides

Sal	100 pts sat solution dissolve pts $\text{AgCl}$	Pts solution required to dissolve 1 pt $\text{AgCl}$
$\text{BaCl}_2$	0 0143	6,993
$\text{SrCl}_2$	0 0884	1,185
$\text{CaCl}_2$	0 0930	1,075
$\text{NaCl}$	0 0950	1,050
$\text{KCl}$	0 0475	2,122
$\text{NH}_4\text{Cl}$	0 1575	634
$\text{MgCl}_2$	0 1710	584
$\text{HCl}$	0 2980	336

(Vogel, N Rep Pharm 23 335)

Experiments by Hahn give different results from those of Vogel as follows —

Solubility in various salts +  $\text{Aq}$ 

Salt	% salt	Sat at $t^\circ$	% $\text{AgCl}$
$\text{KCl}$	24 95	19 6	0 0776
$\text{NaCl}$	25 96	"	0 1053
$\text{NH}_4\text{Cl}$	28 45	24 5	0 3397
$\text{CaCl}_2$	41 26	"	0 5713
$\text{MgCl}_2$	36 35	"	0 5313
$\text{BaCl}_2$	27 32	"	0 0570
$\text{FeCl}_2$			0 1686
$\text{FeCl}_3$			0 0058
$\text{MnCl}_2$		24 5	0 1996
$\text{ZnCl}_2$			0 0134
$\text{CuCl}_2$		24 5	0 0532
$\text{PbCl}_2$		"	0 0000

(Hahn, Wyandotte Silver Smelting Works, 1877)

1 l 4-N  $\text{KCl} + \text{Aq}$  dissolves 0 915 g  $\text{KCl}$  at  $25^\circ$  (Hellwig, Z anorg 1900, 25 166)

Solubility in  $\text{KCl} + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	G equiv per l	
	$\text{Ag} \times 10^{-3}$	$\text{KCl}$
1 0	1 734	3 325
25 0	2 415	3 083
35 0	2 786	2 955

(Forbes, J Am Chem Soc 1911, 33 1937)

Solubility in  $\text{KCl} + \text{Aq}$  at  $25^\circ$   
G per liter

$\text{KCl}$	$\text{AgCl}$	$\text{KCl}$	$\text{AgCl}$
0 00236	0 00184	0 01491	0 00305
0 00471	0 00218	0 02984	0 00321

(Glowczynski, Kolloidchem Beih 1914, 6 147)

Solubility in  $\text{CaCl} + \text{Aq}$ 

t	G equiv per l	
	$\text{Ag} \times 10^4$	$\frac{\text{CaCl}}{2}$
1 0	0 964	3 512
25 0	1 514	3 320
35 0	1 806	3 221

(Forbes, l c)

Sat  $\text{CuCl}_2 + \text{Aq}$  at  $0^\circ$  dissolves 2 835 g  $\text{AgCl}$  per l, at  $100^\circ$ , 8 147 g  $\text{AgCl}$  per l. Solubility in sat  $\text{MgCl}_2 + \text{Aq}$  is still greater (Hahn, Eng Min J 65 434)

More sol in  $\text{HgCl}_2 + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Finzi, Gazz ch it 1902, **32** (2) 324.)

At  $15^\circ$ , 100 g NaCl in 280 ccm  $\text{H}_2\text{O}$  dissolve 485 mg AgCl, 100 g KCl in 300 ccm  $\text{H}_2\text{O}$  dissolve 334 mg, 100 g  $\text{NH}_4\text{Cl}$  in 280 ccm  $\text{H}_2\text{O}$  dissolve 1051 mg

The solubility decreases with dilution rapidly at first until about an equal vol of  $\text{H}_2\text{O}$  has been added, and then much more slowly to a minimum quantity, when the dilution is 1 10 for NaCl and KCl, and 1 20 for  $\text{NH}_4\text{Cl}$

100 g NaCl in 280 ccm  $\text{H}_2\text{O}$  dissolve 2170 mg AgCl at  $109^\circ$  100 g  $\text{NH}_4\text{Cl}$  in 280 ccm  $\text{H}_2\text{O}$  dissolve 4000 mg AgCl at  $110^\circ$ , 100 g NaCl in 620 ccm  $\text{H}_2\text{O}$  (14% solution) dissolve 15 mg AgCl at  $15^\circ$ , and 774 mg at  $104^\circ$  (Schierholz, W A B 101, 2b 4.)

The solubility of AgCl in NaCl+Aq decreases with diminishing concentration of NaCl+Aq (Barlow, J Am Chem Soc 1906, **28** 1448.)

### Solubility in NaCl+Aq

#### Gravimetric measurements $15^\circ$

Strength of salt solution	G AgCl retained per 100 g NaCl
15% NaCl	0 063
20% NaCl	0 134
28% NaCl	0 279

#### Volumetric measurements

NaCl	N/10 AgNO <sub>3</sub> ccm	Opal escent at $t^\circ$	G AgCl retained per 100 g NaCl
20 g of 15% solution	0 25	28	0 119
	0 4	40	0 191
	0 7	64	0 335
	1 0	78	0 478
	1 25	89	0 598
	1 7	102 5	0 812
20 g of 20% solution	0 43	17 0	0 156
	0 65	26 0	0 234
	0 82	37 0	0 295
	1 2	51 5	0 430
	1 6	67 0	0 524
	2 12	79 5	0 765
	2 52	88 5	0 910
	3 08	97 0	1 10
20 g of 28% solution	3 52	105 0	1 27
	2 25	36 5	0 675
	2 75	45 0	0 704
	3 5	56 0	0 896
	4 5	69 0	1 153
	5 5	84 0	1 411
	6 5	94 0	1 664
	7 75	107 5	1 958

### Solubility in salts+Aq at $25^\circ$

C = concentration of the salt in salt solution in g-equivalents per litre

Salt	C	Ag $\times 10^{-3}$ g-equivalents per l
NaCl	0 933	0 086
	1 190	0 130
	1 433	0 184
	1 617	0 245
	1 871	0 348
	2 094	0 446
	2 272	0 570
	2 449	0 684
	2 658	0 851
	2 841	1 040
	3 000	1 194
	3 270	1 583
	3 471	1 897
CaCl <sub>2</sub> 2	3 747	4 462
	3 977	2 879
	4 170	3 335
	4 363	3 810
	4 535	4 298
	5 039	6 039
	1 748	0 289
	2 201	0 501
	2 741	0 900
	3 264	1 463
NH <sub>4</sub> Cl	3 737	2 182
	4 033	2 802
	4 538	4 175
	5 005	5 823
	0 513	0 042
	0 926	0 113
	1 141	0 172
	1 574	0 365
	2 143	0 842
	2 566	1 425
SrCl <sub>2</sub> 2	2 918	2 160
	3 162	2 795
	3 510	4 029
	4 363	9 353
	4 902	14 92
	5 503	24 04
	5 764	30 17
	0 550	0 033
	0 989	0 092
	1 359	0 173
	1 572	0 236
	1 698	0 284
	1 818	0 348
	2 140	0 510
	2 476	0 747
	2 992	1 252
	3 494	2 018
	4 152	3 594
	5 216	8 174
	5 775	12 04

## Solubility 1 salts + Aq at 25°—Continued

Salt	C	AgX $\times 10^{-3}$ g equivalents per l
KCl	1 111	0 141
	1 425	0 235
	1 713	0 391
	2 022	0 616
	2 396	1 050
	2 628	1 390
	2 850	1 845
	3 081	2 435
	3 424	3 602
	3 843	5 725

BaCl <sub>2</sub> 2	1 248	0 186
	1 610	0 339
	2 676	1 274
	3 260	2 366

(Forbes, Am Chem Soc 1911, 33, 1940)

Sol in 1.  $\text{HNO}_3$ ,  $\text{KNO}_3$ ,  $\text{Ca}(\text{NO}_3)_2$ ,  $\text{Mg}(\text{NO}_3)_2$ ,  
and  $\text{NH}_4\text{O}_3$  + Aq, sl sol at ord temp, but  
solubility s much increased by heat

ccm H <sub>2</sub>	g NaNO <sub>3</sub>	mg AgCl dissolved
100	0 787	1 33
200	0 787	1 93
300	2 361	3 99
100	2 787	2 53

## Solubility increases with ascending temp

Temp	ccm H <sub>2</sub> O	g NaNO <sub>3</sub>	mg AgCl dissolved
5°	100	0 787	0 86
15–17°	100	0 787	1 33
18°	100	0 787	1 46
30°	100	0 787	2 33
45–55°	100	0 787	3 99

(Mulder)

At 25° 100,000 pts H<sub>2</sub>O containing a little  
free  $\text{HNO}_3$ , and 0 787 g NaNO<sub>3</sub> dissolve 2 128  
mg AgCl. By adding 2 g more NaNO<sub>3</sub> to  
above solution, 2 5269 mg ( $\frac{1}{10}$  more) AgCl ut  
dissolved (Mulder)

Solubility in H<sub>2</sub>O is not appreciably in-  
fluenced by  $\frac{1}{10}$  N to N- $\text{KNO}_3$  or  $\text{NH}_4\text{NO}_3$  +  
Aq (v. Rossen, C (1912, II 1807))

In presence of N- $\text{NO}_3$  and excess of HCl,  
1 l H<sub>2</sub>O dissolves 0 03 mg AgCl (Richards  
and W.)

$\text{Hg}(\text{NO}_3)_2$  + Aq dissolves considerable quan-  
tities of AgCl, but the other nitrates do not  
(Mulder)

Much more sol in hot than in cold  
 $\text{Hg}(\text{NO}_3)_2$  + Aq, and much more sol therein  
than in  $\text{NH}_4\text{NO}_3$  + Aq. NaCl ppts AgCl  
from the solution, much less sol therein in

presence of  $\text{NaC}_2\text{H}_3\text{O}_2$  or  $\text{NH}_4\text{OH}$  + Aq. AgCl  
is pptd from above solution by  $\text{NaC}_2\text{H}_3\text{O}_2$  +  
Aq (Mulder)

Sol in  $\text{Hg}(\text{NO}_3)_2$  + Aq (Wackenroder, A  
41 317), in considerable amount (Liebig, A  
81 128), and is precipitated by HCl,  $\text{NH}_4\text{Cl}$ ,  
NaCl,  $\text{KC}_2\text{H}_3\text{O}_2$  (Debray, C R 70 849), in-  
completely precipitated by  $\text{AgNO}_3$  and not by  
 $\text{HNO}_3$  (Wackenroder)

Solubility of AgCl in  $\text{Hg}(\text{NO}_3)_2$  + Aq at 25°  
(G mols per l)

$\text{Hg}(\text{NO}_3)_2$ $\text{HNO}_3$	AgCl	$\text{Hg}(\text{NO}_3)_2$ $\text{HNO}_3$	AgCl
0 0100	0 00432	0 050	0 00914
0 0125	0 00499	0 100	0 01395
0 025	0 00690	1 000	0 04810

$\text{HNO}_3$  was present in all cases, and it was  
found that there was no difference in solubil-  
ity of AgCl with concentrations between 0 1N  
and 2N  $\text{HNO}_3$  (Morse, Z phys Ch 1902,  
45 708)

Not sol to appreciable extent in  $\text{Cu}(\text{NO}_3)_2$ ,  
 $\text{Fe}_2(\text{NO}_3)_6$ ,  $\text{Mn}(\text{NO}_3)_2$ ,  $\text{Co}(\text{NO}_3)_2$ ,  $\text{Zn}(\text{NO}_3)_2$ ,  
or  $\text{Ni}(\text{NO}_3)_2$  + Aq, insol or exceedingly sl  
sol in  $\text{Pb}(\text{NO}_3)_2$  + Aq (Mulder)

Imperfectly sol in  $\text{AgNO}_3$  + Aq (Wacken-  
roder)

Conc  $\text{AgNO}_3$  + Aq dissolves AgCl per-  
ceptibly

Less sol in  $\text{AgNO}_3$  + Aq than AgBr (Rasse,  
A 111 39)

Solubility in 0 02N  $\text{AgNO}_3$  + Aq = 0 15  $\times$   
10<sup>-7</sup> g mols per l (Böttger)

100 ccm of 3-N solution of  $\text{AgNO}_3$  dis-  
solve 0 08 g AgCl at 25°. More dil solutions  
dissolve very slight amounts of AgCl (Helli-  
wig, Z anorg 1900, 25 177)

Solubility in 2-N  $\text{AgNO}_3$  + Aq at ord  
temp = 0 03  $\times 10^{-3}$  g equiv AgCl (Forbes,  
J Am Chem Soc 1912, 33 1946)

Solubility in  $\text{AgNO}_3$  + Aq at t°

(Det by volumetric method)

$\text{AgNO}_3$ H O = 2 1			
C $\text{AgNO}_3$	n/10 NaCl ccm	t	g AgCl re- tained per 100 g $\text{AgNO}_3$
6	2	57	0 478
7	2	45	0 410
8	2	40	0 359
9	2	35	0 319
11	2	30	0 261
7	1	26	0 205
10	1	22	0 143
10	4	65	0 572
10	5	86	0 715

Solubility in  $\text{AgNO}_3 + \text{Aq}$  at  $t^\circ$  — *Continued* $\text{AgNO}_3 \text{ H}_2\text{O} = 1 \text{ l}$ 

5	1	94	0 286
6	1	84	0 239
7	1	75	0 205
8	1	66	0 179
9	1	58	0 159
5 5	0 5	48	0 130
6 5	0 5	40	0 110
12	0 5	23	0 060

 $\text{AgNO}_3 \text{ H}_2\text{O} = 1 \text{ 2}$ 

6	0 5	104	0 120
7	0 5	92	0 103
8	0 5	85	0 090
10	0 5	73	0 072
12	0 5	61	0 060
8	0 25	45	0 045
12	0 25	28	0 030

(Lowry, Roy, Soc Proc 1914, 91 A 58)

Solubility in  $\text{AgNO}_3 + \text{Aq}$  at  $20^\circ$   
(Det by gravimetric method)

g $\text{AgNO}_3$	g $\text{H}_2\text{O}$	g $\text{AgCl}$ retained per 100 g $\text{AgNO}_3$
220	110	0 1372
220	165	0 1009
220	220	0 0722
220	330	0 0402
220	440	0 0294

(Lowry, Roy, Soc Proc 1914, 91 A, 56)

Insol in  $\text{Na}_2\text{SO}_4 + \text{Aq}$ Solubility of  $\text{AgCl}$  in  $\text{Na}_2\text{SO}_3 + \text{Aq}$  at  $25^\circ$   
G formula weights per l

$\text{SO}_3$	Ag	$\text{SO}_3$	Ag
0 080	0 011	0 483 *	0 059 *
0 106	0 017	0 470	0 070
0 220	0 033	0 652	0 103
0 234	0 036	0 890	0 140
0 478 *	0 057 *	0 937	0 142

\* In presence of 0 05 Cl

(Luther and Leubner, Z anorg 1912, 74 393)

Easily sol in  $\text{Na}_2\text{S}_2\text{O}_3$  or  $\text{KCN} + \text{Aq}$ 

When freshly pptd, very sol in solutions of soluble thiosulphates, and especially in conc  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ , which dissolves  $\text{AgCl}$  almost as readily as  $\text{H}_2\text{O}$  dissolves sugar.  $\text{K}_2\text{S}_2\text{O}_3 + \text{Aq}$ , even when very dil, also dissolves  $\text{AgCl}$ , also  $\text{SrS}_2\text{O}_3 + \text{Aq}$  (Herschel, 1819)

Sol in  $\text{KAsO} + \text{Aq}$  (Reynoso)

Cold  $\text{NaHSO}_3 + \text{Aq}$  dissolves a considerable amount of  $\text{AgCl}$  (Rosenheim and Steinhauser, Z anorg 1900, 25 78)

Sol in cold sat  $(\text{NH}_4)_2\text{S}_2\text{O}_3 + \text{Aq}$  (Rosen-

heim and Steinhauser, Z anorg 1900, 25 103)

Solubility in  $\text{Na}$  thiosulphate +  $\text{Aq}$  at  $16^\circ$ 

g $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ in 100 cc water	g dissolved $\text{AgCl}$	
	experimental	calculated
2 08	0 29	0 80
4 16	0 64	1 60
6 24	0 88	2 40
8 35	1 26	3 21
16 70	2 54	6 42
20 83	3 28	7 99

(Abney, Z phys Ch 1895, 18 65)

A solution of  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  containing 900 g  $\text{Na}_2\text{S}_2\text{O}_3$  per liter, dissolves 0 454 g  $\text{AgCl}$  per g of  $\text{Na}_2\text{S}_2\text{O}_3$  at  $35^\circ$  (Richards and Faber, Am Ch J 1899, 21 170)

Solubility in salts +  $\text{Aq}$ 

Solvent	% Conc	Grams $\text{AgCl}$ sol in 100 grams solvent
Sodium thiosulphate	1	0 40
	5	2 00
	10	4 10
	20	6 10
Ammonium thiosulphate	1	0 57
	5	1 32
	10	3 92
	20	0 95
Sodium sulphite	10	0 44
	20	0 95
Ammonium sulphite	10	Trace
	10	0 05
Ammonia + $\text{Aq}$	3	1 40
	15	7 58
Magnesium chloride	50	0 50
Potassium cyanide	5	2 75
Ammonium sulphocyanide	5	0 08
	10	0 54
	15	2 88
	20	0 11
Potassium	10	0 15
Calcium	10	0 20
Barium	10	2 02
Aluminum	10	0 83
Thiocarbamide	10	0 40
Thiosinamine	1	1 90
	10	3 90

(Valenta, M 1894, 15 250)

Solubility in salts +  $\text{Aq}$ 

31 71 cc of a solution of sodium thiosulphate containing 31 869 g  $\text{Na}_2\text{S}_2\text{O}_3$  per liter (i e 5 g of the hydrate in 100 cc of the solution) dissolve 0 6124 g  $\text{AgCl}$

21 88 cc of a solution of ammonium thiosulphate containing 50 g  $(\text{NH}_4)_2\text{S}_2\text{O}_3$  per liter dissolve 0 7024 g  $\text{AgCl}$

27 34 cc of a solution of potassium cyanide containing 49 511 g  $\text{KCN}$  per liter dissolve

1.4926 g  
18 63)

Solubility of AgCl in sodium thiosulphate and potassium cyanide solutions may be determined without reference to experimental date (Cohn)

Slightly soluble in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Insoluble in moderately dil  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  normal  $\text{Hg}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  containing 0.1 g dissolve 0.01892 g AgCl at  $15^\circ$  (Stas)

100 ccm of a solution of a mixture of Na and Hg states dissolve 0.00175 g AgCl (Stas, A ch (5) 3 145)

Only slightly soluble in liquid  $\text{NH}_3$

Solubility curve for AgCl, AgCl,  $3\text{NH}_3$ , AgCl,  $5\text{NH}_3$  (Jarry, A ch 1899, 17 342)

Insoluble in alcoholic ammonia (Bodlander, Z phys Chem 1892, 9 731)

Nearly insoluble in ether (Mylus and Huttner, B 1891, 44 1316)

Perceptibly soluble on warming with solution of tartaric acid, but nearly the whole is deposited on cooling

Insoluble in acetone (Naumann, B 1904, 37 4329), insoluble in acetone and in methylal (Eidmann, C C 1899, II 1014)

Insoluble in methyl acetate (Bezold, Dissert 1906, Naumann, B 1909, 42 3790)

Insoluble in ethyl acetate (Hamers, Dissert 1906, Naumann, B 1910, 43 314)

Soluble in methylamine + Aq (Wurtz, A ch (3) 30 45)

Solubility of AgCl in methylamine at  $11.5^\circ$

% $\text{CH}_3\text{NH}_2$	% AgCl	% $\text{CH}_3\text{NH}_2$	% AgCl
1.78	0.16	13.70	3.29
4.44	0.62	18.69	5.43
5.51	0.83	36.69	9.93
7.66	1.32		

(Jarry, A ch 1899, (7) 17 342)

Solubility in methylamine + Aq at  $25^\circ$   
G mols per l

$\text{C}_2\text{H}_5\text{NH}_2$	AgCl
0.200	0.000300
0.400	0.000370
0.740	0.000424
0.947	0.000447
1.950	0.000481

Wuth, B 1902, 35 2416)

Solubility in methylamine + Aq at  $t^\circ$   
G mols per l

$t^\circ$	$\text{CH}_3\text{NH}_2$	Ag
18	0.93	0.0315
25	0.93	0.0338
25	0.93	0.0335

Euler, B 1903, 36 2880)

At  $25^\circ$ , 1 l methylamine + Aq, containing 1.017 g mols  $\text{CH}_3\text{NH}_2$ , dissolves 0.0387 g mol AgCl, 0.508 g mol  $\text{CH}_3\text{NH}_2$ , 0.0178 g mol AgCl (Bodlander and Eberlein, B 1903, 36 3948)

Solubility in ethylamine + Aq at  $25^\circ$   
G mols per l

$\text{C}_2\text{H}_5\text{NH}_2$	AgCl
0.01272	0.000114
0.03942	0.000156
0.05512	0.000235
0.06572	0.000312
0.10300	0.000824

(Wuth, B 1902, 35 2416)

Solubility in ethylamine + Aq at  $t^\circ$   
G mols per l

$t^\circ$	$\text{C}_2\text{H}_5\text{NH}_2$	Ag
18	0.094	0.00458
25	0.093	0.00474
25	0.094	0.00478
18	0.236	0.0132
25	0.234	0.0136
18	0.462	0.0251

(Euler, B 1903, 36 2880)

At  $25^\circ$ , 1 l ethylamine + Aq, containing 0.483 g mol  $\text{C}_2\text{H}_5\text{NH}_2$ , dissolves 0.0314 g mols AgCl, 0.200 g mol  $\text{C}_2\text{H}_5\text{NH}_2$ , 0.0115 g mol AgCl, 0.100 g mol  $\text{C}_2\text{H}_5\text{NH}_2$ , 0.0062 g mol AgCl (Bodlander and Eberlein)

Soluble in amylamine + Aq, but less than in  $\text{NH}_4\text{OH} + \text{Aq}$

Soluble in caprylamine + Aq

Easily soluble on warming in ethylene diamine + Aq (Kurnakow, Z anorg 1898, 17 220)

Easily soluble in alcoholic solution of thiocetamide (Kurnakow, J pr 1895, (2) 51 251)

Insoluble in benzonitrile (Naumann, B 1914, 47 1370)

Solubility in pyridine at  $t^\circ$

$t$	g AgCl sol in 100 g pyridine	Solid phase
-52	0.70	AgCl, $2\text{C}_5\text{H}_5\text{N}$
-49	0.77	
-35	0.99	
-30	1.36	
-25	1.80	
-22	2.20	
transition point	2.75	AgCl, $\text{C}_5\text{H}_5\text{N}$
-20	3.71	
-18	3.85	
-10	4.35	
-5	5.05	
-1	5.60	

Solubility in pyridine at  $t^\circ$ —*Continued*

$t^\circ$	g AgCl sol in 100 g pyridine	Solid phase
transition point		
0	5 35	AgCl
10	3 17	
20	1 91	
30	1 20	
40	0 80	
50	0 53	
60	0 403	
70	0 32	
80	0 25	
90	0 22	
100	0 18	
110	0 12	

(Kahlenberg, J phys Chem 1909, 13 423)

Easily sol in warm piperidine (Varet, C R 1892, 115 335)

Mol wt determined in piperidine (Werner, Z anorg 1897, 15 16)

Quinoline dissolves traces of AgCl (Varet, C R 1893, 116 60)

As sol in concn + Aq as in  $\text{NH}_4\text{OH} + \text{Aq}$  (Blyth, Chem Soc 1 350)Sol in sinamine, and thiosinamine + Aq  
Min *Cerargyrite***Silver chloride ammonia,  $\text{AgCl}, 2\text{NH}_3$** Decomp by  $\text{H}_2\text{O}$  (Terrell, A Phys Beil 7 149) $2\text{AgCl}, 3\text{NH}_3$  Decomp on air and in  $\text{H}_2\text{O}$  to AgCl Sol in conc  $\text{NH}_4\text{OH} + \text{Aq}$ , from which it can be crystallised (Rose)

Sol in alcohol (Bodlander, Z phys Ch 9 730)

 $\text{AgCl}, 3\text{NH}_3$  More easily decomp than  $2\text{AgCl}, 3\text{NH}_3$ Sl sol in liquid  $\text{NH}_3$  (Jarry, A ch 1899, (7) 17 343) $\text{AgCl}, 5\text{NH}_3$  Sl sol in liquid  $\text{NH}_3$  (Jarry, A ch 1899, (7) 17 336)**Silver chlorobromiodides**

(Rodwell, Proc Roy Soc 25 292)

**Silver subfluoride (argentous fluoride),  $\text{Ag}_2\text{F}$** Decomp by  $\text{H}_2\text{O}$  into Ag and AgF (Guntz, C R 110 1337)Decomp by  $\text{H}_2\text{O}$ 

Insol in abs alcohol, ether, acetone and xylene (Wohler and Rodewald, Z anorg 1909, 61 63)

Decomp by  $\text{H}_2\text{O}$  until the solution contains 64.5% AgF, independent of temp (Guntz, C R 1913, 157 981)**Silver fluoride, AgF**

Extremely deliquescent (Gore)

Sol in 0.55 pt  $\text{H}_2\text{O}$  at  $15.5^\circ$  with evolution of heat Sp gr of sat solution at  $15.5^\circ = 2.61$  (Gore)Solubility of AgF in  $\text{H}_2\text{O}$  at  $t^\circ$   
G per 100 g  $\text{H}_2\text{O}$ 

$t^\circ$	AgF	Solid phase
-14 2	60	Ice + AgF, $4\text{H}_2\text{O}$
+18 5	165	AgF, $4\text{H}_2\text{O}$
18 65	169 5	" + AgF, $2\text{H}_2\text{O}$
20	172	AgF, $2\text{H}_2\text{O}$
24	178	"
25	179 5	"
28 5	215	"
32	193	"
39 5	222	AgF, $2\text{H}_2\text{O} + \text{AgF}$
108	205	AgF

(Guntz, A ch 1914, (9) 2 101)

Sp gr AgF + Aq at  $18^\circ$ 

% AgF	Sp gr
7 20	1 07
29 60	1 38
49 20	1 82
56 40	2 09
66 20	2 62

(Guntz, A ch 1914, (9) 2 104)

Data on solubility of AgF in  $\text{HF} + \text{Aq}$  are given by Guntz (l c)Sl sol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 829)+  $\text{H}_2\text{O}$  Deliquescent Sol in  $\text{H}_2\text{O}$  (Guntz, A ch 1914, (9) 2 101)+  $2\text{H}_2\text{O}$  Deliquescent Sol in  $\text{H}_2\text{O}$  (Guntz)+  $4\text{H}_2\text{O}$  Not deliquescent Sol in  $\text{H}_2\text{O}$  (Guntz)+  $\frac{1}{2}\text{H}_2\text{O}$  Unstable in the presence of crystals of  $\text{AgF} + 2\text{H}_2\text{O}$  (Guntz, A ch 1914, (9) 2 101)**Silver hydrogen fluoride, AgF, HF**

(Guntz)

 $\text{AgF}, 3\text{HF}$  Very unstable

Sol in HF (Guntz, Bull Soc 1895, (3) 13 114)

**Silver stannic fluoride**

See Fluostannate, silver

**Silver tungstyl fluoride**

See Fluoxtungstate, silver

**Silver, fulminating**

See Silver nitride

**Silver hydride, AgH**Not decomp by  $\text{H}_2\text{O}$  (Bartlett, Am Ch J 1896, 19 52)**Argentous hydroxide,  $\text{Ag}_2\text{O}_2\text{H}_2$** Sol in  $\text{H}_2\text{O}$  Known only in solution (Weltzen, A 142 105)**Silver hydroxide, AgOH**Decomp into  $\text{Ag}_2\text{O}$  and  $\text{H}_2\text{O}$  above  $-40^\circ$ 

See Silver oxide

**Argentous iodide, Ag<sub>2</sub>I**  
(Guntz, R 112 861)

**Silver iodide, AgI**  
**1 1/2 H<sub>2</sub>O**  
**1 1/2 H<sub>2</sub>O**

Decomp lowly in the air. Somewhat sol in hot, more sol in boiling H<sub>2</sub>O, from which it crystallizes on cooling. In aqueous solution it is precipitated by acids. Difficultly sol in dry pyridine, easily sol in pyridine + Aq (Hantzsch, B 1905, 38 15).

(SO<sub>2</sub>)<sub>2</sub>N<sub>2</sub> Ag<sub>2</sub>S + 5 1/2 H<sub>2</sub>O Nearly insol in hot H<sub>2</sub>O (Ephraim and Michel, B 1909, 42 3845).

(SO<sub>2</sub>)<sub>2</sub>N<sub>2</sub> Ag<sub>2</sub>S + 4 H<sub>2</sub>O (Ephraim and Michel)

(SO<sub>2</sub>)<sub>2</sub>N<sub>2</sub> [Ag<sub>2</sub>S + 1 1/2, 11, and 28 H<sub>2</sub>O] Easily sol in HNO<sub>3</sub> and NH<sub>4</sub>OH + Aq. Sl sol in pyridine. Very sol in pyridine containing py. Recryst from therefrom (Ephraim and Michel).

(SO<sub>2</sub>)<sub>2</sub>N<sub>2</sub> Ag<sub>2</sub>S + 8 H<sub>2</sub>O (Ephraim and Michel)

**Silver iodide, AgI**

Insol in H<sub>2</sub>O. Calculate from electrical conductivity of AgI + Aq, AgI is sol in 1,074,040 pts H<sub>2</sub>O at 28.4°, and 1,420,260 pts at 40° (Holleman, Z phys C 12 130).

1 l H<sub>2</sub>O dissolves 0.1 mg AgI at 18° (Kohlrausch and Rose, Z phys Ch 12 241).

Solubility in H<sub>2</sub>O = 1 × 10<sup>-8</sup> (Rolla)

Solubility in H<sub>2</sub>O = 0.97 × 10<sup>-8</sup> g mols per l (Edwin, Z phys Ch 1894, 13 645).

Solubility of AgI in H<sub>2</sub>O at 25° is 1.05 × 10<sup>-8</sup> (in normal solution at 20.8° contains 0.0020 quiv per l (Kohlrausch, C C 1901, II 1 99)).

1 l H<sub>2</sub>O dissolves 0.0035 mg AgI at 21° (Kohlrausch, Z phys Ch 1904, 50 356).

1 l H<sub>2</sub>O dissolves 0.00253 mg AgI at 60° (Sammet, Z phys Ch 1905, 53 644).

Solubility in H<sub>2</sub>O = 1.23 × 10<sup>-8</sup> g-mol per litre at 25° (A. F. Hill, J Am Chem Soc 1908, 30 74).

0.003 n are contained in 1 l of sat solution (Kohlrausch, Z phys Ch 1908, 64 168).

Insol in dil HNO<sub>3</sub> + Aq or H<sub>3</sub>PO<sub>4</sub> + Aq. Decomp by hot conc HNO<sub>3</sub> + Aq or H<sub>2</sub>SO<sub>4</sub>.

Easily sol in conc HI + Aq. 1 pt Aq dissolves in 2510 pts NH<sub>4</sub>OH + Aq of 0.9 sp gr (Martini, Schw J 56 154).

in 2453 pts of 0.89 sp gr (Wallace and Lamont, Ch Gaz 1859 137).

1 g AgI dissolves in 26,300 g 10% NH<sub>4</sub>OH + Aq (sp gr = 0.96) at 12°.

Insol in 5% NH<sub>4</sub>OH + Aq (Longi, Gazz ch it 13 87).

Coefficient of solubility in NH<sub>4</sub>OH + Aq (density, 1.926) is found lower than previously observed and of the order of 1/60000 at 16° (Bignny, Bull Soc 1908, (4) 3 772).

According to Field, insol in cold conc KCl or NaCl + Aq, and only in traces on boiling, and separates out on cooling.

100 g NaCl in conc NaCl + Aq dissolve 0.95 mg AgI at 15°, 100 g NH<sub>4</sub>Cl in conc NH<sub>4</sub>Cl + Aq dissolve 2.9 mg AgI at 15°, 95 g NaCl + 10 g KBr in conc solution dissolve 1.2 mg AgI at 15°, 100 g KBr + 225 g H<sub>2</sub>O dissolve 430 mg AgI at 15°, 100 g KBr in conc KBr + Aq dissolve 525 mg AgI at 15°, 100 g KI + 69 g H<sub>2</sub>O dissolve 89.8 g AgI at 15°, 100 g KI + 92 g H<sub>2</sub>O dissolve 54.0 g AgI at 15°, 100 g KI + 366 g H<sub>2</sub>O dissolve 7.25 g AgI at 15° (Schierholz, W A B 101, 2b 4).

Sol in conc KI + Aq, from which it is precipitated by H<sub>2</sub>O (Field, C N 3 17).

KI gives a ppt with AgNO<sub>3</sub> in presence of 30,000 pts H<sub>2</sub>O (Harting).

#### Solubility in KI + Aq at 15°

% KI	% AgI	% KI	% AgI
59 16	53 13	33 3	7 33
57 15	40	25 0	2 75
50 0	25 0	21 74	1 576
40 0	13 C	20	0 80

(Schierholz, W A B 1890, 101 2b 10)

#### Solubility in KI + Aq at 25°

Mol KI per l	g AgI per l
1 937	46 42
1 6304	24 01
1 482	15 46
1 406	12 55
1 018	3 47
1 008	3 32
0 734	1 032
0 586	0 512
0 335	0 0853

Hellwig, Z anorg 1900, 25 180)

#### Solubility in KI + Aq

t = 50

% AgI	% KI	Solid phase
2 5	24 8	AgI
16 0	33 8	"
28 0	36 7	"
39 0	38 1	"
51 8	36 2	"
53 5	36 5	"
53 5	36 6	AgI + AgI, KI
53 5	37 1	AgI, KI
53 4	37 6	KI + AgI, KI
50 4	40 2	KI
45 0	43 2	"
38 0	47 1	"
22 8	55 5	"
10 7	59 1	"



t = 30°		
% AgI	% KI	Solid phase
0 1	10 2	AgI
10 0	31 4	"
29 4	37 6	"
42 8	38 8	"
49 7	38 6	AgI + AgI, 2KI
49 6	39 5	AgI, 2KI
47 7	40 9	"
46 3	41 4	"
44 1	43 2	AgI, 2KI + KI
42 8	43 9	KI
35 8	46 9	"
16 0	55 5	"
0	60 35	"

t = 0°		
% AgI	% KI	Solid phase
0 2	9 8	AgI
1 5	20 5	"
6 5	26 1	"
26 6	34 6	"
28 1	36 4	"
38 0	41 3	AgI + AgI, KI
37 9	42 0	AgI, KI
37 6	42 7	"
37 9	44 0	AgI, KI + KI
31 3	46 6	KI
21 7	50 5	"
18 0	51 2	"
9 0	53 0	"
0	56 1	"
27 5	48 7	AgI, 2KI + KI
21 0	50 3	AgI, 2KI

(Van Dam and Donk, Chem Weekbl 1911, 8 848)

Very sol in KI<sub>2</sub> + Aq (Muth, Dissert 1895)

Very sol in H<sub>2</sub>O in presence of NaI (Kurnakow, Ch Z 1900, 24 60)

#### Solubility in KI + Aq at 15°

Composition of the sat solution in mols per 1000 mols H <sub>2</sub> O		Solid phase
Mols Na <sub>2</sub> I <sub>2</sub>	Mols Ag <sub>2</sub> I <sub>2</sub>	
35 63	8 14	AgI
40 54	10 94	"
61 55	25 15	"
80 55	38 19	"
94 25	47 79	"
107 52	57 52	AgI + AgI, NaI, 3½H <sub>2</sub> O
117 96	51 70	AgI, NaI, 3½H <sub>2</sub> O
134 40	46 82	"
135 83	46 36	AgI, NaI, 3½H <sub>2</sub> O + NaI
133 81	43 03	NaI
129 02	34 85	"
122 56	22 82	"
117 11	11 93	"
111 52		"

(Krym, J Russ Phys Chem Soc 1909, 41 382.)

Traces are dissolved by alkali nitrates + Aq. Easily sol in hot KOH + Aq, from which it is pptd by H<sub>2</sub>O or alcohol. Not decomp by boiling KOH + Aq (Vogel, N Rep Pharm 20 129)

100 pts of AgNO<sub>3</sub> + Aq sat at 11° dissolve 2 3 pts AgI in the cold, and 12 3 pts on boiling (Schnauss)

#### Solubility of AgI in AgNO<sub>3</sub> + Aq at 25°

Mol AgNO <sub>3</sub> in 1 l	g AgI in 1 l	Solid phase
0 20	0 0680	AgI
0 25	0 080	
0 30	0 090	
0 35	0 125	
0 40	0 167	
0 45	0 224	
0 50	0 299	
0 55	0 400	
0 60	0 528	
0 65	0 672	
0 70	0 850	
1 215	3 08	Ag <sub>2</sub> INO <sub>3</sub>
1 63	6 26	
2 04	10 90	
2 54	16 1	Ag <sub>3</sub> I(NO <sub>3</sub> ) <sub>2</sub>
3 115	22 7	
3 75	33 2	
4 055	40 0	
4 69	53 2	
5 90	85 0	

(Hellwig, Z anorg 1900, 25 171)

Solubility of AgI in 25% AgNO<sub>3</sub> + Aq reaches a maximum at about 60° and at the point of maximum solubility the quantity dissolved amounts to about 5 g AgI per 100 g AgNO<sub>3</sub> (Lowry, Roy Soc Proc 1914, 91, A, 66)

Sol in hot Hg(NO<sub>3</sub>)<sub>2</sub> + Aq, from which it crystallizes on cooling

#### Solubility of AgI in Hg(NO<sub>3</sub>)<sub>2</sub> + Aq at 25°

Mols Hg(NO <sub>3</sub> ) <sub>2</sub> per l	g AgI per l	Mols Hg(NO <sub>3</sub> ) <sub>2</sub> per l	g AgI per l
0 010	0 800	0 050	1 737
0 0125	0 841	0 100	2 730
0 025	1 118	1 000	25 160

Solubility is not affected by presence of 0 1 to 2N HNO<sub>3</sub>

(Morse, Z phys Ch 1902, 41 708)

Sol in KCN + Aq

Sl sol in Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Aq when suspended in much H<sub>2</sub>O, but separates again on addition of KI + Aq (Field)

Insol in Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Aq (Fogh, C R 1890, 110 711)

Solubility in salts + Aq			
Solvent	% Conc	grams AgI sol in 100 grams solvent	
Sodium thiosulphate	1	0.03	20
	5	0.15	
	10	0.30	
	15	0.40	
	20	0.60	
Sodium sulphite	10	0.01	25
	20	0.02	
	Traces		
Ammonium sulphate	10	8.23	20
Potassium cyanide	5	0.02	
Potassium	10	0.08	
	15	0.13	
	10	0.03	25
Calcium	10	0.02	
Barium	10	0.02	
Aluminum	10	0.02	
Thiocarbamide	10	0.79	
Thiosemamine	1	0.008	
	5	0.05	
	10	0.09	

(Valenta, M 1894 15 250)

Very soluble in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 17 370)

Easily soluble in liquid  $\text{NH}_3$  (Ruff and Geisel, B 1905, 38 62)

Insoluble in acetone (Eidmann, C C 1899, II, 1014), (Naumann, B 1904, 37 4329)

Insoluble in ethyl acetate (Bezold, Dissert 1906), (Naumann, B 1909, 42 3790)

Insoluble in C (Arctowski, Z anorg 1894, 6 257)

Much less soluble in hot alcoholic thiourea than AgCl and AgBr (Reynolds, Chem Soc 1892, 61 253)

Insoluble in nitrile (Naumann, B 1914, 47 137)

Slowly soluble in piperidine at  $100^\circ$  (Varet, C R 1892, 1 336)

0.10 pts soluble in 100 pts pyridine at  $10^\circ$

8.60 pts soluble in 100 pts pyridine at  $121^\circ$  (Laszczyński, B 1894, 27 2283)

Mol wt determined in piperidine (Werner, Z anorg 1897, 15 16)

Min Iodine

Silver hydroiodide,  $3\text{AgI}$ ,  $\text{HI} + 7\text{H}_2\text{O}$  (Berthelot, R 91 1024)

Silver sodium iodide,  $2\text{AgI}$ ,  $\text{NaI}$

Very soluble in acetone (Marsh, Chem Soc 1913, 103 78)

$\text{AgI}$ ,  $\text{NaI}$   $3\frac{1}{2}\text{H}_2\text{O}$  (Krym, J Russ Phys Chem Soc 1909, 41 382)

See  $\text{AgI} + \text{I}$  under  $\text{AgI}$

Silver iodide ammonia,  $\text{AgI}$ ,  $\text{NH}_3$

Soluble in liquid  $\text{NH}_3$  (Jarry, A ch 1899, (7) 17 371)

$2\text{AgI}$ ,  $\text{NH}_3$  (Rammelsberg, Pogg 48 170)

Composition is  $\text{AgI}$ ,  $\text{NH}_3$  (Longi, Gazz ch it 13 86)

Soluble in liquid  $\text{NH}_3$  (Jarry, A ch 1899, (7) 17 371)

$\text{AgI}$ ,  $2\text{NH}_3$  (Terrel, C R 98 1279)

### Silver nitride, $\text{Ag}_3\text{N}$

Berthollet's "knallsilber" Very explosive Insol in  $\text{H}_2\text{O}$  Sol in  $\text{KCN} + \text{Aq}$  Slowly sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Raschig, A 233 93) (Angeli, Chem Soc 1894, 66 (2) 93)

### Argentous oxide, $\text{Ag}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Decomp by acids into argentic oxide and silver Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  or  $\text{HC}_2\text{H}_3\text{O}_2$  (v der Pfordten, B 20 1458)

Contains H, and is a hydroxide  $\text{Ag}_4\text{H}_2\text{O}$  (v der Pfordten, B 21 2288)

The above substance is a mixture, according to Friedheim (B 20 2557)

### Silver oxide, $\text{Ag}_2\text{O}$

Somewhat sol in  $\text{H}_2\text{O}$  (Bucholz)

Sol in 3000 pts  $\text{H}_2\text{O}$  (Bineau C R 41 509) sol in 96 pts  $\text{H}_2\text{O}$  (Abl)

Sol in 15,360 pts  $\text{H}_2\text{O}$  (Levi, Gazz ch it 1901, 31 (1) 1)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 2.16 \times 10^{-4}$  mols  $\text{AgOH}$  per litre (Noyes, J Am Chem Soc 1902, 24 1147)

1 liter sat aqueous solution at  $19.96^\circ$  contains  $2.14 \times 10^{-2}$  g, at  $24.94^\circ$  contains  $2.5 \times 10^{-2}$  g  $\text{Ag}_2\text{O}$  (Böttger, Z phys Ch 1903, 46 603)

1 l  $\text{H}_2\text{O}$  at  $25^\circ$  dissolves  $1.8 \times 10^{-4}$  gram—atoms of silver Determined from its solubility in  $\text{NH}_3$  (Abegg and Cox, Z phys Ch 1903, 46 11)

1 l  $\text{H}_2\text{O}$  dissolves 0.0215 g  $\text{Ag}_2\text{O}$  at  $20^\circ$  (Whitby, Z anorg 1910, 67 108)

The solubility of  $\text{Ag}_2\text{O}$  in  $\text{H}_2\text{O}$  varies with the method of preparation

Solubility of  $\text{Ag}_2\text{O}$  (prepared by action of  $\text{NaOH}$ , freshly prepared by the solution of Na in  $\text{H}_2\text{O}$ , on a dil solution of  $\text{AgNO}_3$ ) =  $2.16 \times 10^{-4}$  g-mol in 1 l  $\text{H}_2\text{O}$  at  $25^\circ$ ,  $2.97 \times 10^{-4}$  g-mol at  $50^\circ$

Solubility of  $\text{Ag}_2\text{O}$  (prepared by action of aqueous barium hydroxide on  $\text{AgNO}_3$ ) =  $2.23 \times 10^{-4}$  g-mol in 1 l  $\text{H}_2\text{O}$  at  $25^\circ$ ,  $3.09 \times 10^{-4}$  g-mol in 1 l  $\text{H}_2\text{O}$  at  $50^\circ$

Solubility of  $\text{Ag}_2\text{O}$  (prepared by action of conc  $\text{NaOH} + \text{Aq}$  on moist, freshly pptd  $\text{AgCl}$ ) =  $2.32 \times 10^{-4}$  g-mol in 1 l  $\text{H}_2\text{O}$  at  $25^\circ$ ,  $3.55 \times 10^{-4}$  g-mol at  $50^\circ$

Solubility of  $\text{Ag}_2\text{O}$  (prepared by action of conc  $\text{NaOH} + \text{Aq}$  on moist, freshly pptd  $\text{Ag}_2\text{CO}_3$ ) =  $2.95 \times 10^{-4}$  g-mol in 1 l  $\text{H}_2\text{O}$  at  $25^\circ$ ,  $3.89 \times 10^{-4}$  g-mol at  $50^\circ$  (Rebiere, Bull Soc 1915, (4) 7 311)

Sol in acids,  $\text{NH}_4\text{OH}$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  Decomp by alkali chlorides, bromides,

and iodides + Aq Sol in alkali cyanides, and thiosulphates + Aq Sl sol in nitrates + Aq, insol in sulphates + Aq When freshly pptd, sol in  $\text{NH}_4\text{SCN} + \text{Aq}$  Sl sol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  Abundantly sol in  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  without pptn of  $\text{BaO}_2\text{H}_2$  Sol in boiling  $\text{Mn}(\text{NO}_3)_2$ ,  $\text{Ni}(\text{NO}_3)_2$ ,  $\text{Co}(\text{NO}_3)_2$ ,  $\text{Cu}(\text{NO}_3)_2$ , and  $\text{Ce}_2(\text{NO}_3)_6 + \text{Aq}$  with pptn of oxides (Persoz)

Insol in  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq}$  Sl sol in  $\text{BaO}_2\text{H}_2 + \text{Aq}$  (Berzelius ?)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$

G at Ag per l	Mol $\text{NH}_3$ per l
0 0654	0 214
0 0658	0 220
0 134	0 458
0 140	0 469
0 205	0 671
0 205	0 684
0 225	0 720
0 224	0 733
0 251	0 811
0 248	0 827
0 242	0 830
0 257	0 876
0 278	0 899
0 276	0 915
0 299	0 999
0 343	1 147
0 454	1 498
0 470	1 522

(Whitney and Melcher, J Am Chem Soc 1903, 25 78)

Insol in liquid  $\text{NH}_3$  (Franklin, Am ch J 1898, 20 829)

Insol in acetone (Eidmann, C C 1899, II 1014), (Naumann, B 1904, 37 4329)

Insol in ethyl acetate (Hamers, Dissert 1906, Naumann, B 1910, 43 314)

Sl sol in amylamine + Aq, easily in methylamine + Aq (Wurtz, A ch 30 453), also in ethylamine, and thiosinamine + Aq

Solubility in methylamine + Aq at  $18^\circ$

G mols per l

$\text{CH}_3\text{NH}_2$	Ag
0 1	0 0221
0 5	0 118
1 0	0 228

(Euler, B 1903, 36 2879)

Solubility in ethylamine + Aq at  $18^\circ$

G mols per l

$\text{C}_2\text{H}_5\text{NH}_2$	Ag
0 1	0 0322
0 5 (interpolated)	0 160
1 0 "	0 314
0 561	0 180
0 927	0 291

(Euler)

Silver peroxide,  $\text{Ag}_2\text{O}_2$

Sol in conc  $\text{H}_2\text{SO}_4$  (Rose), and in pure  $\text{HNO}_3 + \text{Aq}$  without decomp Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Schönbein, J pr 41 321)

Sol in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  with decomp (Mulder, R t c 1898, 17 151)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 829)

Silver oxide ammonia

See Silver nitride

Silver oxybromide,  $\text{Ag}_7\text{OBr}_7$

Insol in  $\text{H}_2\text{O}$  Insol in  $\text{HNO}_3$  Sol in hot ammonia and in  $\text{NaOCl} + \text{Aq}$  (Seyewetz C R 1912, 154 357)

Silver oxyfluoride,  $\text{AgF}$ ,  $\text{AgOH}$

Decomp by  $\text{H}_2\text{O}$  with separation of  $\text{Ag}_2\text{O}$  (Pfaundler)

Silver per oxyfluoride,  $2\text{Ag}_2\text{O}_4$ ,  $\text{AgF}$

(Tanatar, Z anorg 1901, 28 335)

$4\text{Ag}_2\text{O}_4$ ,  $3\text{AgF}$  (Tanatar, Z anorg 1901 28 335)

Silver oxyiodide,  $\text{Ag}_2\text{O}$ ,  $\text{Ag}_5\text{I}_7$

(Seyewitz, Bull Soc 1894, (3) 11 452)

Silver phosphide,  $\text{AgP}_2$

Sol in  $\text{HNO}_3$  Attacked by aqua regia (Granger, C R 1897, 124 897)

$\text{Ag}_3\text{P}_5$  Insol in  $\text{HCl} + \text{Aq}$ , easily sol in  $\text{HNO}_3 + \text{Aq}$  (Schrotter, J B 1849 247)

$\text{Ag}_2\text{P}_5$  (Hackspill, C R 1913, 157 720)  
 $\text{Ag}_3\text{P}$  (?) (Fresenius and Neubauer, anal 1 340)

Silver phosphoselenide,  $\text{Ag}_2\text{Se}$ ,  $\text{P}_2\text{Se}$

Insol in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$  Sol in  $\text{HNO}_3$  Ac Insol in cold, decomp by hot alkalis Aq (Hahn, J pr 93 436)

$2\text{Ag}_2\text{Se}$ ,  $\text{P}_2\text{Se}_3$  Insol in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{HNO}_3 + \text{Aq}$ , slowly sol in red fuming  $\text{HNC}$  (Hahn, J pr 93 440)

$2\text{Ag}_2\text{Se}$ ,  $\text{P}_2\text{Se}_5$  Sol only in fuming  $\text{HNC}$  (Hahn)

Silver phosphosulphide,  $2\text{Ag}_2\text{S}$ ,  $\text{P}_2\text{S}$

$\text{Ag}_2\text{S}$ ,  $\text{P}_2\text{S}_3$  (Berzelius, A 46 254)

$2\text{Ag}_2\text{S}$ ,  $\text{P}_2\text{S}_5$  Easily sol in  $\text{HNO}_3 + \text{A}$  without separation of P (Berzelius)

$\text{Ag}_4\text{P}_2\text{S}$  (Berzelius)

$\text{Ag}_4\text{P}_2\text{S}_3$  Easily attacked by hot conc  $\text{HCl}$  Sl decomp Insol in hot  $\text{HNO}_3$  D comp by aqua regia (Ferrand, A ch 189 (7) 17 413)

Silver selenide,  $\text{Ag}_2\text{Se}$

Sol in boiling  $\text{HNO}_3 + \text{Aq}$  as  $\text{Ag}_2\text{SeCl}$  which separates out by dilution with  $\text{H}_2\text{O}$  (Berzelius)

Insol in  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$  (Wackenrodt, A 41 327)

Min Na *nannite* Insol in dil, but sol  
in conc H<sub>2</sub>O + Aq

Silver sulphide (silver thionyl amide),  
SO<sub>2</sub>(N Ag)<sub>2</sub>  
Insol in yridine (Hantzsch and Holl, B  
1901, **34** 3  
+H<sub>2</sub>O (Ephraim and Gurevitch, B  
1910, **43** 1 )

Argentous sulphide, Ag<sub>2</sub>S  
Easily sol in warm dil HNO<sub>3</sub> + Aq, and in  
conc H<sub>2</sub>SC without separation of S Sol in  
conc KCN + Aq (v der Pfordten, B **20**  
1458, Gunt C R **112** 861)

Silver sulphide, Ag<sub>2</sub>S  
Less sol in H<sub>2</sub>O than AgI (Lucas, Z  
anorg 190, **41** 210 )  
1 l H<sub>2</sub>O dissolves about 4 × 10<sup>-11</sup> g at Ag  
as Ag<sub>2</sub>S at 3° (Bernfeld, Z phys Ch 1898,  
**25** 72 )  
1 l H<sub>2</sub>O dissolves 0.8 × 10<sup>-6</sup> g mols at  
16-18° (Hantzsch, Z phys Ch 1907, **58** 291 )  
1 l H<sub>2</sub>O dissolves 0.552 × 10<sup>-6</sup> g mols  
Ag<sub>2</sub>S at 18° (Weigel, Z phys Ch 1907, **58**  
294 )

Sol in conc HNO<sub>3</sub> + Aq with separation  
of S Sol in hot conc HCl + Aq Not de-  
comp by CuCl<sub>2</sub> + Aq, but by CuCl<sub>2</sub> + NaCl  
+ Aq Insol in NH<sub>4</sub>OH + Aq Insol in  
H<sub>2</sub>SO<sub>4</sub> + Aq or in Hg(NO<sub>3</sub>)<sub>2</sub> + Aq  
Insol in H<sub>2</sub>O, dil acids, alkalies, and alkali  
sulphides + Aq (Fresenius)  
Sol in KCN + Aq (Hahn, C C **1870**  
240 )

Pptd Ag<sub>2</sub>S is very sol in HNO<sub>3</sub> containing  
more than 5% HNO<sub>3</sub> (Gruener, J Am  
Chem Soc 1910, **32** 1032 )

Only very sl sol in AgNO<sub>3</sub> + Aq, even at  
100° (Lowe, Roy Soc Proc 1914, **91**, A  
70 )

Sol in KCN + Aq (Hahn, C C **1870**  
240 )

Difficult sol in KCN + Aq, less difficultly  
if Ag<sub>2</sub>S is pptd from a very dil solution  
Amt of K<sub>2</sub>CO<sub>3</sub> present also has influence on  
the solubility Ag<sub>2</sub>S dissolved in conc KCN  
+ Aq separates out on dilution (Béchamp,  
J pr **60** 6 )

Insol in H<sub>4</sub>Cl or NH<sub>4</sub>NO<sub>3</sub> + Aq (Brett )  
Min Ar *nannite* *Acanthite* Sol in conc  
HNO<sub>3</sub> + Aq with separation of S  
Sol in trichloric acid + Aq with addition of  
KNO<sub>3</sub> (Hilton, C N **37** 48 )

Silver disulphide, Ag<sub>2</sub>S<sub>2</sub>

Sol in H<sub>2</sub>O with decomp, also sol with  
decomp in Cl<sub>2</sub>, HNO<sub>3</sub>, CS<sub>2</sub> does not dissolve  
out S (Hantzsch, Z anorg 1898, **19** 105 )

Silver sodium sulphide, 3Ag<sub>2</sub>S, Na<sub>2</sub>S + 2H<sub>2</sub>O  
Sol in conc Na<sub>2</sub>S + Aq with decomp, sol  
in H<sub>2</sub>O with decomp (Ditte, C R 1895,  
**120** 93 )

Silver zinc sulphide, Ag<sub>2</sub>S, 3ZnS  
(Schneider, J pr (2) **8** 29 )

Silver sulphamide (silver thionyl amide),  
SO<sub>2</sub>NaAg

Very sl sol in cold, more sol in hot H<sub>2</sub>O  
Very sol in dil HNO<sub>3</sub> (Traube, B 1892,  
**25** 2474 )

Silver sulphophosphide

See Silver phosphosulphide

Silver telluride, Ag<sub>2</sub>Te

Min *Hessite* Sol in warm HNO<sub>3</sub> + Aq

Sodammonium, Na<sub>2</sub>(NH<sub>3</sub>)<sub>2</sub>

100 g liq NH<sub>3</sub> dissolve 60.5 g at -23°,  
56.4 g at 0°, 56 g at +5°, 55 g at 9° (Joannis  
A ch 1906, (8) **7** 41 )

Sodium, Na<sub>2</sub>

Violently decomposes H<sub>2</sub>O, alcohol, etc  
Insol in hydrocarbons Easily sol in acids  
with violent action

Solubility in fused NaOH

G sol in 100 g fused NaOH at temp

t°	G per 100 g NaOH
480	25.3
600	10.1
610	9.9
670	9.5
760	7.9
800	6.9

(Hevesy, Z Elektrochem 1909, **15** 531 )

Insol in liquid CO<sub>2</sub> (Buchner, Z phys  
Ch 1906, **54** 674 )

Sol in liquid NH<sub>3</sub> (Franklin, Am Ch J  
1898, **20** 829 )

1 gr atom dissolves —

at +22°	in 6.14 mol	liquid NH <sub>3</sub>
" 0°	" 5.87	" "
" -30°	" 5.52	" "
" -50°	" 5.39	" "
" -70°	" 5.20	" "
" -105°	" 4.98	" "

(Ruff, B 1900, **39** 839 )

½ ccn oleic acid dissolves 0.0449 g Na<sub>2</sub>  
in 6 days (Gates, J phys Chem 1911, **15**  
143 )

Insol in ethylamine and in secondary and  
tertiary amines (Krius, J Am Chem Soc  
1907, **29** 1561 )

Sodium acetylde acetylene, Na<sub>2</sub>C<sub>2</sub>, C<sub>2</sub>H<sub>2</sub>

Very deliquescent Decomp by H<sub>2</sub>O and  
by absolute alcohol Insol in ether, ligroin,  
etc (Moissan, C R 1898, **127** 915 )

**Sodium amalgam**

$\text{NaHg}_8$  Stable in contact with the liquid amalgam from  $0^\circ$ – $40^\circ 5'$ . Can be cryst from Hg without decomp at any temp between these limits

$\text{NaHg}_8$  Stable in contact with the liquid malgam from  $40^\circ 5'$ – $150^\circ$ . Can be cryst rom Hg without decomp at any temp between these limits (Kerp, Z anorg 1900, '5 68)

**sodium amide,  $\text{NaNH}_2$** 

Decomp by  $\text{H}_2\text{O}$  and alcohol

**umidochloride,  $\text{Na}_2\text{NH}_2\text{Cl}$** 

$\text{H}_2\text{O}$  with decomp (Joannis, C R )

**" arsenide,  $\text{Na}_3\text{As}$** 

mp  $\text{H}_2\text{O}$  (Lebeau, C R 1900, 130

**sodium arsenide ammonia,  $\text{Na}_3\text{As}, \text{NH}_3$** 

Easily sol in liquid  $\text{NH}_3$  (Lebeau, C R 1900, 130 502)

Sl sol in liquid  $\text{NH}_3$  (Hugot, C R 1898, 127 554)

**Sodium azomide,  $\text{NaN}_3$** 

Not hygroscopic Sol in  $\text{H}_2\text{O}$  Insol in alcohol and ether (Curtius, B 24 3344)

40 16 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $10^\circ$

40 7 " " " " 100 "  $\text{H}_2\text{O}$  " 15 2

41 7 " " " " 100 "  $\text{H}_2\text{O}$  " 17 0

0 3153 pt is sol in 100 pts abs alcohol at  $16^\circ$

Insol in pure ether (Curtius, J pr 1898, (2) 58 279)

**Sodium bromide,  $\text{NaBr}$ , and  $+2\text{H}_2\text{O}$** 

Not deliquescent Solubility in  $\text{H}_2\text{O}$  differs according as  $\text{NaBr}$  or  $\text{NaBr}+2\text{H}_2\text{O}$  is used The following data for anhydrous  $\text{NaBr}$  were found

Pts  $\text{NaBr}$  dissolved by 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts NaBr	$t^\circ$	Pts NaBr	$t^\circ$	Pts NaBr
44 1	115 6	74 5	118 4	97 2	119 9
51 5	116 2	80 5	118 6	100 3	120 6
55 1	116 8	86 0	118 8	110 6	122 7
60 3	117 0	90 5	119 7	114 3	124 0
64 5	117 3				

Solubility is represented by a straight line of the formula  $S = 110.34 + 0.1075t$

Below  $50^\circ$  the salt usually crystallizes with

$2\text{H}_2\text{O}$ , of which the solubility in 100 pts  $\text{H}_2\text{O}$  was found to be as follows

$t^\circ$	Pts NaBr	$t^\circ$	Pts NaBr	$t^\circ$	Pts NaBr
—21	71 1	+5	82 0	30	97 3
—20	71 4	10	84 5	35	101 3
—15	73 1	15	87 3	40	105 8
—10	75 1	20	90 3	45	110 6
—5	77 1	25	93 8	50	116 0
0	79 5				

(Coppet, A ch (5) 30 420)

If solubility  $S = \text{pts NaBr in 100 pts solution}$ ,  $S = 40.0 + 0.1746t$  from  $-20^\circ$  to  $+40^\circ$ ,  $S = 52.3 + 0.0125t$  from  $50^\circ$  to  $150^\circ$  (Étard, C R 98 1432)

100 pts  $\text{H}_2\text{O}$  dissolve at  $0^\circ$ , 77 5 pts  $\text{NaBr}$ , at  $20^\circ$ , 88 4 pts, at  $40^\circ$ , 104 2 pts, at  $60^\circ$ , 111 1 pts, at  $80^\circ$ , 112 4 pts, at  $100^\circ$ , 114 9 pts (Kremers)

Sat solution boils at  $121^\circ$  (Kremers, Pogg 97 14)

Sat  $\text{NaBr} + \text{Aq}$  contains at

$-22^\circ$	$-10^\circ$	$+140^\circ$	$163^\circ$
40 1	42 5	56 5	57 5% $\text{NaBr}$ ,

$180^\circ$	$180^\circ$	$210^\circ$	$212^\circ$	$230^\circ$
59 5	59 0	60 9	61 0	62 0% $\text{NaBr}$

(Étard, A ch 1894, (7) 2 539)

100 g sat  $\text{NaBr} + \text{Aq}$  at  $16.4^\circ$  contain 47 g  $\text{NaBr}$  (Greenish, Pharm J 1900, 65 190)

Solubility of  $\text{NaBr} + 2\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $30^\circ = 65.5\%$  anhydrous  $\text{NaBr}$  (Cocheret, Dissert 1911)

Sp gr of  $\text{NaBr} + \text{Aq}$  at  $19.5^\circ$  containing

5	10	15	20	25 % $\text{NaBr}$ ,
1 040	1 080	1 125	1 174	1 226

30	35	40	45	50 % $\text{NaBr}$
1 281	1 334	1 410	1 483	1 565

(Gerlach, Z anal 8 285)

$\text{NaBr} + \text{Aq}$  containing 17 15%  $\text{NaBr}$  has sp gr  $20^\circ/20^\circ = 1.1473$

$\text{NaBr} + \text{Aq}$  containing 22 72%  $\text{NaBr}$  has sp gr  $20^\circ/20^\circ = 1.2060$

(Le Blanc and Rohland, Z phys Ch 1896, 19 278)

Sp gr of  $\text{NaBr} + \text{Aq}$  at  $20.5^\circ$

Normalty of $\text{NaBr} + \text{Aq}$	g $\text{NaBr}$ in 100 g of solution	Sp gr $20.5^\circ/4^\circ$
4 33	33 57	1 3284
3 00	25 10	1 2284
1 99	17 77	1 1526
0 98	9 41	1 0750

(Oppenheimer, Z phys Ch 1898, 27 452)

Sp gr	g	t 20° of NaBr+Aq containing	M g	mols	NaBr per liter
M	(	0	0 025	0 05	0 075
Sp gr	10	732	1 002177	1 004074	1 005972

M	(	0	0 25	0 50	0 75
Sp gr	10	'88	1 01964	1 03908	1 05811

M	(	1	1 5	2 0	
Sp gr	10	32	1 11963	1 15240	

(Jones and Pearce, Am Ch J 1907, 38 728)

Sol in  $\text{Na}_2\text{SO}_4$  (Walden, Z anorg 1902, 29 384)

100 pts NaBr+Aq sat at 18-19° contain 46 05 pts NaBr, 100 pts NaBr+NaCl+Aq sat at 18 9° contain 46 59 pts of the two salts, 100 s NaBr+NaI+Aq sat at 18-19° contain 6 15 pts of the two salts, 100 pts NaBr+N I+NaI+Aq sat at 18-19° contain 63 20 pts of the three salts (v Hauer, J pr 98 17)

Solubili of NaBr in NaOH+Aq at 17°  
(G per 100 g  $\text{H}_2\text{O}$ )

NaOH	NaBr	NaOH	NaBr
0 0	91 38	22 35	59 60
3 26	79 86	24 74	55 03
9 24	68 85	28 43	48 00
13 43	64 90	36 61	38 41
17 17	63 06	46 96	29 37
19 12	62 51	54 52	24 76

(Atte, C R 1897, 124 30)

Easily sol in liquid HF (Franklin, Z anorg 1901, 46 2)

Very sl sol in alcohol  
NaBr+  $\text{H}_2\text{O}$  is sol in 1 10 pts  $\text{H}_2\text{O}$  at 15°, in 1 pts absolute alcohol at 15°, in 1200 pts absolute ether at 15° (Fder, Dingl 22 89)

NaBr+  $\text{H}_2\text{O}$  is sol in 2 25 pts 60% alcohol, and 90% alcohol NaBr is sol in 3 pts 60% alcohol, and 10 pts 90% alcohol (Hager)

100 pt absolute methyl alcohol dissolve at 19 5° (de Bruyn, Z phys Ch 10 783)

100 g aBr+ $\text{CH}_3\text{OH}$  contain 0 9 g NaBr at the critical temp (Centnerszwer, Z phys Ch 1910, 72 437)

At room temp, 1 pt NaBr by weight is sol in

4 6	ts methyl alcohol	D <sup>15</sup> 0 7990
14 0	" ethyl	" D <sup>15</sup> 0 8100
49 7	" propyl	" D <sup>15</sup> 0 8160

(Rol and, Z anorg 1898, 18 325)

## Solubility in ethyl alcohol at 30°

Wt %		Solid phase
Alcohol	NaBr	
0	59 4	NaBr, 2 $\text{H}_2\text{O}$
11 79	42 90	"
31 78	32 12	"
43 22	26 79	"
54 59	20 83	"
65 51	16 08	"
72 36	13 41	"
76 92	12 03	NaBr, 2 $\text{H}_2\text{O}$ +NaBr
87 35	7 44	NaBr
97 08	3 01	"

(Cocheret, Dissert 1911)

## Solubility in mixtures of methyl and ethyl alcohol at 25°

P = % methyl alcohol in the solvent  
G = g NaBr in 10 ccm of the solution  
S = Sp gr of the sat solution

P	G	S 25°/4°
0 00	0 293	0 8189
4 37	0 365	0 8265
10 40	0 404	0 8273
41 02	0 724	0 8593
80 69	1 251	0 9079
84 77	1 286	0 9104
91 25	1 432	0 9235
100 00	1 440	0 9238

(Herz and Kuhn, Z anorg 1908, 60 155)

## Solubility in mixtures of methyl and propyl alcohol at 25°

P = % propyl alcohol in the solvent  
G = g NaBr in 10 ccm of the solution  
S = Sp gr of the sat solution

I	G	S 25 /4
0	1 440	0 9238
11 11	1 243	0 9048
23 8	1 053	0 8887
65 2	0 442	0 8390
91 8	0 147	0 8153
93 75	0 126	0 8144
100	0 074	0 8093

(Herz and Kuhn, Z anorg 1908, 60 156)

Solubility in mixtures of propyl and ethyl alcohol at 25°

P = % propyl alcohol in the solvent  
G = g NaBr in 10 ccm of the solution  
S = Sp gr of the sat solution

P	G	S 25°/4°
0	0 293	0 8189
8 1	0 249	0 8147
17 85	0 247	0 8145
56 6	0 190	0 8107
88 6	0 111	0 8116
91 2	0 083	0 8083
95 2	0 082	0 8090
100	0 074	0 8093

(Herz and Kuhn, Z anorg 1908, 60 159)

2 05 g are sol in 100 g propyl alcohol (Schlamp, Z phys Ch 1894, 14 276)

Sl sol in acetone (Krug and M'Elroy, J Anal Ch 6 184)

100 g 95% formic acid dissolve 22 3 g NaBr at 18 5° (Aschan, Ch Ztg 1913, 37 1117)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314), benzonitrile (Naumann, B 1914, 47 1370)

The composition of the hydrates formed by NaBr at different dilutions is calculated from determinations of the lowering of the frpt produced by NaBr and of the conductivity and sp gr of NaBr + Aq (Jones, Am Ch J 1905, 34 303)

#### Sodium stannic bromide

See Bromostannate, sodium

#### Sodium uranous bromide, Na<sub>2</sub>UBr<sub>3</sub>

As K salt (Aloy, Bull Soc 1899, (3) 21 264)

#### Sodium zinc bromide, NaBr, ZnBr<sub>2</sub> + H<sub>2</sub>O

Hygroscopic (Ephraim, Z anorg 1908, 59 63)

2NaBr, ZnBr<sub>2</sub> + 5H<sub>2</sub>O Hygroscopic (Ephraim)

#### Sodium carbide, Na<sub>2</sub>C<sub>2</sub>

Insol in all neutral solvents, decomp on heating and by H<sub>2</sub>O (Matignon, C R 1897, 125 1034)

#### Sodium carbonyl, Na<sub>2</sub>C<sub>2</sub>O<sub>2</sub>

Decomp by H<sub>2</sub>O with explosion (Joannis, C R 116 1518)

#### Sodium subchloride, NaCl<sub>2</sub>

Decomp by H<sub>2</sub>O into NaCl and NaOH + Aq (Kreutz, B 1897, 30 403)

#### Sodium chloride, NaCl

Sol in H<sub>2</sub>O

100 pts H<sub>2</sub>O at t° dissolve pts NaCl

t°	Pts NaCl	Authority
0	More than at 13 89°	Gay Lussac A ch (2) 11 310
13 89	35 81	
16 90	35 88	
59 93	37 14	
109 73	40 38	
120	35 91	Fehling A 77 382
100	39 92	
18 75	37 731	Bischof
10-15	35 42	Bergmann
106+	42 86	Griffiths 1825
20	35 9	Schiff A 109 326
All temps	37	Fuchs and Reichenbach 1826
25	35 7	Kopp A 34 262
18 75	36 53	C J B Karsten 1840
1	36 121	
18 75	36 724	
100	41 076	G Karsten
1 25 Boiling	36 119	Unger J pr 8 285
	39 324	
18 75	35 40	Karsten (?) cited by Unger l c
100	36 95	
15 56	34 2-35 42	Ure s Diet
100	36 16	
15	35 837	Michel and Kraft

1 pt NaCl is sol in 2 789 pts H<sub>2</sub>O at 15° (Gerlach) in 3 pts H<sub>2</sub>O at 18 75° (Abt) in 2 8235 pts H<sub>2</sub>O at ord temp (Bergmann) in 2 7647 pts boiling H<sub>2</sub>O (Bergmann) in 2 857 pts hot or cold H<sub>2</sub>O (Fourcroy)

Not deposited from boiling aqueous solution unless the vessel containing it is open to the air (Unger l c)

Solubility in 100 pts H<sub>2</sub>O at t°

t°	Pts NaCl	t°	Pts NaCl
1 5	33 6	70	38 1
13 75	35 8	108 5	39 4

(Nordenskjöld Pogg 136 315)

Solubility in 100 pts H<sub>2</sub>O at t°

t°	Pts NaCl	t°	Pts NaCl
13 89	35 8	59 93	37 1
16 90	35 9	109 73	40 4

(Gay Lussac A ch 11 296)

Solubility of NaCl at various pressures The figures represent pts NaCl in 100 pts sat NaCl + Aq at t° and A pressure in atmospheres

A	0°	9°	12°	15°	20°	25	30°
1	26 25	26 32	26 35	26 30	26 35	26 37	26 47
20	26 35	26 38		26 39	26 37	26 47	26 53
40	26 44			26 40			

(Müller Pogg 117 386)

10	pts H <sub>2</sub> O dissolve at t°		
t°	Pts NaCl	t°	Pts NaCl
-15	32 73	40	36 64
-10	33 49	50	36 98
-5	34 22	60	37 25
0	35 52	70	37 88
5	35 63	80	38 22
9	35 74	90	38 87
14	35 87	100	39 61
25	36 13	109 7	40 35

(P gale, A ch (3) 8 649)

100 pts	H <sub>2</sub> O dissolve at		
0°	12°	15°	
35 59	37 72	35 77	35 68 pts NaCl,

20°	25°	30°	
35 7	35 81	36 00	pts NaCl
(Fuller, Pogg 122 337)			

100 pts	H <sub>2</sub> O dissolve			35 76-36 26 pts
NaCl at 1'	° and the sp gr of sat solution			
= 1.204	Page and Keightley, Chem Soc			
(2) 10 566	NaCl + Aq sat at 18-19° contain			
100 pts	aCl (v Hauer, J pr 98 137)			
26 47 pts				

Solubility of NaCl in 100 pts H<sub>2</sub>O at t°

t°	Pts Na	t	Pts NaCl	t°	Pts NaCl
0	35	30	36 3	60	37 3
1	35	31	36 3	61	37 3
2	35	32	36 3	62	37 4
3	35	33	36 4	63	37 4
4	35	34	36 4	64	37 5
5	35	35	36 4	65	37 5
6	35	36	36 5	66	37 6
7	35	37	36 5	67	37 7
8	35	38	36 5	68	37 7
9	35	39	36 6	69	37 8
10	35	40	36 6	70	37 9
11	35	41	36 6	71	37 9
12	35	42	36 7	72	38 0
13	35	43	36 7	73	38 0
14	35	44	36 8	74	38 1
15	35	45	36 8	75	38 2
16	35	46	36 8	76	38 2
17	35	47	36 9	77	38 2
18	35	48	36 9	78	38 2
19	36	49	36 9	79	38 3
20	36	50	37 0	80	38 4
21	36	51	37 0	81	38 4
22	36	52	37 0	82	38 5
23	36	53	37 1	83	38 6
24	36	54	37 1	84	38 6
25	36	55	37 1	85	38 7
26	36	56	37 2	86	38 7
27	36	57	37 2	87	38 8
28	36	58	37 2	88	38 9
29	36	59	37 3	89	39 0

Solubility of NaCl in 100 pts H<sub>2</sub>O at t° —  
*Continued*

t	Pts NaCl	t°	Pts NaCl	t°	Pts NaCl
90	39 1	97	39 5	104	40 0
91	39 1	98	39 6	105	40 1
92	39 2	99	39 7	106	40 1
93	39 3	100	39 8	107	40 2
94	39 3	101	39 8	108	40 3
95	39 4	102	39 9	109	40 3
96	39 4	103	40 0	109 7	40 4

(Calculated by Mulder from his own and other observations, Scheik Verhandel 1864 37)

Solubility in 100 pts H<sub>2</sub>O at

0-4°	20°	40°	60°	80°
35 630	35 825	36 32	37 06	38 00

(Andreae, J pr (2) 29 456)

Solubility in 100 pts H<sub>2</sub>O from most careful experiments

0°	20°	60°	80°
35 571	35 853	37 091	38 046
(Raupenstrauch, M Ch 6 563)			

Solubility of NaCl in 100 pts H<sub>2</sub>O at t°

t	Pts NaCl	t°	Pts NaCl
-14 0	32 5	44 75	36 64
-13 8	32 15	52 5	37 04
-6 25	34 22	55 0	36 99
-5 95	34 15	59 75	37 31
0	35 7	71 3	37 96
3 6	35 79	74 45	37 96
5 3	35 8	82 05	38 41
14 45	35 94	86 7	38 47
20 85	35 63	93 65	38 90
25 45	35 90	101 7	40 76
38 55	36 52		

Solubility above 20° is represented by the formula  $S = 34.359 + 0.0527t$  (Coppet, A ch (5) 30 426)Solubility of NaCl in 100 pts H<sub>2</sub>O at high temp

t°	Pts NaCl	t°	Pts NaCl
118	39 8	160	43 6
140	42 1	180	44 9

(Tilden and Shenstone, Phil Trans 1884 23)



Sat NaCl+Aq contains % NaCl at t°

t°	% NaCl	t°	% NaCl
-21	23 7	77	28 0
-21	23 4	90	28 2
-18	23 5	115	29 1
-17	23 3	135	28 9
- 7	25 5	140	28 8
0	25 8	150	29 6
+15	26 7	180	30 2
55	26 8	215	31 6

(Étard, A ch 1894, (7) 2 532)

100 g H<sub>2</sub>O dissolve 0.616 gram-equivalent NaCl at 25° (Van't Hoff and Meyerhoffer, Z phys Ch 1904, 49 315)

Solubility of NaCl in H<sub>2</sub>O at t°

Most careful experiments

t°	g NaCl per 100 g H <sub>2</sub> O	Sp gr	t	g NaCl per 100 g H <sub>2</sub> O	Sp gr
		.090	61 70	37 28	1 1823
		.020	75 65	37 82	1 1764
		.956	90 50	38 53	1 1701
		1.1891	107	39 65	1 1631

(Berkeley, Phil Trans Roy Soc 1904, 203 A 189)

Sat NaCl+Aq at 25° contains 26.5% NaCl (Foote, Am Ch J 1906, 35 239)

100 g H<sub>2</sub>O dissolve 35.80 g NaCl at 25° (Cameron, Bell and Robinson, J phys Ch 1907, 11 396)

100 g NaCl+Aq sat at 15° contains 26.3 g NaCl, at 30°, 26.47 g (Schreinemakers, Arch neer Sc 1910, (2) 15 81)

5.456 g mol are contained in 1 l NaCl+Aq sat at 25° (Herz, Z anorg 1911, 73 274)

5.40 g mol are contained in 1 l NaCl+Aq sat at 30° (Masson, Chem Soc 1911, 99 1136)

26.47 g NaCl are contained in 100 g NaCl+Aq sat at 30° (Cocheret, Dissert 1911)

35.79 g NaCl are sol in 100 g H<sub>2</sub>O at room temp (Frankforter, J Am Chem Soc 1914, 36 1106)

100 mol H<sub>2</sub>O dissolve at

19 3° 29 7° 40 1° 54 5°  
11 04 11 06 11 15 11 35 mol NaCl

(Sudhaus, Miner Jahrb Beil Bd 1914, 37 18)

Solubility of NaCl in H<sub>2</sub>O at 24.5° at varying pressures

S = g NaCl in 100 g solvent

P = pressure in atmospheres

P	S	100 g of solution contains g NaCl
1	35 90	26 42
250	36 25	26 61
500	36 55	26 77
1000	37 02	27 02
1500	37 36	27 20

(Cohen, Inouye and Euwen, Z phys Ch 1910, 75 257)

Sp gr of NaCl+Aq containing 15% NaCl is 1.109 at 15° (Franceour) 1.116 at 15° (Soubeiran) 1.1107 at 15° (Coulier) 1.111 at 15° (Baudin C R 63 932)

Sp gr of NaCl+Aq saturated at 15° is 1.20715 (Michel and Kraft) at 17.5° is 1.2046 (Karsten) at 8° is 1.205 (Anthon)

Sp gr of NaCl+Aq

% NaCl	Sp gr	% NaCl	Sp gr	% NaCl	Sp gr
5	1 037	15	1 112	25	1 192
10	1 074	20	1 154	26.43	1 204

(Dahlmann J B 7 321)

Sp gr of NaCl+Aq at 20°

% NaCl	Sp gr	% NaCl	Sp gr
1	1 0066	15	1 1090
2	1 0133	16	1 1168
3	1 0201	17	1 1247
4	1 0270	18	1 1327
5	1 0340	19	1 1408
6	1 0411	20	1 1490
7	1 0483	21	1 1572
8	1 0556	22	1 1655
9	1 0630	23	1 1738
10	1 0705	24	1 1822
11	1 0781	25	1 1906
12	1 0857	26	1 1990
13	1 0934	27	1 2075
14	1 1012		

(Schiff, A 110 76)

Sp gr of NaCl+Aq at 19.5°

% NaCl	Sp gr	% NaCl	Sp gr
6 402	1 0460	22 631	1 1712
12 265	1 0895	26 530	1 2036
17 533	1 1303		

(Kremers, Pogg 95 120)

Sp gr of NaCl+Aq at 15°

% NaCl	Sp gr	% NaCl	Sp gr
1	1 00725	15	1 11146
2	1 01450	16	1 11938
3	1 02174	17	1 12730
4	1 02899	18	1 13523
5	1 03624	19	1 14315
6	1 04366	20	1 15107
7	1 05108	21	1 15931
8	1 05851	22	1 16755
9	1 06593	23	1 17580
10	1 07335	24	1 18404
11	1 08097	25	1 19228
12	1 08859	26	1 20098
13	1 09622	26 395	1 20433
14	1 10384		

Gerlach, Z anal 8 279 )

Sp gr of NaCl+Aq at 18°

% NaCl	Sp gr	% NaCl	Sp gr
5	1 0345	25	1 1898
10	1 0707	26	1 1982
15	1 1087	26 4	1 2014
20	1 1477		

(Kohlrausch, W Ann 1879 1 )

Sp gr of NaCl+Aq at 20°, containing  
mols H<sub>2</sub>O to 1 mol NaCl

n	Sp gr	n	Sp gr
12 5	1 15292	100	1 02069
25	1 08207	200	1 00965
50	1 04227		

Mirignac, J B 1870 110 )

Sp gr of NaCl+Aq at 0° N<sub>1</sub>Cl=g NaCl  
to 0 g H<sub>2</sub>O, d<sup>0</sup>=sp gr at 0°, d<sup>t</sup>=  
max sp gr, t=temp of maximum

G NaCl	d	d <sup>t</sup>	t
0	1 00000	1 000130	+ 4°
0 5	1 003925	1 003988	+ 3
1	1 007634	1 007666	+ 1 77
2	1 015366	1 015367	— 0 58
3	1 023530	1 023583	— 3 24
4	1 030669	1 030890	— 5 63
6	1 045975	1 046952	—11 07

Rosetti, A ch (4) 17 382 )

Sp gr of NaCl+Aq at 20° x=mols NaCl  
to 100 mols H<sub>2</sub>O

x	Sp gr	x	Sp gr
0 5	1 01145	4 0	1 08408
1 0	1 02255	5 0	1 10276
2 0	1 04393		

(Nicol, Phil Mag (5) 16 122 )

Sp gr of NaCl+Aq at 0° S=weight of salt  
in 100 g of solution of the given sp gr,  
S<sub>1</sub>=No mols of salt contained in 100  
mols of the solution

S	S <sub>1</sub>	Sp gr
23 0821	8 627	1 1821
19 1932	6 769	1 1502
14 3415	4 898	1 1111
9 4120	3 097	1 0722
5 1536	1 644	1 0394

(Charpy, A ch (6) 29 23 )

Sp gr of NaCl+Aq

G equivalents NaCl per liter	t°	Sp gr t°/t°
0 005028	18 549	1 0002119
0 01005	18 550	1 0004258
0 02005	18 538	1 000848
0 04983	18 509	1 002101
0 09873	18 525	1 004143
0 19388	18 542	1 008093
0 28999	18 559	1 012053
0 47574	18 558	1 019627
0 49860	18 06	1 02054
4 9860	17 85	1 18783
0 00259	14 07	1 0001108
0 005178	14 076	1 0002210
0 010318	14 097	1 0004401
0 12580	14 097	1 005315
0 25019	14 076	1 010505

(Kohlrausch, W Ann 1894, 53 26 )

Sp gr of NaCl+Aq at 18°/18°

g equivalents of NaCl in 1 liter of solution	Sp gr
0 005	1 0002104
0 010	1 0004206
0 020	1 0008476
0 050	1 002109
0 100	1 004205

(Tammann, Z phys Ch 1895, 16 93 )

Sp gr of NaCl+Aq sat 18°0', when p=percent strength of solution, d=observed density, and w=volume conc in grams per cc ( $\frac{pd}{100}=w$ )

p	d	w
25 37	1 1928	0 30263
21 25	1 1592	0 24637
17 35	1 1277	0 19503
13 25	1 0958	0 14518
9 34	1 0665	0 09960
4 810	1 0332	0 04969
2 991	1 0202	0 03052
2 593	1 0173	0 2638
1 746	1 0111	0 01765

(Barnes J Phys Chem 1898, 2 544)

Sp gr of NaCl+Aq at 20 5°

Normality of NaCl+Aq	G NaCl in 100 g of solution	Sp gr 20 5°/4°
3 97	20 22	1 1489
2 96	15 56	1 1124
2 01	10 90	1 0775
0 97	5 49	1 0373

(Oppenheimer Z phys Ch 1898, 27 451)

Sp gr of NaCl+Aq at 15°

Per cent NaCl	Sp gr
0	1 00000
5	1 03624
10	1 07335
15	1 11146
20	1 15107
25	1 19228
Sat at 15°	1 20433

(H C Hahn, J Am Chem Soc 1898, 20 622)

Sp gr of NaCl+Aq at 18°/4°

g NaCl in 100 g of solution	Sp gr
0 19560	1 0001
0 097952	0 9994
0 065410	0 99918
0 048977	0 99905

(Jahn, Z phys Ch 1900, 33 572)

Sp gr 20°/4° of a normal solution of NaCl =1 03866 (Haugh, J Am Chem Soc 1912, 34 1151)

Sp gr of sat NaCl+Aq at t°

t°	g NaCl sol in 100 g H <sub>2</sub> O	Sp gr
-10°	32 90	1 200
0	35 63	1 210
10	35 69	1 205
20	35 82	1 202
30	36 03	1 198
40	36 32	1 193
50	36 67	1 189
60	37 06	1 184
70	37 51	1 178

(Tscherna, J Russ Phys Chem Soc 1912, 44 1565)

Sp gr of dil NaCl+Aq at 20 004°

Conc=g equiv NaCl per l at 20 004°

Sp gr compared with H<sub>2</sub>O at 20 004°=1

Conc	Sp gr
0 0000	1 000,000,0
0 0001	1 000,004,2
0 0002	1 000,008,5
0 0005	1 000,021,3
0 0010	1 000,042,7
0 0020	1 000,085,1
0 0040	1 000,169,6
0 0050	1 000,211,7
0 0100	1 000,423,3

(Lamb and Lee, J Am Chem Soc 1913, 35 1686)

The saturated solution boils at 109° (Kremers)

NaCl+Aq containing 42 9 pts NaCl to 100 pts H<sub>2</sub>O boils at 106 8° (Griffiths), containing 41 2 pts NaCl to 100 pts H<sub>2</sub>O boils at 108 2° (Legrand), containing 40 38 pts NaCl to 100 pts H<sub>2</sub>O boils at 109 73° (Gay-Lussac), containing 38 7 pts NaCl to 100 pts H<sub>2</sub>O forms a crust at 108 3°, highest point observed, 108 8° (Gerlach, Z anal 26 426)

Boiling-point of NaCl+Aq

% NaCl	B pt according to	
	Bischof	G Karsten
5	101 50°	101 10°
10	103 03	102 38
15	104 63	103 83
20	106 26	105 46
25	107 93	107 27
29 4	107 9-108 99	

% NaCl	B pt according to	
	Legrand	Gerlach
5	100 80°	100 9°
10	101 75	101 9
15	103 00	103 3
20	104 60	105 3
25	106 60	107 6

B-pt of NaCl + Aq containing pts NaCl to 100 pt H<sub>2</sub>O G=according to Gerlach (Z ar 26 438, L=according to Le-grand A ch (2) 59 431)

B pt	L	B pt	G	L
100 5°	4 4 4	105 5°	27 5	29 8
101	6 7 7	106	29 5	31 8
101 5	6 10 8	106 5	31 5	33 9
102	1 4 13 4	107	33 5	35 8
102 5	1 9 15 9	107 5	35 5	37 7
103	1 2 18 3	108	37 5	39 7
103 5	1 4 20 7	108 4		41 2
104	2 5 23 1	108 5	39 5	
104 5	2 5 25 5	108 8	40 7	
105	2 5 27 7			

B-pt of NaCl + Aq containing g NaCl in 100 g H<sub>2</sub>O  
 g NaCl 7 6 11 0 14 9 16 1 18 8  
 B-pt 2 2° 103 104 2 104 8 106 1

g NaCl 2 3 24 0 26 0 28 7  
 B-pt 7 1 107 7 108 7 109 5

(Rich ond, Analyst, 1893, 18 142)

If NaCl is dissolved in 15 pts H<sub>2</sub>O, heat is absorbed if the temp is 15°, but much less if temp is 86°, at 100° there is neither absorption nor evolution of heat (Berthelot, C R 78 22)

36 pts NaCl mixed with 100 pts H<sub>2</sub>O at 12.6° lower the temp 2.5° (Rudorff, B 2 68)

33 pts NaCl with 100 pts snow at -1° gave a temp of -21.3° (Rudorff, Pogg 122 337)

The freezing-point of NaCl + Aq is lowered 0.60° for every gram NaCl up to 10 g. When more NaCl is added the freezing-point sinks proportionally. For 100 g NaCl, 2H<sub>2</sub>O, 0.342° for every gram of salt (Rudorff, Pogg 113 163)

Insol in conc HCl + Aq

Solubility of NaCl in HCl + Aq at 0° NaCl = mols NaCl (in milligrams) dissolved in 10 m of liquid, HCl = mols HCl (in mms) dissolved in 10 cem of liquid

NaCl	HCl	Sum of mols	Sp gr
53 5	1	54 5	1 2045
52 2	1 85	54 05	1 2025
48 5	5 1	53 6	1 196
44 0	9 275	53 275	1 185
37 95	15 05	53 00	1 1725
23 5	30 75	54 95	1 141
6 1	56 35	62 45	1 1159

(F gel, Bull Soc (2) 45 654)

### Solubility in HCl + Aq at 10-10 5°

g per 100 cc		G per 100 cc	
HCl	NaCl	HCl	NaCl
0 0	35 77	26 06	30 89
9 84	33 76	94 77	20 01
12 76	33 19	102 1	19 04
15 68	32 71	120 6	16 03
20 78	31 77		

(Enklaar, R t c 1901, 20 183)

### Solubility in HCl + Aq at 30°

Composition of the solution	
% by wt HCl	% by wt NaCl
0	26 47
6 93	16 16
12 50	9 35
17 35	4 52
35 60	0 11

(Schreinemakers, Z phys Ch 1909, 68 85)

### Solubility in HCl + Aq

Conc = concentration of HCl g mol per 1,000 g H<sub>2</sub>O  
 NaCl = wt NaCl dissolved in 1,000 g H<sub>2</sub>O

t°	Conc	NaCl	Molecular solubility
0	0	357 75	6 13
	0 25	341 70	5 85
	0 50	324 45	5 56
	1 00	291 20	4 99
25	0	360 80	6 18
	0 25	344 50	5 90
	0 50	329 05	5 64
	1 00	298 10	5 10

(Armstrong and Eyre, Proc R Soc 1910, (A) 84 127)

### Solubility in HCl + Aq at 30°

G mols per l

HCl	NaCl	Sp gr 30	HCl	NaCl	Sp gr 30
0 0	5 400	1 2018	3 052	2 463	1 1427
0 4575	4 932	1 1906	4 152	1 628	1 1289
0 969	4 386	1 1801	5 950	0 630	1 1188
1 786	3 589	1 1633	7 205	0 268	1 1258
2 412	2 412	1 1512			

(Masson, Chem Soc 1911, 99 1132)

Solubility in HCl+Aq at 25°	
Millimols HCl in 10 ccm	Millimols NaCl in 10 ccm
	54 56
6 07	48 50
10 32	44 67
15 90	37 82
21 17	32 97
32 83	23 43

(Herz, Z anorg 1912, **73** 274)

Moderately dil  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ +Aq precipitate NaCl from NaCl+Aq (Karsten)  
 Sol in  $\text{H}_2\text{SO}_4$  (Walden, Z anorg 1902, **29** 384)

Solubility of NaCl in  $\text{NH}_4\text{OH}$ +Aq at 30°  
 (G in 1 l sat solution)

Sp gr	$\text{NH}_3$	NaCl	Sp gr	$\text{NH}_3$	NaCl
1 1735	29 535	293 38	1 1406	72 07	283 38
1 1656	40 655	292 5	1 1395	72 715	283 06
1 160	47 26	289 7	1 1301	81 855	277 49
1 1494	60 78	286 5	1 205	97 49	270 57

(Hempel and Tedesco, Z anorg 1911, **24** 2467)Solubility of NaCl in  $\text{NH}_4\text{Cl}$ +Aq at t°

t°	G per 100 g $\text{H}_2\text{O}$		Sp gr
	$\text{NH}_4\text{Cl}$	NaCl	
0	0	356 3	1 185
	146 1	286 4	
15	0	357 6	1 200
	57 3	326 4	1 191
	118 9	300	1 183
	186 4	271 6	1 176
	198 8	266 8	1 175
30	0	360 3	1 166
	255 4	249	
45	0	365	
	322 1	233 9	

(Fedotieff, Z phys Ch 1904, **49** 168)See also under  $\text{NH}_4\text{Cl}$ 

Solubility in NaOH+Aq at 0° NaCl=mols  
 NaCl (in milligrams) in 10 ccm solution,  
 $\text{Na}_2\text{O}$ =mols  $\text{Na}_2\text{O}$  (in milligrams) in  
 10 ccm solution

NaCl	$\text{Na}_2\text{O}$	$\text{Na}_2\text{O} + \text{NaCl}$	Sp gr
54 7	0	54 7	1 207
49 375	4 8	54 175	1 221
47 212	6 725	53 937	1 225
42 375	10 406	52 781	1 236
39 55	14 78	54 33	1 249
24 95	30 5	55 45	1 295
19 3	37 875	57 175	1 314
9 408	53 25	62 66	1 362

(Engel, C R **112** 1130)

Solubility in NaOH+Aq at 20°

G NaOH in 1 liter	G NaCl in 1 liter	Sp gr	deg Baumé
10	308	1 200	23 5
20	308	1 210	24 0
30	306	1 215	25 5
40	302	1 225	26 4
50	297	1 230	26 9
60	286	1 235	27 4
70	277	1 240	27 9
80	269	1 245	28 4
90	261	1 250	28 8
100	253	1 250	28 8
110	244	1 252	29 0
120	236	1 252	29 0
130	229	1 260	29 7
140	221	1 265	30 2
150	213	1 270	30 6
160	205	1 275	31 1
170	197	1 275	31 1
180	189	1 280	31 5
190	181	1 285	32 0
200	173	1 290	32 4
210	165	1 295	32 8
220	159	1 295	32 8
230	152	1 300	33 3
240	146	1 303	33 5
250	139	1 305	33 7
260	134	1 310	34 2
270	129	1 315	34 6
280	124	1 320	35 0
290	118	1 325	35 4
300	112	1 330	35 8
310	107	1 333	36 0
320	101	1 335	36 2
330	96	1 340	36 6
340	90	1 345	37 0
350	85	1 350	37 4
360	80	1 355	37 8
370	76	1 360	38 2
380	71	1 365	38 6
390	66	1 370	39 0
400	61	1 375	39 4
410	56	1 380	40 0
420	52	1 385	40 2
430	48	1 390	40 6

Solubility in NaOH + Aq at 20° — *Continued*

G NaOH in 1 liter	G NaCl in 1 liter	Sp gr	deg Baumé
440	45	1 395	41 0
450	42	1 400	41 5
460	39	1 405	41 9
470	37	1 410	42 0
480	34	1 415	42 3
490	32	1 420	42 6
500	30	1 425	43 0
510	28	1 430	43 5
520	27	1 435	43 7
530	27	1 440	44 0
540	26	1 445	44 3
550	26	1 450	44 6
560	25	1 450	44 6
570	24	1 455	45 0
580	23	1 460	45 5
590	23	1 465	45 9
600	22	1 470	46 2
610	21	1 475	46 5
620	20	1 480	46 8
630	19	1 485	47 0
640	18	1 490	47 5

(Wintre r, Z Elektrochem, 1900, 7 360)

Solubility in Na<sub>2</sub>O + Aq at 30°

Composition of the solution		Solid phase
% by w Na <sub>2</sub> O	% by wt NaCl	
0	26 47	NaCl
4 4	21 49	"
12 2	13 62	"
24 4	4 36	"
29 3	2 40	"
37 8	1 12	"
41 4	0 97	NaCl + NaOH, H <sub>2</sub> O
42	0	NaOH, H <sub>2</sub> O

(Schreiner, Z phys Ch 1909, 68 85)

The presence of other salts increases the solubility of NaCl in H<sub>2</sub>O

Sol in sat NH<sub>4</sub>Cl + Aq with pptn of NH<sub>4</sub>Cl. When the reaction is complete, the solution has sp gr 1 1788, and contains 32 62% mixed salts, or 100 pts H<sub>2</sub>O dissolve 48 42 p mixed salts, viz, 26 36 pts NaCl and 22 6 pts NH<sub>4</sub>Cl (Karsten) (See under NaCl)

Sol in sat BaCl<sub>2</sub> + Aq with pptn of BaCl<sub>2</sub> until a state of equilibrium is reached, when 100 pts H<sub>2</sub>O at 17° dissolve 38 6 pts of mixed salts, of which 4 1 pts are BaCl<sub>2</sub> (Karsten) (See under BaCl<sub>2</sub>)

Sol in sat CaCl<sub>2</sub> + Aq (Vauquelin, Ann de Chim 13 95)

Much more sol in hot than in cold H<sub>2</sub>O contain g MgCl<sub>2</sub> or CaCl<sub>2</sub>, but NaCl is pptd from sat NaCl + Aq when that solution is mixed with MgCl<sub>2</sub> or CaCl<sub>2</sub> + Aq (Fuchs and G Reinbach, 1826) (See under MgCl<sub>2</sub>)

Less sol in conc CaCl<sub>2</sub> + Aq than in H<sub>2</sub>O (Hermann)

Solubility of NaCl + CaCl<sub>2</sub> in H<sub>2</sub>O at 25°  
G per 100 g H<sub>2</sub>O

NaCl	CaCl <sub>2</sub>	Sp gr 25°/25°	Solid phase
0	84		CaCl <sub>2</sub> , 6H <sub>2</sub> O
1 846	78 49	1 4441	" + NaCl
1 637	58 48	1 3651	NaCl
1 799	53 47	1 3463	"
7 77	36 80	1 2831	"
10 70	30 08	1 2653	"
18 85	19 53	1 2367	"
32 48	3 92	1 2080	"
35 80	0	1 2030	"

(Cameron, Bell and Robinson, J phys Chem 1907, 11 396)

Solubility of NaCl in NaHCO<sub>3</sub> sat with CO<sub>2</sub> at t°

t°	G per 1000 g H <sub>2</sub> O	
	NaHCO <sub>3</sub>	NaCl
0	6 0	356 3
"	7 7	350 1
15	0 0	357 6
"	10 0	354 6
30	0 0	360 3
"	13 9	358 1
45	0 0	356 0
"	0 23	361 5

(Fedotieff, Z phys Ch 1904, 49 170)

Sol in sat KClO<sub>3</sub> + Aq, the solution can then dissolve more KClO<sub>3</sub> (Marguerite, C R 38 305)

In solution containing Na, K, Cl and NO<sub>3</sub> ions, the solubility—relations between the four salts NaCl, KCl, NaNO<sub>3</sub> and KNO<sub>3</sub> have been studied (Uyeda, Z anorg 1911, 71 2)

Sol in sat NH<sub>4</sub>NO<sub>3</sub> + Aq, without causing pptn (Karsten)

Sol in sat NH<sub>4</sub>NO<sub>3</sub> + Aq, from which solution it is not pptd by salts which would cause its pptn in aqueous solution (Marguerite, C R 38 307)

Sol in sat Ba(NO<sub>3</sub>)<sub>2</sub> + Aq without causing pptn

Sol in Ca(NO<sub>3</sub>)<sub>2</sub> + Aq

Sol in Mg(NO<sub>3</sub>)<sub>2</sub> + Aq with pptn of small portion of Mg(NO<sub>3</sub>)

Sol in sat KNO<sub>3</sub> + Aq, the mixed solution having the power to dissolve more KNO<sub>3</sub>, and the solubility of the KNO<sub>3</sub> apparently increasing in the same ratio as the amount of NaCl present (Fourcroy and Vauquelin, Ann de Chim 11 130)

Sol in sat KNO<sub>3</sub> + Aq, the solution thus

obtained at 18 13° contains 40 34% of the mixed salts, or 100 pts H<sub>2</sub>O dissolve 67 72 pts of the mixed salts, viz, 38 25 pts NaCl and 29 45 pts KNO<sub>3</sub> (Karsten)

Solubility of NaCl in KNO<sub>3</sub>+Aq at 25°  
KNO<sub>3</sub>=g KNO<sub>3</sub> in 100 cc of solution  
NaCl=g mol per l

KNO <sub>3</sub>	NaCl	KNO <sub>3</sub>	NaCl
0	5 44	12	5 28
4	5 52	16	5 21
8	5 45	20	5 15

(Ritzel, Z Krist 1911, 49 152)  
(See also under KNO<sub>3</sub>)

Solubility of NaCl in NaNO<sub>3</sub>+Aq at 15 5°

Sp gr	g per 100 cc sat solution		
	NaNO <sub>3</sub>	NaCl	H <sub>2</sub> O
1 2025	0	31 78	88 47
1 2305	7 53	27 89	87 63
1 2580	13 24	26 31	86 25
1 2810	21 58	23 98	82 66
1 3090	28 18	22 30	80 42
1 3345	33 80	20 40	79 25
1 3465	37 88*	19 40*	77 37
1 3465	37 64*	19 67*	77 34

\*Solutions sat with both salts  
(Bodlander, Z phys Ch 1891, 1 361)

Sol in sat NaNO<sub>3</sub>+Aq with pptn of NaNO<sub>3</sub>

Solubility of NaCl in NaNO<sub>3</sub>+Aq

Conc = concentration of NaNO<sub>3</sub> in g mol per 1,000 g H<sub>2</sub>O  
NaCl=g NaCl dissolved in 1,000 g H<sub>2</sub>O

t°	Conc	NaCl	Molecular solubility
0	0	359 65	6 16
	0 25	355 90	6 09
	0 50	351 20	6 02
	1	342 15	5 86
25	0	362 95	6 20
	0 25	356 65	6 11
	0 50	352 30	6 03
	1	343 65	5 88
	2	325 50	5 58

(Armstrong and Eyre, Proc R Soc 1910, A 84 127)

(See also under NaNO<sub>3</sub>)

Sol in sat KCl+Aq with elevation of temp (Vauquelin)

100 g H<sub>2</sub>O sat with KCl dissolve 0 494 gram-equivalent NaCl at 25° (Fuler, Z phys Ch 1904, 49 315)

Solubility in KCl+Aq at t°

t°	Sat solution contains	
	% NaCl	% KCl
-20	21 3	5 7
-10	21 3	6 7
0	21 3	7 7
+10	21 3	8 6
20	21 3	9 6
30	21 3	10 6
40	21 3	11 5
50	21 3	12 5
60	21 3	13 5
70	21 3	14 4
80	20 7	15 8
90	19 9	17 8
100	18 8	19 8
110	17 2	22 4
120	16 5	24 1
130	16 4	25 1
140	16 4	26 1
150	16 4	27 1
160	16 4	28 0
170	16 4	29 0
180	16 4	30 0

(Etard A ch 1894, (7) 3 277)  
(See under KCl)

100 pts NaCl+NaI+Aq sat at 18-19° contain 62 33 pts of the two salts (v Hauer)

Sol in sat Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+Aq with no pptn (Vauquelin)

Sol in sat (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq with pptn of considerable amt of (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq (Vauquelin)

Sol in sat CuSO<sub>4</sub>+Aq

100 pts H<sub>2</sub>O dissolve 36 71 pts NaCl and 7 19 pts K<sub>2</sub>SO<sub>4</sub> at 15°, and solution has sp gr 1 24 (Page and Keightley)

NaCl is sol in K<sub>2</sub>SO<sub>4</sub>+Aq, and vice versa, without separation of a salt

100 pts H<sub>2</sub>O dissolve 7 03 pts K<sub>2</sub>SO<sub>4</sub> and 37 60 pts NaCl, when warmed and cooled to 14° (Rudorff)

Solubility of NaCl and K<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O at t°  
100 pts H<sub>2</sub>O contain pts NaCl, K<sub>2</sub>SO<sub>4</sub>, and KCl

t	Pts NaCl	Pts K <sub>2</sub> SO <sub>4</sub>	Pts KCl
10	33 43	8 10	3 18
20	34 01	8 90	3 06
30	34 56	9 56	2 95
40	35 16	10 38	2 81
50	35 77	11 07	2 84
60	36 40	11 93	2 72
70	36 64	12 82	3 20
80	36 04	12 26	5 06
90	35 86	12 42	6 98
100	35 63	12 56	8 79

(Precht and Wittgen, B 15 1666)

Sol in cold sat  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at first without pptn, afterwards  $\text{Na}_2\text{SO}_4$  separates out (Karsten)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 7.45 g  $\text{Na}_2\text{SO}_4$  in 100 g of the solution

t°	g NaCl in 100 g of the solution
80	23.30
90	23.33
85	23.45
60	23.485
75	23.525
18	23.55
28	23.68

(Marie and Marquis, C. R. 1903, 136 684)  
See also under  $\text{Na}_2\text{SO}_4$

Sol in sat  $\text{ZnSO}_4 + \text{Aq}$  with separation of  $\text{Na}_2\text{SO}_4$  (Karsten)

Insol in liquid  $\text{CO}_2$  (Büchner, Z. phys. Ch. 1905, 54 674)

Modestly sol in liquid  $\text{NH}_3$  (Franklin, Am. Ch. J. 1898, 20 829)

12.2 g  $\text{NaCl}$  are sol in 1 pt hydrazine at 12.5–13° (de Bruyn, R. t. c. 1899, 18 297)

100 g hydroxylamine dissolve 14.7 g  $\text{NaCl}$  at 17.5° (de Bruyn, Z. phys. Ch. 1892, 10 782)

100 g 95% formic acid dissolve 5.8 g at 19.7° (Lischan, Ch. Ztg. 1913, 37 1117)

Solubility in alcohol

100 pts alcohol of 0.900 sp gr dissolve 5.8 pts  $\text{NaCl}$  of 0.872 sp gr dissolve 6.1 pts  $\text{NaCl}$  (Kirwan)

100 pts alcohol containing given % by weight of salt dissolve pts  $\text{NaCl}$  at 25°

% alcohol	Pts NaCl	% alcohol	Pts NaCl	% alcohol	Pts NaCl
0.0	3.70	33.4	16.08	66.9	5.95
8.4	30.49	41.8	13.28	75.2	3.75
16.7	24.84	50.2	11.28	83.6	1.59
25.1	19.30	58.6	7.96		

(Kopp, A. 40 206)

100 pts alcohol of 75% by weight dissolve at 14° 15.2 pts, 38° 71.5° pts, 0.66° 0.700 pts, 0.736 pts  $\text{NaCl}$

100 pts alcohol of 90.5% by weight dissolve at 15° 77.2° pts, 0.174° 0.171 pts  $\text{NaCl}$

(Wagner, A. 64 293)

100 pts alcohol containing % alcohol by weight dissolve pts  $\text{NaCl}$  at 15°, or 100 pts solution contain %  $\text{NaCl}$

10	20	30	40	% alcohol,
28.5	22.55	17.51	13.25	pts $\text{NaCl}$ ,
22.2	18.4	14.9	11.7	% $\text{NaCl}$ ,

50	60	80	% alcohol,
9.77	5.93	1.22	pts $\text{NaCl}$ ,
8.9	5.6	1.2	% $\text{NaCl}$

(Schiff, A. 118 365)

Solubility of  $\text{NaCl}$  in alcohol increases with the temperature

100 pts (by weight) of alcohol of 0.9282 sp gr (50.5% by weight) dissolve at

4°	10°	13°	23°	32°
10.9	11.1	11.43	11.9	12.3 pts $\text{NaCl}$ ,

33°	44°	51°	60°
12.5	13.1	13.8	14.1 pts $\text{NaCl}$

(Gerardin, A. ch. (4) 5 146)

Solubility in alcohol at 13°

Sp. gr.	100 ccm contain in g		
	Alcohol	Water	Salt
1.2030	0	88.70	31.60
1.1348	11.81	78.41	23.26
1.1144	15.99	74.64	20.81
1.0970	19.39	71.45	18.86
1.0698	24.95	65.80	16.23
1.0295	32.33	57.96	12.66
0.9880	40.33	49.34	9.13
0.9445	49.28	38.54	5.93
0.9075	57.91	29.37	3.47
0.8700	63.86	21.62	1.52
0.8400	72.26	11.24	0.50

(Bodlander, Z. phys. Ch. 7 317)

Solubility in ethyl alcohol + Aq at 30°

wt % alcohol	g $\text{NaCl}$ per 100 g		wt % alcohol	g $\text{NaCl}$ per 100 g	
	solution	H <sub>2</sub> O		solution	H <sub>2</sub> O
0	26.50	36.05	50	9.34	20.60
5	24.59	34.29	60	6.36	16.96
10	22.56	32.57	70	3.36	12.75
20	19.05	29.40	80	1.56	7.95
30	15.67	26.53	90	0.43	4.30
40	12.45	23.70			

(Taylor, J. phys. Ch. 1897, 1 723)

Solubility in ethyl alcohol + Aq at 40°

wt % alcohol	g $\text{NaCl}$ per 100 g		wt % alcohol	g $\text{NaCl}$ + 100 g	
	solution	H <sub>2</sub> O		solution	H <sub>2</sub> O
0	26.68	36.38	50	9.67	21.42
5	24.79	34.69	60	6.65	17.82
10	22.90	33.00	70	3.87	13.10
20	19.46	30.20	80	1.69	8.68
30	16.02	27.25	90	0.50	5.10
40	12.75	24.37			

(Taylor, l. c.)



## Solubility of NaCl in ethyl alcohol+Aq at 28°

C <sub>2</sub> H <sub>5</sub> OH	% H <sub>2</sub> O	% NaCl	C <sub>2</sub> H <sub>5</sub> OH	% H <sub>2</sub> O	% NaCl
0	73 53	26 47	45 35	45 35	9 3
3 8	71 6	24 6	56 2	37 5	6 3
7 7	69 7	22 6	67 4	28 9	3 7
16 1	64 6	19 3	78 8	19 7	1 5
25 3	58 9	15 8	89 6	10	0 4
35 0	52 5	12 5			

(Fontem, Z phys Ch 1904, 73 212)

## Solubility of NaCl in ethyl alcohol+Aq at 25°

Conc = concentration of alcohol in g mol per 1,000 g H<sub>2</sub>O  
NaCl = g in 1,000 g H<sub>2</sub>O

Conc	NaCl	Molecular solubility
0	359 65	6 16
0 25	355 15	6 08
0 50	349 65	5 98
1	337 80	5 79
3	301 60	5 16

(Armstrong and Eyre, Proc R Soc 1910, (A) 84 127)

100 pts absolute methyl alcohol dissolve 1 41 pts at 18 5°, 100 pts absolute ethyl alcohol dissolve 0 085 pt at 18 5° (de Bruyn, Z phys Ch 10 782)

100 pts wood-spirit of 40% (by weight) dissolve 13 0 pts NaCl (Schiff, A 118 365)

100 g NaCl+CH<sub>3</sub>OH contain 0 1 g NaCl at the critical temp (Centnerszwer, Z phys Ch 1910, 72 437)

## Solubility of NaCl in methyl alcohol+Aq at 25°

Conc = concentration of alcohol in g mol per 1,000 g H<sub>2</sub>O  
NaCl = g in 1,000 g H<sub>2</sub>O

t	Conc	NaCl	Molecular solubility
0°	0	357 75	6 13
	0 25	355 20	6 08
	0 50	353 10	6 05
	1	347 45	5 95
25°	0	362 95	6 20
	0 25	359 40	6 14
	0 50	357 60	6 11
	1	353 20	6 04
	3	336 25	5 75

(Armstrong and Eyre, Proc R Soc 1910, (A) 84 127)

1 16 cc dissolve in propyl alcohol (Schlamp Z phys Ch 1894, 14 276)

## Solubility of NaCl in propyl alcohol+Aq at 25°

Conc = concentration of alcohol in g mol per 1,000 g H<sub>2</sub>O  
NaCl = g NaCl in 1,000 g H<sub>2</sub>O

t°	Conc	NaCl	Molecular solubility
0	0	357 75	6 13
	0 25	351 20	6 01
	0 50	345 55	5 91
25	0	362 95	6 20
	0 25	355 75	6 10
	0 50	350 20	6 00

(Armstrong and Eyre, Proc R Soc 1910, A 84 127)

## Solubility of NaCl in propyl alcohol+Aq at 23-25°

% NaCl	% C <sub>3</sub> H <sub>7</sub> OH	% H <sub>2</sub> O	% NaCl	% C <sub>3</sub> H <sub>7</sub> OH	% H <sub>2</sub> O
0 55	87 7	11 75	14 38	5 39	80 23
2 23	51 57	46 20	15 42	5 11	79 47
3 55	18 99	77 46	16 38	4 47	79 14
3 90	14 78	81 32	18 08	3 83	78 09
5 27	12 77	81 96	20 12	3 27	76 61
8 04	9 49	82 47	22 35	2 64	75 01
10 49	7 79	81 72	24 50	2 13	75 37
12 20	6 57	81 23	24 90	2 3	72 80

(Frankforter and Frary, J phys Ch 1913, 17 402)

100 g sat solution of NaCl in 99 6% propyl alcohol contain 0 04 g NaCl at 25° (Frankforter and Frary)

Insol in fusel oil (Gooch, Am Ch J 9 53)

## Solubility of NaCl in amyl alcohol+Aq Liquid phases conjugated at 28°

Upper layer			Lower layer		
NaCl	amyl alcohol	H <sub>2</sub> O	NaCl	amyl alcohol	H <sub>2</sub> O
0 05	95 45	4 5	26 36	0 22	73 42
"	94 1	5 9	19	0 4	80 4
"	92 9	7 1	12 7	0 8	86 5
"	91 6	8 4	6 2	1 5	92 3
0	90 2	9 8	0	2 3	97 7

(Fontem, Z phys Ch 1910, 73 226)

At room temp 1 pt by weight is sol in 75 pts methyl alcohol D<sup>1</sup> 0 7990

566 " ethyl " D<sup>1</sup> 0 8100

3000 " propyl " D<sup>15</sup> 0 8160

(Rohland Z anorg 1898, 18 325)

100 g methyl alcohol dissolve 1 31 g NaCl at 25°

100 g ethyl alcohol dissolve 0.065 g NaCl at 25°  
 100 g propyl alcohol dissolve 0.012 g NaCl at 25°  
 100 g isopropyl alcohol dissolve 0.002 g NaCl at 25°  
 (Turner and Bissett, Chem Soc 1913, 103 1909)

Solubility of NaCl in ethyl+amyl alcohol at 28°

Upper layer				Lower layer		
% NaCl	% alc	ethyl alcohol	% ethyl alcohol	% NaCl	% ethyl alcohol	% isopropyl alcohol
0.05	95	5	0	26.35	0.22	0
0.10	86		9.5	25.30	0.25	1.9
0.25	75		19.1	24.02	0.3	9.5
0.58	59		30.9	22.64	0.4	6.9
1.23	47		38.7	21.19	0.5	10.3
2.81	31		44.8	19.26	1.3	15.2
6.56	17		41.5	15.81	3.69	22.1

Critical solution amyl alcohol, 10%, ethyl alcohol, 32.5%, NaCl, 11%, H<sub>2</sub>O, 46.5%

(Fontana, Z phys Ch 1910, 73 244)

Ether pts NaCl from NaCl+Acq (Gmelin)  
 Very slight sol in a mixture of equal pts of alcohol and ether (Berzelius)  
 500 mg NaCl treated with above mixture yielded on 0.5 mg to the liquid (Lawrence Smith, Am J Sci (2) 16 57)  
 100 pts of a mixture of 1 pt 96% alcohol and 1 pt 3% ether dissolve 0.11 pt NaCl (Mayer, A 98 205)  
 Insol in acetone (Krug and M'Elroy, J Anal Ch 184, Friedman, C C 1899, II 1014)

Solubility in acetone+Acq at 20°

A = ccm acetone in 100 ccm of the solvent  
 NaCl = millimols NaCl in 100 ccm of the solution

		NaCl
0	2 phases	537.9
10		464.6
20		394.8
30		330.1
32		lower layer 308.5
to 87		
88		upper layer 7.7
89		7.3
90		5.6
100		4.3

(Herz and Knoch, Z anorg 1904, 41 318)

Solubility in acetone+Acq at 20°

% NaCl	% H <sub>2</sub> O	% acetone
25.9	73.06	1.04
24.19	71.18	4.03
25.06	72.00	2.94
20.85	66.78	12.37
20.17	66.01	13.82
18.32	63.16	18.52
20.44	66.19	13.37
17.89	62.21	19.90
0.32	13.92	85.76
0.19	10.82	88.99
0.15	9.62	90.23
0.12	8.94	90.94

(Frankforter and Cohen, J Am Chem Soc 1914, 36 1127)

Solubility in glycol at 14.8° = 31.7% (de Coninck, Belg Acad Bull 1905 275)  
 Sol in glycerine (Pelouze)

Solubility of NaCl in glycerine+Acq at 25°  
 G = g glycerine in 100 g glycerine+Acq  
 NaCl = millimols NaCl in 100 cc of the solution

G	NaCl	Sp gr
0	545.6	1.1960
13.28	501.1	1.2048
25.98	448.4	1.2133
45.36	370.2	1.2283
54.23	333.9	1.2381
83.84	220.8	1.2696
100	167.1	1.2964

(Herz and Knoch, Z anorg 1905, 45 267)

Insol in benzonitrile (Naumann B 1914, 47 1370)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3602)

Solubility of NaCl in solutions of HgCl<sub>2</sub> in ethyl acetate

100 mols ethyl acetate dissolve			
Mols HgCl <sub>2</sub>	Mols NaCl	Mols HgCl	Mols NaCl
40.0	20.0	18.0	5.1
38.1	19.6	16.4	4.3
36.0	19.2	14.1	3.8
34.9	18.5	13.2	2.9
34.8	18.3	12.4	2.3
32.1	13.8	12.0	1.6
28.0	9.1	12.2	1.3
22.8	7.0	12.9	0.8
22.9	7.0		

(Linebarger, Am Ch J 1894, 16 215)

## Solubility of NaCl in urea + Aq at 25°

% urea	% NaCl	% urea	% NaCl
0	31 80	18	27 65
5	30 63	23	27 24
9 6	29 05	28	26 56
13	28 46		

(Ritzel, Z Kryst Min 1911, 49 152)

Solubility of NaCl in urea + Aq at (?)°

g = g urea in 100 cc of solution

sol = increase of solubility of NaCl in g per 100 cc of the solution

g	sol	g	sol
5	0 044	30	0 709
10	0 124	35	0 910
15	0 234	40	1 134
20	0 372	45	1 370
25	0 529	50	1 602

(Fastert, N Jahrb Min Beil Bd 1912, 23 286)

## Solubility of NaCl in formamide + Aq at 25°

% HCONH <sub>2</sub>	% NaCl	% HCONH	% NaCl
0	31 80	11	29 11
2 3	30 98	15	28 52
5 3	30 86	18 8	27 76
8	30 40		

(Ritzel, Z Kryst Min 1911, 49 152)

Insol in anhydrous and in 97% pyridine  
 Very sl sol in 95% pyridine + Aq Sl sol  
 in 93% pyridine + Aq (Kahlenberg, J Am  
 Chem Soc 1908, 30 1107)

Insol in oil of turpentine (T S Hunt,  
 Am J Sci (2) 19 417)

100 g H<sub>2</sub>O dissolve 236 3 g sugar + 42 3 g  
 NaCl at 31 25°, or 100 g sat aq solution  
 contain 62 17 g sugar + 11 13 g NaCl  
 (Kohler, Z Ver Zuckerind, 1897, 47 447)

Solubility of NaCl in glucose + Aq at 25°

Conc = concentration of glucose + Aq in g  
 mol per 1,000 g H<sub>2</sub>Osol = solubility in 1,000 g H<sub>2</sub>O

Conc	Sol	Molecular solubility
0	361 40	6 18
0 25	364 15	6 22
0 50	364 30	6 23
1 0	369 90	6 32

(Armstrong and Evre, Proc R Soc 1910,  
 (A) 84 127)

Min Halite

+ 2H<sub>2</sub>O Efflorescent below 0°, sl deli-  
 quescient at temps above 0° (Fuchs, 1826)

The solubility in H<sub>2</sub>O at -12 25° corre-  
 sponds to 32 9 pts of NaCl per 100 pts H<sub>2</sub>O  
 (Matignon, C R 1909, 148 551)

Sodium stannic chloride, 2NaCl, SnCl<sub>4</sub>·6H<sub>2</sub>O

See Chlorostannate, sodium

Sodium thallic chloride, 3NaCl, TlCl<sub>3</sub>·12H<sub>2</sub>O

Very sol in H<sub>2</sub>O (Pratt, Am J Sc  
 1895, (3) 49 404)

Sodium uranium chloride, 2NaCl, UCl<sub>4</sub>

Non volatile and not hygroscopic (Mor-  
 san, C R 1896, 122 1089)

Sol in H<sub>2</sub>O (Colani, A ch 1907, (8) 1  
 59)

Sodium uranyl chloride, Na<sub>2</sub>(UO<sub>2</sub>)Cl<sub>4</sub>

As K salt (Aloy, Bull Soc 1899, (3) 2  
 264)

Sodium zinc chloride, 2NaCl, ZnCl<sub>2</sub>·3H<sub>2</sub>O

Deliquescent Easily sol in H<sub>2</sub>O (Schu-  
 nler, Mag Pharm 36 48)

Sodium zirconium chloride, 2NaCl, ZrCl<sub>4</sub>

(Paykull)

Sodium chloriodide, NaCl<sub>4</sub>I·2H<sub>2</sub>O

Easily decomp by alcohol or ether (W-  
 and Wheeler, Sil Am J 143 42)

## Sodium fluoride, NaF

Very sl sol in cold, and not more abun-  
 antly in boiling H<sub>2</sub>O (Rose)

100 pts H<sub>2</sub>O dissolve 4 78 pts at 16° (B  
 zelius)

100 pts H<sub>2</sub>O dissolve 4 pts at 15° (Frer  
 A ch (3) 47 32)

Sp gr of aqueous solutions containing  
 100 pts H<sub>2</sub>O

1 1081 2 2162 3 3243 pts NaF  
 1 0110 1 0221 1 0333

Sat solution has sp gr 1 0486 (Gerls  
 Z anal 27 277)

Sp gr of solution sat at 18° = 1 044, c-  
 taining 4 3% NaF (Mylus and Funk,  
 1897, 30 1718)

## Solubility of NaF in HF + Aq at 21°

g per 1000 g H <sub>2</sub> O		g per 1000 g H <sub>2</sub> O	
HF	NaF	Hf	NaF
0 0	41 7	83 8	22 4
10 0	41 4	129 7	23 4
45 8	22 5	596 4	48
56 5	22 7	777 4	81

(Ditte, C R 1896, 123 1282)

Easily sol in liquid HF (Franklin  
 anorg 1905, 46 2)

Sl sol in conc KC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq (St-  
 eyer)

Almost insol in alcohol (Berzelius, P  
 1 13)

Insol in methyl acetate (Naumann  
 1909, 42 3790)

**Sodium hydrogen fluoride, NaHF<sub>2</sub>**

Rather difficultly sol in cold, more easily in hot H<sub>2</sub>O (Berzelius, Pogg 1 13)

**Sodium tantalum fluoride**

See Fluotantalate, sodium

**Sodium tin (stannous) fluoride, 2NaF, 3SnF<sub>2</sub>**

Sol in H<sub>2</sub>O (Wagner B 19 896)

**Sodium tin (stannic) fluoride**

See Fluostannate, sodium

**Sodium tantalum fluoride**

See Fluotantalate, sodium

**Sodium tellurium fluoride, NaF, TeF<sub>4</sub>**

Decomp by H<sub>2</sub>O (Berzelius)

**Sodium titanium fluoride**

See Fluotitanate, sodium

**Sodium tungstic fluoride**

See Fluoxytungstate, sodium

**Sodium uranium fluoride, NaF, UF<sub>4</sub> (?)**

Somewhat soluble in H<sub>2</sub>O (Bolton)

**Sodium uranyl fluoride**

See Fluoxyuranate, sodium

**Sodium vanadium sesquifluoride**

See Fluovanadate, sodium

**Sodium zinc fluoride, NaF, ZnF<sub>2</sub>**

Sol in H<sub>2</sub>O (R Wagner)

**Sodium zirconium fluoride, 5NaF, 2ZrF<sub>4</sub>**

See Fluozirconate, sodium

**Sodium fluoride vanadium pentoxide**

See Fluoxyvanadate, sodium

**Sodium hydrazide, NH<sub>2</sub>, NHNa**

Decomp by H<sub>2</sub>O with explosive violence

Decomp by alcohol (Schlenk, B 1915, 48 670)

**Sodium hydride, NaH**

Decomp by H<sub>2</sub>O and by acids

Sol in fused Na or Na amalgam Insol in liquid NH<sub>3</sub> Insol in CS<sub>2</sub>, CCl<sub>4</sub>, C<sub>6</sub>H<sub>6</sub> and terebenthene (Moissan, C R 1902, 134 73)

NaH<sub>4</sub> Decomp violently by H<sub>2</sub>O

**Sodium hydrosulphide, NaSH**

Deliquescent Sol in H<sub>2</sub>O and alcohol

+3H<sub>2</sub>O Difficultly sol in H<sub>2</sub>O (Damoiseau, C C 1885 36)

**Sodium hydroxide, NaOH**

Very deliquescent 100 pts NaOH under a bell jar with H<sub>2</sub>O at 16–20° absorb 552 pts in 56 days (Mulder)

Very sol in H<sub>2</sub>O with evolution of much heat Sol in 0.47 pt H<sub>2</sub>O (Bineau, C R 41 509)

**Solubility of NaOH in H<sub>2</sub>O**

t°	g per 100 g		Solid phase
	Solu- tion	H <sub>2</sub> O	
— 7 8	8 0	8 7	Ice
—20	16 0	19 1	
—28	19 0	23 5	
—24	22 2	28 5	Ice + NaOH 7H <sub>2</sub> O NaOH 7H <sub>2</sub> O + NaOH 5H <sub>2</sub> O NaOH 5H <sub>2</sub> O + NaOH 4H <sub>2</sub> O NaOH 4H <sub>2</sub> O
—17 7	24 5	32 5	
0	29 6	42 0	
+ 5	32 2	47 5	NaOH 4H <sub>2</sub> O + NaOH 3½H <sub>2</sub> O NaOH 3½H <sub>2</sub> O f pt
10	34 0	51 5	
15 5	38 9	63 53	
5	45 5	83 5	NaOH 3½H <sub>2</sub> O + NaOH 2H <sub>2</sub> O NaOH 2H <sub>2</sub> O + NaOH H <sub>2</sub> O NaOH H <sub>2</sub> O
12	50 7	103 0	
20	52 2	109	
30	54 3	119	f pt NaOH H <sub>2</sub> O + NaOH NaOH (?)
40	56 3	129	
50	59 2	145	
60	63 5	174	f pt NaOH H <sub>2</sub> O + NaOH NaOH (?)
64 3	69 0	222 3	
61 8	74 2	288	
80	75 8	313	f pt NaOH H <sub>2</sub> O + NaOH NaOH (?)
110	78 5	365	
192	83 9	521	

(Pickering, Chem Soc 1893, 63 890, Mylius and Funk, W A B 1900, 3 450 Calc by Seidell, Solubilities, 2d Edition, p 653)

100 g sat NaOH + Aq at 15° contain 46.36 g NaOH (de Forcrand, C R 149 1344)

**Sp gr and b pt of NaOH + Aq**

% Na <sub>2</sub> O	Sp gr	B pt	% Na <sub>2</sub> O	Sp gr	B pt
4 7	1 06	100.56	31 0	1 44	120 00
9 0	1 12	101 11	34 0	1 47	123 89
13 0	1 18	102 75	36 8	1 50	129 44
16 0	1 23	104 44	41 2	1 56	137 78
19 0	1 29	106 66	46 6	1 63	148 89
23 0	1 32	108 89	53 8	1 72	204 44
26 0	1 36	112 78	63 6	1 85	315.56
29 0	1 40	116 66	77 8	2 00	red heat

(Dalton)

**Sp gr of NaOH + Aq at 15°**

% Na <sub>2</sub> O	Sp gr	% Na <sub>2</sub> O	Sp gr	% Na <sub>2</sub> O	Sp gr
0 302	1 0040	10 879	1 1630	21 154	1 3053
0 601	1 0081	11 484	1 1734	21 758	1 3125
1 209	1 0163	12 088	1 1841	21 891	1 3143
1 813	1 0246	12 692	1 1945	22 363	1 3198
2 418	1 0330	13 297	1 2058	22 967	1 3273
3 022	1 0414	13 901	1 2176	23 572	1 3349
3 626	1 0500	14 506	1 2280	24 176	1 3426
4 231	1 0587	15 110	1 2392	24 780	1 3505
4 835	1 0675	15 714	1 2453	25 385	1 3586
5 440	1 0764	16 319	1 2515	25 989	1 3668
6 044	1 0855	16 923	1 2578	26 594	1 3751
6 648	1 0948	17 528	1 2642	27 200	1 3836
7 253	1 1042	18 132	1 2708	27 802	1 3923
7 857	1 1137	18 736	1 2775	28 407	1 4011
8 462	1 1233	19 341	1 2843	29 011	1 4101
9 066	1 1330	19 954	1 2912	29 616	1 4193
9 670	1 1428	20 550	1 2982	30 220	1 4285
10 275	1 1528				

(Tünnerman N J Pharm 18 2)

Sp gr of NaOH+Aq					
% Na <sub>2</sub> O	Sp gr	% Na <sub>2</sub> O	Sp gr	% Na <sub>2</sub> O	Sp gr
2 07	1 02	14 73	1 16	28 16	1 30
4 02	1 04	16 73	1 18	29 96	1 32
5 89	1 06	18 71	1 20	31 67	1 34
7 69	1 08	20 66	1 22	32 40	1 35
9 43	1 10	22 58	1 24	33 08	1 36
11 10	1 12	24 47	1 26	34 41	1 38
12 81	1 14	26 33	1 28		

(Richter)

Sp gr of NaOH+Aq at 15°					
°C	Sp gr if % Na <sub>2</sub> O	Sp gr if % NaOH	%	Sp gr if % Na <sub>2</sub> O	Sp gr if % NaOH
1	1 015	1 012	32	1 450	1 351
2	1 020	1 023	33	1 462	1 363
3	1 043	1 035	34	1 475	1 374
4	1 058	1 046	35	1 488	1 384
5	1 074	1 059	36	1 500	1 395
6	1 089	1 070	37	1 515	1 405
7	1 104	1 081	38	1 530	1 415
8	1 119	1 092	39	1 543	1 426
9	1 132	1 103	40	1 558	1 437
10	1 145	1 115	41	1 570	1 447
11	1 160	1 126	42	1 583	1 456
12	1 175	1 137	43	1 597	1 468
13	1 190	1 148	44	1 610	1 478
14	1 203	1 159	45	1 623	1 488
15	1 219	1 170	46	1 637	1 499
16	1 233	1 181	47	1 650	1 508
17	1 245	1 192	48	1 663	1 519
18	1 258	1 202	49	1 678	1 529
19	1 270	1 213	50	1 690	1 540
20	1 285	1 225	51	1 705	1 550
21	1 300	1 236	52	1 719	1 560
22	1 315	1 247	53	1 730	1 570
23	1 329	1 258	54	1 745	1 580
24	1 341	1 269	55	1 760	1 591
25	1 355	1 279	56	1 770	1 601
26	1 369	1 290	57	1 785	1 611
27	1 381	1 300	58	1 800	1 622
28	1 395	1 310	59	1 815	1 633
29	1 410	1 321	60	1 830	1 643
30	1 422	1 332	70		1 748
31	1 438	1 343			

(Gerlach, Z anal 8 279, calculated from Schiff, A 107 300)

Sp gr of NaOH+Aq at 15°			
°C NaOH	Sp gr	% NaOH	Sp gr
0 61	1 0070	4 0	1 0435
0 9	1 0105	4 32	1 0473
1 0	1 0107	4 64	1 0511
1 2	1 0141	4 96	1 0549
1 6	1 0177	5 29	1 0588
2 0	1 0213	5 58	1 0627
2 36	1 0249	5 87	1 0667
2 71	1 0286	6 21	1 0706
3 0	1 0318	6 55	1 0746
3 35	1 0360	6 76	1 0787
3 67	1 0397	7 31	1 0827

Sp gr of NaOH+Aq at 15°—Continued			
% NaOH	Sp gr	% NaOH	Sp gr
7 66	1 0868	24 81	1 2748
8 0	1 0909	25 3	1 2800
8 34	1 0951	25 8	1 2857
8 68	1 0992	26 31	1 2905
9 0	1 1030	26 83	1 2973
9 42	1 1077	27 31	1 3032
9 74	1 1120	27 8	1 3091
10 0	1 1158	28 31	1 3151
10 5	1 1195	28 83	1 3211
10 97	1 1250	29 38	1 3272
11 42	1 1294	30 0	1 3339
11 84	1 1339	30 57	1 3395
12 24	1 1383	31 22	1 3458
12 64	1 1423	31 85	1 3521
13 0	1 1474	32 47	1 3585
13 55	1 1520	33 0	1 3642
13 86	1 1566	33 69	1 3714
14 5	1 1631	34 38	1 3780
14 75	1 1662	35 0	1 3858
15 0	1 1697	35 65	1 3913
15 5	1 1755	36 25	1 3981
15 91	1 1803	36 86	1 4049
16 38	1 1852	37 47	1 4118
16 77	1 1901	38 13	1 4187
17 22	1 1950	38 8	1 4267
17 67	1 2000	39 39	1 4328
17 12	1 2050	40 0	1 4410
18 58	1 2101	40 75	1 4472
19 0	1 2148	41 41	1 4545
19 58	1 2202	42 12	1 4619
20 0	1 2250	42 83	1 4694
20 59	1 2308	43 66	1 4769
21 0	1 2361	44 38	1 4845
21 42	1 2414	45 27	1 4922
22 0	1 2462	46 15	1 5000
22 64	1 2522	46 87	1 5079
23 15	1 2576	47 60	1 5158
23 67	1 2632	48 81	1 5238
24 24	1 2687	49 02	1 531

Hager, Comm 1883)

The sp gr increases or diminishes for each degree as follows

% NaOH	Corr
40-50	0 00045
30-39	0 0004
20-29	0 0003
10-19	0 0002

Hager, Comm 1883)

Sp gr of NaOH+Aq at 15°

% NaOH	Sp gr	% NaOH	Sp gr
2 5	1 0280	20	1 226
5	1 0568	25	1 282
10	1 1131	30	1 337
15	1 1790		

(Kohlrausch, W Ann 1879)

Sp gr of NaOH+Aq at 20° containing  
2 mols NaOH to 100 mols H<sub>2</sub>O = 1.04712  
(Nicol, Phil Mag (5) 16 122)

Sp gr of NaOH+Aq at 15°

% Na O	Sp gr	% Na <sub>2</sub> O	Sp gr
5	1.069	25	1.353
10	1.139	30	1.426
15	1.210	35	1.500
20	1.281		

(Hager, Adjumenta Varia, Leipsic, 1876)

Sp gr of NaOH+Aq at 15°

% NaOH	Sp gr	% NaOH	Sp gr	% NaOH	Sp gr
0	0.999180	17	1.188707	34	1.373453
1	1.010611	18	1.199783	35	1.383815
2	1.021920	19	1.210861	36	1.394092
3	1.033109	20	1.221933	37	1.404279
4	1.044317	21	1.233062	38	1.414363
5	1.055463	22	1.244119	39	1.424353
6	1.066602	23	1.255134	40	1.434299
7	1.077733	24	1.266092	41	1.444161
8	1.088856	25	1.277063	42	1.453929
9	1.099969	26	1.287990	43	1.463623
10	1.111069	27	1.298877	44	1.473249
11	1.122165	28	1.309708	45	1.482850
12	1.133250	29	1.320496	46	1.492406
13	1.144353	30	1.331213	47	1.501927
14	1.155450	31	1.341879	48	1.511412
15	1.166538	32	1.352472	49	1.520868
16	1.177619	33	1.362991	50	1.530282

(Pickering, Phil Mag 1894, (5) 37 373)

Sp gr of a N solution of NaOH+Aq at  
18°/18° = 1.0418 (Ioomis, W Ann 1890, 60  
550)

Sp gr of NaOH+Aq  
%NaOH 8.73 3.67 3.82  
Sp gr 20°/20° 1.0968 1.0416 1.0464  
(Ie Blanc and Rohland, Z phys Ch 1896,  
19 272)

Sp gr of NaOH+Aq at t H O at 4° = 1  
The solutions contained a small amount  
of Na<sub>2</sub>CO<sub>3</sub>

t	% NaOH	% Na CO <sub>3</sub>	Sp gr
60	22.57	0.61	1.2312
	20.04	0.48	1.2026
	17.04	0.35	1.1692
	14.16	0.38	1.1374
	10.92	0.36	1.1020
80	22.81	0.55	1.2207
	14.01	0.42	1.1232

(Wegscheider and Walter, M 1905, 26 691)

Sat NaOH+Aq boils at 215.5° (Griffiths)

Sat NaOH+Aq boils at 310° (Gerlach,  
Z anal 26 427)

NaOH+Aq of 1.500 sp gr contains 36.8%  
NaOH and boils at 130°

B-pt of NaOH+Aq containing pts NaOH  
to 100 pts H<sub>2</sub>O

B pt	Pts NaOH	B pt	Pts NaOH
105°	17	210°	425.5
110	30	215	475.5
115	41	220	526.3
120	51	225	583.3
125	60.1	230	645.2
130	70.1	235	714.3
135	81.1	240	800
140	93.5	245	888.8
145	106.5	250	1000
150	120.4	255	1142.8
155	134.5	260	1333.3
160	150.8	265	1534
165	168.8	270	1739.1
170	187	275	2000
175	208.3	280	2353
180	230	285	2857
185	254.5	290	3571.4
190	281.7	300	4651.1
195	312.3	305	6451.6
200	345	310	10526.3
205	380.9	314	22222.2

(Gerlach, Z anal 26 463)

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch  
J 1898, 20 829)

Sp gr of Na CO<sub>3</sub>+NaOH+Aq at 11.5°  
H O at 4° = 1

% Na CO <sub>3</sub>	% NaOH	Sp gr
3.84	14.10	1.196
3.171	13.63	1.182
2.204	12.51	1.164
1.642	10.17	1.136
0.2686	16.64	1.186

(Wegscheider and Walter, M 1905, 26 693)

Sp gr of Na<sub>2</sub>CO<sub>3</sub>+NaOH+Aq at t° H O  
at 4° = 1

t	% Na CO <sub>3</sub>	% NaOH	Sp gr
60°	15.38	10.65	1.2621
	13.79	9.22	1.2302
	12.10	8.29	1.1952
	9.965	6.86	1.1594
	9.47	6.70	1.1521
	7.69	5.22	1.1158
80°	15.26	11.14	1.2510
	9.48	6.93	1.1417

(Wegscheider and Walter, M 1905, 26 692)

Solubility of  $\text{NaOH} + \text{Na}_2\text{SbS}_4$  at  $30^\circ$ 

$\% \text{ NaOH}$	$\% \text{ Na}_2\text{SbS}_4$	Solid phase
0	27.1	$\text{Na}_2\text{SbS}_4 \cdot 9\text{H}_2\text{O}$
9.9	13	"
24.8	5.9	"
32.9	10.5	"
42.6	16.4	"
47.2	17.7	" $+\text{NaOH}, \text{H}_2\text{O}$
49.5	9.1	$\text{NaOH}, \text{H}_2\text{O}$
54.3	0	"

(Donk, Chem Weekbl 1908, 5 529, 629, 767)

Easily sol in alcohol or wood spirit, sol in fusel-oil. Sol in an aqueous solution of mannite (Favre, A ch (3) 11 76)

Easily sol in glycerine

Sol to a certain extent in ether

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3602), benzonitrile (Naumann, B 1914, 47 1370)

$+\text{H}_2\text{O}$  100 g solution in  $\text{H}_2\text{O}$  sat at  $25^\circ$  contain 42 g  $\text{Na}_2\text{O}$  (Schreinemakers, Arch Néer Sc 1910, (2) 15 81)

Mpt  $64.3^\circ$  (See above)

$+1\frac{1}{2}\text{H}_2\text{O}$  (Cripps, Pharm J Trans (3) 14 833)

 $+2\text{H}_2\text{O}$  See above

$+3\frac{1}{2}\text{H}_2\text{O}$  Deliquescent. Sol in  $\text{H}_2\text{O}$  with absorption of much heat. Melts at  $6^\circ$  (Hermes)

Mpt  $15.5^\circ$  (See above) $+4, 5$  and  $7\text{H}_2\text{O}$  (See above)

The composition of the hydrates formed by  $\text{NaOH}$  at different dilutions is calculated from determinations of the lowering of the fr-pt produced by  $\text{NaOH}$  and of the conductivity and sp gr of  $\text{NaOH} + \text{Aq}$  (Jones, Am Ch J 1900, 34 336)

Sodium perhydroxide,  $\text{NaO}_2\text{H}$ 

"Natriv hydroxide"

Decomp by  $\text{H}_2\text{O}$ . Sol in cold alcoholic acetic acid (Tafel, B 1894, 27 2300)

Sodium iodide,  $\text{NaI}$ , and  $+2\text{H}_2\text{O}$ 

Solubility of  $\text{NaI}$  and of  $\text{NaI} + 2\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  differ. Below  $65^\circ$ ,  $\text{NaI} + 2\text{H}_2\text{O}$  usually separates out and above that temp  $\text{NaI}$  separates

Solubility of  $\text{NaI}$  in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	Pts $\text{NaI}$	$t$	Pts $\text{NaI}$	$t$	Pts $\text{NaI}$
71.3	294.4	92.4	300.2	124.7	317.5
74.1	295.3	97.1	300.3	132.5	317.3
81.6	296.8	101.7	302.5	138.1	319.2
86.4	298.3	110.7	306.2		

Solubility is represented by a straight line of the formula  $S = 264.19 + 0.3978t$

Solubility of  $\text{NaI} + 2\text{H}_2\text{O}$  in 100 pts at  $t^\circ$ 

$t^\circ$	Pts $\text{NaI}$	$t^\circ$	Pts $\text{NaI}$	$t^\circ$	Pts $\text{NaI}$
-17	149.4	15	173.7	45	215.6
-15	150.3	20	178.7	50	227.8
-5	155.4	25	184.2	55	241.2
0	158.7	30	190.3	60	256.8
5	163.6	35	197.0	65	278.4
10	168.6	40	205.1		

(Coppet, A ch (5) 50 424)

If solubility  $S = \text{pts NaI in 100 pts solution}$ ,  $S = 61.3 + 0.1712t$  from  $0^\circ$  to  $80^\circ$ ,  $S = 75 + 0.0258t$  from  $80^\circ$  to  $160^\circ$  (Etard, C R 98 1432)

$\text{NaI} + 2\text{H}_2\text{O}$  is sol in 0.55 pt  $\text{H}_2\text{O}$  at  $15^\circ$  (Eder, Dingl 221 89)

100 pts  $\text{NaI} + \text{Aq}$  at  $18-19^\circ$  contain 62.9 pts  $\text{NaI}$  (v Hauer, J pr 98 137)

100 pts  $\text{H}_2\text{O}$  dissolve at

$0^\circ$	$20^\circ$	$40^\circ$	$60^\circ$
158.7	178.6	208.4	256.4 pts $\text{NaI}$

$80^\circ$	$100^\circ$	$120^\circ$	$140^\circ$
303	312.5	322.5	333.3 pts $\text{NaI}$

(Kremers, Pogg 97 14)

Transition pt for  $\text{NaI} + 2\text{H}_2\text{O}$  to  $\text{NaI}$  1  $64.3^\circ$ , and sat solution containing 74.4%  $\text{NaI}$  (Panfiloff, J Russ Phys Chem Soc 1893, 25 162)

100 g  $\text{H}_2\text{O}$  dissolve 172.4 g  $\text{NaI}$  at  $15^\circ$ , and sp gr of sat solution = 1.893. (Greenish, Pharm J 1900, 65 190)

100 g solution of  $\text{NaI} + 2\text{H}_2\text{O}$  sat at  $30^\circ$  contains 65.5 g anhyd  $\text{NaI}$  (Cochere Dissert 1910)

Sp gr of  $\text{NaI} + \text{Aq}$  at  $19.5^\circ$  containing

5	10	15	20	25	30 % $\text{NaI}$
1.040	1.082	1.128	1.179	1.234	1.294

35	40	45	50	55	60 % $\text{NaI}$
1.360	1.432	1.510	1.60	1.70	1.81

(Gerlach, Z anal 8 285)

Sat solution boils at  $141^\circ$ 

Sol in liquid  $\text{SO}_2$  (Walden, B 1899, 32 2864),  $\text{POCl}_3$  (Walden, Z anal 1900, 2 212)

Very easily sol in liquid  $\text{NH}_3$  (Franklin Am Ch J 1898, 20 829)

Sol in 12.0 pts absolute alcohol, in 3 pts ether (Eder, Dingl 221 89)

Sol in 3 pts 90% alcohol (Hager)

100 pts absolute methyl alcohol dissolv 77.7 pts  $\text{NaI}$  at  $22.5^\circ$ , ethyl alcohol, 43.1 pt (de Bruyn, Z phys Ch 10 783)

Very sol in abs methyl alcohol and is n pptd therefrom on the addition of a lar volume of abs ether, while wet ether produc immediate separation (Loeb, J Am Chem Soc 1905, 27 1020)

Solubility of NaI in ethyl alcohol  
(g NaI in 100 g alcohol)

t°	NaI	t	NaI
10	43 77	200	42 3
30	44 25	220	38 5
50	44 50	230	36 2
80	45 0	240	32 7
100	45 1	250	26 2
120	45 2	255	21 0
160	45 0	260	10 8
180	44 3	261 5*	8 6

\*Critical temp of solution

(Tyrer, Chem Soc 1910, 97 626)

100 g sat solution of NaI in ethyl alcohol at 30° contains 30.9 g (Cocheret, Dissert, 1910)

Solubility in ethyl alcohol + Aq at 30°

% NaI	% alcohol	Solid phase
65 52	0	NaI, 2H <sub>2</sub> O
64	3 40	"
54 2	18 5	"
54	18 8	"
48 8	28 5	"
42 35	41 7	"
38 5	53 2	"
37 91	54 7	"
37 49	55 37	NaI, 2H <sub>2</sub> O + NaI
35 65	59 24	NaI
33 24	61 78	"
30 90	68 70	"

(Cocheret, Dissert 1911)

At room temp 1 pt by weight is sol in

1 2 pts methyl alcohol D<sup>15</sup> 0 7990  
1 7 " ethyl " D<sup>15</sup> 0 8100  
3 8 " propyl " D<sup>15</sup> 0 8160

(Rohland, Z anorg 1898, 18 325)

100 g methyl alcohol dissolve 90.35 g NaI at 25°

100 g ethyl alcohol dissolve 46.02 g NaI at 25°

100 g propyl alcohol dissolve 28.22 g NaI at 25°

100 g isoamyl alcohol dissolve 16.30 g NaI at 25°

(Turner and Bissett, Chem Soc 1913, 103 1909)

Solubility in methyl alcohol + ethyl alcohol at 25°

P = % methyl alcohol in the solvent  
G = g NaI in 10 ccm of the solution  
S = Sp gr of the sat solution at 25°

P	G	S 25°/4°
0 00	3 515	1 0806
4 37	3 768	1 1029
10 40	3 971	1 1123
41 02	4 598	1 1742
80 69	5 744	1 2741
84 77	5 892	1 2886
91 25	6 110	1 3056
100 00	6 322	1 3250

(Herz and Kuhn, Z anorg 1908, 60 154)

Solubility in mixtures of methyl and propyl alcohol at 25°

P = % propyl alcohol in the solvent  
G = g NaI in 10 ccm of the solution  
S = Sp gr of the sat solution

P	G	S 25°/4°
0	6 322	1 3250
11 11	5 845	1 2853
23 8	5 464	1 2528
65 2	4 071	1 138
91 8	2 914	1 0420
93 75	2 649	1 0178
100 00	2 411	0 9968

(Herz and Kuhn, Z anorg 1908, 60 156)

Solubility in mixtures of propyl and ethyl alcohol at 25°

P = % propyl alcohol in the solvent  
G = g NaI in 10 ccm of the solution  
S = Sp gr of the sat solution

P	G	S 25°/4°
0	3 515	1 0806
8 1	3 460	1 0732
17 85	3 405	1 0720
56 6	2 841	1 0276
88 6	2 613	1 0130
91 2	2 588	1 0104
95 2	2 474	1 0020
100	2 411	0 9968

(Herz and Kuhn, Z anorg 1908, 60 159)

Sol in normal propyl alcohol (Loeb, J Am Chem Soc 1905, 27 1020)

28.74 g are sol in 100 g propyl alcohol (Schlamp, Z phys Ch 1894, 14 276)

Sol in methyl acetate (Naumann, B 1909, 42 3789)

Sol in ethyl acetate (Casasaca, C R 30 821)

Insol in ethyl acetate (Naumann, B 1910, 43 314)



Sl sol in benzonitrile (Naumann, B 1914, 47 1369)

Solubility in organic solvents at  $t^\circ$

C=pts by wt of NaI in 100 cem of the sat solution

L=no of liters which at the saturation temp hold in solution 1 mol NaI

Solvent	$t^\circ$	C	L
Furfural	25	25 10	0 597
Acetonitrile	25	18 43	0 813
"	0	22 09	0 679
Propionitrile	25	6 230	2 406
"	0	9 091	1 649
Nitromethane	25	0 478	31 36
"	0	0 339	44 27

(Walden, Z phys Ch 1906, 55 718)

Very sol in acetone (Walden)  
 $+5H_2O$  Transition point of  $NaI+5H_2O$  to  $NaI+2H_2O$  is  $-13.5^\circ$ , and sat solution contains 60.2% NaI (Panfiloff, J Russ Phys Chem Soc 1893, 25 162)

Sodium tin (stannous) iodide,  $NaI, SnI_2$

Very sol in  $H_2O$  When treated with little  $H_2O$ , NaI is dissolved out, but a larger amt of  $H_2O$  dissolves it completely (Boullay, A ch (2) 34 375)

Sodium zinc iodide,  $2NaI, ZnI_2+3H_2O$

Deliquescent  
 $NaZnI_3+2H_2O$  Very hygroscopic (Ephraim, Z anorg 1910, 67 383)

Sodium nitride,

Decomp by heat (Franz Fisher, B 1910, 43 1468)

Sodium suboxide,  $Na_2O$

Decomp by  $H_2O$  (de Forciand, C R 1898, 127 365)

Sodium oxide,  $Na_2O$

Very deliquescent, and sol in  $H_2O$  with evolution of heat

See Sodium hydroxide

Sodium peroxide,  $Na_2O_2$

Deliquescent, and very sol in  $H_2O$  with partial decomp

Solution decomp on boiling  
 Cryst with  $2H_2O$ , and  $8H_2O$  (Fairley, Chem Soc 1877 125)

Forms hydrate  $Na_2O_2(OH)_4+4H_2O$   
 Easily sol in  $H_2O$  or dil acids without decomp (Schone, A 193 241)

Sodium peroxide carbonate,  $Na_2CO_3$

Easily decomp (Woffenstein, B 1908 41 285)

Sodium peroxide dicarbonate,  $Na_2C_2O_6$

Easily decomp (Woffenstein, B 1908 41 287)

Sodium trioxide,  $NaO_3$

Sol in  $H_2O$  forming a solution of  $Na_2O$  (Joannis, C R 1893, 116 1371)

Sodium trioxide carbonate,  $Na_2CO_3$

(Woffenstein, B 1908, 41 296)

Sodium trioxide dicarbonate,  $NaHCO_3$

Two isomeric modifications (Woffenstein, B 1908, 41 390)

Sodium trioxide hydrate,  $NaO OH$

See Sodium perhydroxide

Isomeric with Tafel's sodyl hydroxid  $O Na OH$  (B 27, 2297)

Insol in alcohol

Very unstable (Woffenstein, B 1908 41 290)

Sodium phosphide,  $NaP_3$

Easily decomp by  $H_2O$  (Hugot, C R 1895, 121 208)

Sodium hydrogen phosphide,  $NaH_2P$

Decomp by  $H_2O$  (Joannis, C R 1893 119 558)

$Na_3H_3P_2$  Decomp by acids and  $H_2O$  (Hugot, C R 1898, 126 1721)

Sodium selenide,  $Na_2Se$

Very deliquescent. Decomp by  $H_2O$  (Uelsmann, A 116 127)

Insol in liquid  $NH_3$ , sol in an free  $H_2$  to a colorless liquid (Hugot, C R 1893 129 299)

Cryst with  $16H_2O$ ,  $9H_2O$ , and  $9/2 H_2O$  (Fabre, C R 102 613)

$+10H_2O$  Very sol in  $H_2O$ , very unstable in the air (Cleva, Z anorg 1895, 10 14)

Sodium diselenide,  $Na_2Se_2$

(Jackson, B 7 1277)

Sodium triselenide,  $Na_2Se_3$

Sol in  $H_2O$  (Mathewson, J Am Chem Soc 1907, 29 873)

Sodium hexaselenide,  $Na_2Se_6$

Sol in  $H_2O$  (Mathewson, J Am Chem Soc 1907, 29 873)

Sodium monosulphide,  $Na_2S$

Sol in  $H_2O$  Much less sol in alcohol than in  $H_2O$  Insol in ether (Roussin)

+5H<sub>2</sub>O Tr pt from Na<sub>2</sub>S+5½H<sub>2</sub>O, 94°

+5½H<sub>2</sub>O

The sat solution contains —

28	48%	anhydrous salt at	50°
29	27	"	55°
29	92	"	60°
31	38	"	70°
33	95	"	80°
37	20	"	90°

Labile from 48.9–91.5°, stable from 91.5–96°

(Parravano and Fornaini, C C 1908, I 5)

+6H<sub>2</sub>O Less efflorescent than with 9H<sub>2</sub>O  
Sol in H<sub>2</sub>O and alcohol

The sat solution contains —

26	7%	anhydrous salt at	50°
28	1	"	60°
30	22	"	70°
32	95	"	80°
36	42	"	90°

Tr pt to Na<sub>2</sub>S+5½H<sub>2</sub>O, 91.5°

(Parravano and Fornaini)

+9H<sub>2</sub>O Efflorescent Much less sol in alcohol than H<sub>2</sub>O When dissolved in H<sub>2</sub>O, temp sinks from +22 to –6.1° (Finger, Pogg 128 635)

The sat solution contains —

9	34%	anhydrous Na <sub>2</sub> S at	–10°
13	36	"	+10°
14	36	"	15°
15	30	"	18°
16	2	"	22°
17	73	"	28°
19	09	"	32°
20	98	"	37°
24	19	"	45°

Tr pt to Na<sub>2</sub>S+5½H<sub>2</sub>O, 48.9°

(Parravano and Fornaini)

**Sodium disulphide, Na<sub>2</sub>S**

Sol in H<sub>2</sub>O and alcohol

+5H<sub>2</sub>O Not efflorescent

**Sodium trisulphide, Na<sub>2</sub>S<sub>3</sub>**

Sol in H<sub>2</sub>O with decomp

Cryst with 3H<sub>2</sub>O from in alcoholic solution (Bottger, A 223 355)

**Sodium tetrasulphide, Na<sub>2</sub>S<sub>4</sub>+6H<sub>2</sub>O**

Very deliquescent, and sol in H<sub>2</sub>O Difficultly sol in absolute alcohol Insol in ether (Schone)

+8H<sub>2</sub>O Efflorescent (Bottger)

**Sodium pentasulphide, Na<sub>2</sub>S<sub>5</sub>+6H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Schone)

Sol in alcohol

+8H<sub>2</sub>O (Bottger)

Solution is easily decomp by warming (Jones, Chem Soc 37 461)

**Sodium tellurium sulphide**

See Sulphotellurate, sodium

**Sodium stannic sulphide**

See Sulphostannate, sodium

**Sodium yttrium sulphide, Na<sub>2</sub>S, Y<sub>2</sub>S<sub>3</sub>**

Decomp by dil acids, even by HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq (Dubois, C R 107 243)

**Sodium zinc sulphide, Na<sub>2</sub>S, 3ZnS**

Not so stable as the corresponding K salt (Schneider, J pr (2) 8 29)

**Sodium sulphoselenide, Na<sub>2</sub>SSe<sub>2</sub>+5H<sub>2</sub>O**

Hydrosopic, and decomp in the air (Meesinger, B 1897, 30 806)

**Sodium telluride, Na<sub>2</sub>Te**

Sol in H<sub>2</sub>O (Demarçay, Bull Soc (2) 40 99)

**Sodium tritelluride, Na<sub>2</sub>Te<sub>3</sub>**

Sol in H<sub>2</sub>O

Sol in liq NH<sub>3</sub> (Hugot, C C 1899, II 580)

**Stannic acid, H<sub>2</sub>SnO<sub>3</sub>**

Insol in H<sub>2</sub>O Sol in HCl, and H<sub>2</sub>SO<sub>4</sub>+Aq, even when dil (Fremy) Easily sol in acids, from which solution it may be pptd by dilution or boiling While moist it is sol in HNO<sub>3</sub>+Aq, but gradually separates on standing, and coagulates at once when heated to 50° If NH<sub>4</sub>NO<sub>3</sub> be added to the solution, it remains clear at ord temp (Berzelius)

Easily sol in HNO<sub>3</sub>+Aq, when previously treated with NH<sub>4</sub>OH+Aq (Thénard)

Easily sol in KOH+Aq, but addition of large excess ppts K<sub>2</sub>SnO<sub>3</sub>, insol in KOH+Aq

Easily sol in NaOH+Aq, and not pptd by an excess of that reagent (Barfoed, J B 1867 267)

Sl sol in NH<sub>4</sub>OH+Aq or (NH<sub>4</sub>) CO<sub>3</sub>+Aq Completely sol in K<sub>2</sub>CO<sub>3</sub>+Aq, but not in Na<sub>2</sub>CO<sub>3</sub>+Aq

Insol in alkali hydrogen carbonates or NH<sub>4</sub>Cl+Aq

Sol in alkali sulphides+Aq (Berzelius)

Sol in triethyltoluene ammonium hydrate+Aq

Not pptd by NH<sub>4</sub>OH+Aq in presence of Na citrate+Aq

SnO<sub>2</sub> 2H<sub>2</sub>O (Weber, Pogg 122 358)

"*a Orthostannic acid*" Easily sol in HCl+Aq (Neumann, M 12 515)

H<sub>10</sub>Sn<sub>5</sub>O<sub>15</sub> (?)

**Metastannic acid** Insol in H<sub>2</sub>O, HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub>+Aq Insol in HCl+Aq, but converted thereby into metastannic chloride, which dissolves after excess of HCl has been removed (Fresenius) Insol in HCl+Aq of sp gr 1.1 (Barfoed) Sol in large amount

of conc HCl + Aq (Allen, Chem Soc (2) 10 274)

In contact with HCl + Aq, metastannic acid is converted into stannic acid (Barfoed)

Insol in  $\text{HNO}_3$  + Aq even after treatment with  $\text{NH}_4\text{OH}$  + Aq

Insol in  $\text{NH}_4\text{OH}$  + Aq

Sol in KOH or NaOH + Aq with formation of metastannates, which are insol in dil NaOH + Aq, but sol in H<sub>2</sub>O or KOH + Aq, therefore KOH + Aq dissolves metastannic acid, while NaOH + Aq does not, but if the clear solution in KOH + Aq is treated with a large excess of that reagent, a further pptn occurs (Barfoed, J pr 101 368)

Insol in  $\text{K}_2\text{CO}_3$  + Aq (Rose), alkali carbonates + Aq (Fremy)

Insol in  $\text{NH}_4\text{Cl}$  + Aq even after long boiling

Sol in  $\text{Fe}(\text{NO}_3)_3$  + Aq containing  $\text{HNO}_3$  (Lepéz and Storch, W A B 98, 2b 270)

Also in  $\text{Cr}(\text{NO}_3)_3$  + Aq, but not in  $\text{Ce}(\text{NO}_3)_3$ ,  $\text{Al}(\text{NO}_3)_3$ ,  $\text{Co}(\text{NO}_3)_2$  + Aq, etc (L and S)

A colloidal metastannic acid sol in  $\text{H}_2\text{O}$  can be obtained (Lepéz and Storch)

According to Weber (Pogg 122 358), stannic and metastannic acids are only different hydrates of same oxide, and it is not a case of allotropic modification

*Colloidal*  $\text{H SnO}_3$  in colloidal state can be obtained in aqueous solution containing 5.164 g SnO in a litre. This solution is coagulated by  $\text{HNO}_3$  + Aq only when in great excess, easily by dil  $\text{H}_2\text{SO}_4$  + Aq, but not by conc HCl + Aq.  $\text{NH}_4\text{OH}$  + Aq in large excess causes coagulation, also  $\text{NH}_4\text{Cl}$ , NaOH, NaCl, Na<sub>2</sub>SO<sub>4</sub>, etc (Schneider, Z anorg 5 83)

*Parastannic acid*,  $\text{H Sn}_2\text{O}_{11} + 3\text{H}_2\text{O}$

(Engel, C R 1897, 125 711)

### Stannates

Stannates of alkali metals are sol in  $\text{H}_2\text{O}$ , others are insol. All metastannates, excepting Na, K, and  $\text{NH}_4$  salts, are insol in  $\text{H}_2\text{O}$  (Fremy, A ch (3) 12 474)

*Ammonium stannate*,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{SnO}_2$

Sol in H<sub>2</sub>O Insol in dil  $\text{NH}_4\text{OH}$  + Aq (Berzelius)

+ xH<sub>2</sub>O (Moberg, 1838)

*Ammonium cupric stannate*,  $(\text{NH}_4)_2\text{O}$ ,  $\text{CuSnO} + 2\text{H}_2\text{O}$

Insol in H<sub>2</sub>O Sol in acids (Ditte, C R 96 701)

*Barium stannate*,  $\text{BaSnO}_3 + 6\text{H}_2\text{O}$

Ppt Sol in HCl + Aq (Moberg)

$\text{Ba SnO}_4 + 10\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in acids (Ditte, C R 95 641)

*Calcium stannate*,  $\text{CaSnO}_3 + 4\text{H}_2\text{O}$

Ppt (Moberg)

+  $5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in acids (Ditte, C R 96 701)

$2\text{CaO}$ ,  $\text{SnO}_2$  (Zulkowski, Chem Ind 1901, 24 422)

*Cobaltous stannate*,  $\text{CoSnO}_3 + 6\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in acids (Ditte)

*Cupric stannate*,  $\text{CuSnO}_3 + 3\text{H}_2\text{O}$

(Moberg)

+  $4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Ditte)

*Cuprous stannous stannate*,  $\text{Cu}_2\text{O}$ ,  $3\text{SnO}$ ,  $\text{SnO}_2 + 5\text{H}_2\text{O}$

Slowly decomp by dil acids, and  $\text{NH}_4\text{OH}$  + Aq, completely decomp by conc acids (Lenssen, J pr 79 90)

*Gold (aurous) stannate*

See Gold purple

*Lead stannate*,  $\text{RbSn}(\text{OH})_6$

Ppt (Bellucci, Chem Soc 1905, 98 (2) 40)

*Lithium stannate hexatungstate*,  $2\text{Li}_2\text{O}$ ,  $\text{SnO}_2$ ,  $6\text{WO}_3 = \text{Li}_2\text{SnO}_3$ ,  $\text{Li}_2\text{W}_6\text{O}_{18}$

Insol in  $\text{H}_2\text{O}$  (Knorre, J pr (2) 27 49)

*Magnesium stannate*

Ppt (Moberg)

*Manganous stannate*

Ppt (Moberg)

*Mercurous stannate*,  $\text{Hg}_2\text{SnO}_3 + 5\text{H}_2\text{O}$

Ppt

*Mercuric stannate*,  $\text{HgSnO}_3 + 6\text{H}_2\text{O}$

Ppt (Moberg, J pr 28 231)

*Nickel stannate*,  $\text{NiSnO}_3 + 5\text{H}_2\text{O}$

Insol in H<sub>2</sub>O Sol in acids (Ditte, C R 96 701)

*Platinous sodium stannous stannate*,  $2\text{PtO}$ ,  $\text{Na}_2\text{O}$ ,  $\text{SnO}$ ,  $\text{SnO}_2$  (?)

(Schneider, Pogg 136 105)

*Platinous stannous stannate*,  $\text{PtO}$ ,  $2\text{SnO}$ ,  $\text{SnO}_2$

Decomp by conc alkalies (Schneider, Pogg 136 105)

*Potassium stannate*,  $\text{K}_2\text{SnO}_3 + 3\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve 106.6 pts at 10°, solution has sp gr = 1.618, 100 pts dissolve 110.5 pts at 20°, solution has sp gr = 1.627 (Ordway, Sill Am J (2) 40 173)

Very sl sol in conc KOH + Aq  
 Insol in KCl + Aq (Fremy)  
 Insol in alcohol  
 Pptd from aqueous solution by the addition of any soluble salt, especially those of K, Na, and  $\text{NH}_4$  (Fremy), by  $\text{NH}_4\text{Cl}$ , but not by KCl or NaCl (Ordway)  
 Insol in acetone (Naumann, B 1904, 37 329)

**Potassium metastannate,  $\text{K}_2\text{O}, 10\text{SnO}_2$**

$\text{K}_2\text{O}, 7\text{SnO}_2 + 3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Solution gelatinises on heating (Rose)  
 $\text{K}_2\text{O}, 6\text{SnO}_2 + 5\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , but loses its solubility by drying (Fremy, A ch (3) 12 475)  
 $\text{K}_2\text{O}, 5\text{SnO}_2 + 4\text{H}_2\text{O}$  Completely sol in  $\text{H}_2\text{O}$  Insol in alcohol (Fremy, A ch (3) 23 396)  
 $\text{K}_2\text{O}, 3\text{SnO}_2 + 3\text{H}_2\text{O}$  Deliquescent (Fremy)

**Silver stannate,  $\text{Ag}_2\text{SnO}_3$**

Insol in  $\text{H}_2\text{O}$  Unacted upon by  $\text{NH}_4\text{OH}$  or  $\text{HCl}$  + Aq (Ditte)

**Silver (argentous) stannous stannate (?),  $\text{Ag}_2\text{O}, \text{SnO}, 3\text{SnO}_2 + 3\text{H}_2\text{O}$  (?)**

Cold dil  $\text{HNO}_3$  + Aq slowly dissolves all Ag, hot  $\text{HNO}_3$  + Aq rapidly  
 Easily sol in boiling conc  $\text{H}_2\text{SO}_4$  (Schulze, J B 1857 257)

**Sodium stannate,  $\text{Na}_2\text{SnO}_3 + 3\text{H}_2\text{O}$**

More easily sol in cold than in hot  $\text{H}_2\text{O}$  (Fremy)  
 Sol in 2 pts  $\text{H}_2\text{O}$  at  $20^\circ$  and  $100^\circ$  (Magnac)  
 100 pts  $\text{H}_2\text{O}$  dissolve 67.4 pts at  $0^\circ$ , 61.3 pts at  $20^\circ$ , and solutions have sp gr = 1.472 and 1.438 at  $15.5^\circ$  (Ordway, Sill Am J (2) 40 173)

Pptd from  $\text{Na}_2\text{SnO}_3$  + Aq by salts of K, Na, and  $\text{NH}_4$

Insol in acetone (Naumann, B 1904, 37 4329)

+  $4\text{H}_2\text{O}$  (Prandtl, B 1907, 40 2129)  
 +  $8\text{H}_2\text{O}$  (Haefely, J B 1857 650)  
 +  $9\text{H}_2\text{O}$  (Jones, C C 1865 607)  
 +  $10\text{H}_2\text{O}$  Very efflorescent (Schuren-Kestner, Bull Soc (2) 8 389)

**Sodium metastannate,  $\text{Na}_2\text{O}, 9\text{SnO}_2 + 8\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  Insol in  $\text{NaOH}$  + Aq or alcohol (Barfoed, J B 1867 267)

$\text{Na}_2\text{O}, 5\text{SnO}_2$  Very difficultly sol in  $\text{H}_2\text{O}$  (Fremy, A ch (3) 23 399)

Insol in  $\text{KOH}$  + Aq  
 +  $8\text{H}_2\text{O}$  (Haefely, Chem Gaz 1855 59)

**Sodium stannate vanadate,**

$\text{Na}_2\text{SnO}_3, 3\text{Na}_2\text{VO}_4 + 32\text{H}_2\text{O}$   
 $\text{Na}_2\text{SnO}_3, 4\text{Na}_2\text{VO}_4 + 48\text{H}_2\text{O}$   
 $\text{Na}_2\text{SnO}_3, 5\text{Na}_2\text{VO}_4 + 64\text{H}_2\text{O}$   
 $\text{Na}_2\text{SnO}_3, 6\text{Na}_2\text{VO}_4 + 80\text{H}_2\text{O}$  (Prandtl, B 1907, 40 2123)

**Strontium stannate,  $3\text{SrO}, 2\text{SnO}_2 + 10\text{H}_2\text{O}$**

Ppt Insol in  $\text{H}_2\text{O}$  Sol in acids (Ditte, C R 95 641)

$\text{SrSn}(\text{OH})_6$  (Belluci, Chem Soc 1905, 88 (2) 40)

**Tin (stannous) stannate,  $\text{SnO}, 6\text{SnO}_2 + 5\text{H}_2\text{O}$**

Insol in  $\text{H}_2\text{O}$  Decomp by  $\text{HNO}_3$  + Aq into metastannic acid (Schiff, A 120 53)

Sol in  $\text{HCl}$  + Aq, and in  $\text{KOH}$  + Aq

**Tin (stannous) metastannate,  $\text{SnO}, 7\text{SnO}_2$**

$\text{SnO}, 6\text{SnO}_2 + 9\text{H}_2\text{O}$  Sol in  $\text{KOH}$  + Aq or in  $\text{HCl}$  + Aq (Fremy)  
 +  $4\text{H}_2\text{O}$  (Schiff)

**Zinc stannate,  $\text{ZnSnO}_3 + 2\text{H}_2\text{O}$**

Ppt (Moberg, 1838)

$3\text{ZnO}, 2\text{SnO}_2 + 10\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in acids (Ditte)

**Perstannic acid,  $\text{H}_2\text{Sn}_2\text{O}_7$**

See Perstannic acid

**Stannophosphomolybdic acid**

**Ammonium stannophosphomolybdate,**

$3(\text{NH}_4)_2\text{O}, 4\text{SnO}_2, 3\text{P}_2\text{O}_5, 16\text{MoO}_3 + 28\text{H}_2\text{O}$

Quite insol even in boiling  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 7 392)

**Stannophosphotungstic acid**

**Ammonium stannophosphotungstate,**

$2(\text{NH}_4)_2\text{O}, 2\text{SnO}_2, \text{P}_2\text{O}_5, 22\text{WO}_3 + 15\text{H}_2\text{O}$

Precipitate Sl sol in boiling  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 7 319)

**Stannosulphuric acid**

See Sulphate, stannic

**Stibine**

See Hydrogen antimonide

**Strontium, Sr**

Decomp by  $\text{H}_2\text{O}$  with violence Dil  $\text{H}_2\text{SO}_4$ , and  $\text{HCl}$  + Aq decomp and dissolve, cold  $\text{H}_2\text{SO}_4$  attacks slowly Fuming  $\text{HNO}_3$  has scarcely any action even when boiling (Franz, J pr 107 253)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 829)

Sol in excess of liquid  $\text{NH}_3$  at  $-60^\circ$  forming  $\text{Sr}(\text{NH}_3)_6$  (Roederer, C R 1905, 140 1252)

**Strontium amalgam,  $\text{SrHg}_{1.0}$**

Stable below  $30^\circ$  Above  $30^\circ$  the composition of the amalgam varies Can be cryst from Hg at any temp below  $30^\circ$  (Kerp, Z anorg 1900, 25 68)

**Strontium amide,  $\text{Sr}(\text{NH}_2)_2$**

(Roederer, Bull Soc 1906, (3) 35 715)

**Strontium arsenide,  $\text{Sr}_3\text{As}_2$** 

Decomp by  $\text{H}_2\text{O}$  (Lebeau, C R 1899, 129 47)

**Strontium azoimide,  $\text{SrN}_3$** 

Hydroscopic

45 83 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $16^\circ$   
0 095 " " " " 100 " abs alcohol at  $16^\circ$

Insol in pure ether (Curtius, J pr 1898, (2) 58 287)

**Strontium boride,  $\text{SrB}_2$** 

Sol in fused oxidizing agents, not decomp by  $\text{H}_2\text{O}$ , insol in aq acids, sl sol in conc  $\text{H}_2\text{SO}_4$ , sol in dil and conc  $\text{HNO}_3$  (Moissan, C R 1897, 125 633)

**Strontium bromide,  $\text{SrBr}_2$ , and  $+6\text{H}_2\text{O}$** 

100 pts  $\text{H}_2\text{O}$  dissolve at

$0^\circ$  20° 38° 59° 83° 110°  
87 7 99 112 133 182 250 pts  $\text{SrBr}_2$

(Kremers, Pogg 103 65)

Sat  $\text{SrBr}_2 + \text{Aq}$  contains at

$-11^\circ$   $-1^\circ$   $+7^\circ$   $18^\circ$   
43 1 46 85 48 2 51 7%  $\text{SrBr}_2$ ,

20° 93° 97° 107°  
51 8 68 5 68 7 69 8%  $\text{SrBr}_2$

(Étard, A ch 1894, (7) 2 540)

Sp gr of  $\text{SrBr}_2 + 19.5^\circ$  containing

5 10 15 20 25 %  $\text{SrBr}_2$ ,  
1 046 1 094 1 146 1 204 1 266

30 35 40 45 50 %  $\text{SrBr}_2$   
1 332 1 41 1 492 1 59 1 694

(Kremers, Pogg 99 444, calculated by Gerlach, Z anal 8 285)

Somewhat sol in absolute alcohol (Lowig)

Solubility of anhydrous  $\text{SrBr}$  in alcohol is practically constant between  $0^\circ$  and  $40^\circ$ , 100 ccm of abs alcohol dissolving about 64.5 g of the anhydrous salt and forming a solution having a sp gr = 1.210 at  $0^\circ$  (Fonze-Diacon, Chem Soc 1895, 68 (2) 223)

Much more sol than  $\text{BaBr}_2$  in boiling amyl alcohol

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Difficultly sol in methyl acetate (Naumann, B 1909, 42 3790)

**Strontium stannic bromide**

See Bromostannate, strontium

**Strontium bromide ammonia,  $2\text{SrBr}_2 \cdot \text{NH}_3$** 

Sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 55 238)

**Strontium bromide hydrazine,  $\text{SrBr}_2 \cdot 3\text{N}_2\text{H}_4$** 

Very sol in  $\text{H}_2\text{O}$  (Franzen, Z anorg 1908, 60 290)

**Strontium bromofluoride,  $\text{SrF}_2 \cdot \text{SrBr}$** 

Decomp by  $\text{H}_2\text{O}$  (Defaqqz, A ch 1904, (8) 1 356)

**Strontium carbide,  $\text{SrC}_2$** 

Easily decomp by  $\text{H}_2\text{O}$  and dil acids (Moissan, Bull Soc 1894, (3) 11 1008)

**Strontium carbonyl,  $\text{Sr}(\text{CO})_2$** 

(Roederer, Bull Soc 1906, (3) 35 725)

**Strontium chloride,  $\text{SrCl}_2$ , and  $+6\text{H}_2\text{O}$** 

Deliquescent in moist air

Sol in 15 pts  $\text{H}_2\text{O}$  at  $15^\circ$  and 0.8 pt at boiling (Dumas) in 1996 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach)  
1 pt anhydrous  $\text{SrCl}_2$  is sol in 27 pts  $\text{H}_2\text{O}$  at  $0^\circ$   
2 1 pts at  $40^\circ$  in 18 pts at  $60^\circ$   
103 66) 1 pt at  $100^\circ$  (Kremers Pogg)

100 pts  $\text{H}_2\text{O}$  dissolve 106.2 pts  $\text{SrCl}_2 + 6\text{H}_2\text{O}$  at  $0^\circ$ , and 205.8 pts at  $40^\circ$  (Tilden, Chem Soc 45 409)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{SrCl}_2$	$t^\circ$	Pts $\text{SrCl}_2$	$t^\circ$	Pts $\text{SrCl}_2$
0	44 2	41	67 4	81	92 7
1	44 5	42	68 2	82	93 1
2	44 8	43	68 9	83	93 4
3	45 2	44	69 7	84	93 7
4	45 6	45	70 4	85	94 1
5	46 0	46	71 2	86	94 5
6	46 5	47	72 0	87	94 9
7	46 9	48	72 8	88	95 4
8	47 4	49	73 6	89	95 8
9	47 8	50	74 4	90	96 2
10	48 3	51	75 3	91	96 7
11	48 8	52	76 1	92	97 2
12	49 4	53	77 0	93	97 9
13	49 9	54	77 9	94	98 2
14	50 4	55	78 7	95	98 8
15	51 0	56	79 6	96	99 4
16	51 5	57	80 4	97	100 0
17	52 1	58	81 3	98	101 6
18	52 7	59	82 2	99	101 3
19	53 3	60	83 1	100	101 9
20	53 9	61	84 0	101	102 6
21	54 5	62	84 9	102	103 3
22	55 1	63	85 8	103	104 0
23	55 7	64	86 6	104	104 7
24	56 3	65	87 5	105	105 4
25	56 9	66	88 4	106	106 1
26	57 5	66 5	88 8	107	106 9
27	58 1	67	88 9	108	107 6
28	58 7	68	89 1	109	108 4
29	59 3	69	89 3	110	109 1
30	60 0	70	89 6	111	109 9
31	60 6	71	89 8	112	110 7
32	61 3	72	90 1	113	111 4
33	61 9	73	90 3	114	112 2
34	62 5	74	90 6	115	113 0
35	63 2	75	90 9	116	113 8
36	63 9	76	91 2	117	114 6
37	64 6	77	91 5	118	115 5
38	65 3	78	91 8	118 8	116 4
39	66 0	79	92 1		
40	66 7	80	92 4		

(Mulder, Scheik Verhandel 1864 118)

100 pts H<sub>2</sub>O dissolve 52.4 pts SrCl<sub>2</sub> at 18° (Gerardin)

Sat SrCl + Aq contains % SrCl at t°

t°	% SrCl	t°	% SrCl <sub>2</sub>
-17	26.5	75	46.5
-11	28.6	80	47.1
-5	29.3	92	47.5
-1	30.8	98	49.6
+2	31.3	104	50.7
7	31.7	105	50.7
18	33.7	118	52.0
21.5	34.7	132	52.5
35	37.8	144	54.7
44.5	39.8	153	55.7
54	42.8	175	60.5
55	43.8	215	64.1
59	47.7	222	65.4
64	46.4	250	67.3
70	46.1		

(Étard, A ch 1894, (7) 2 535)

SrCl<sub>2</sub> + Aq sat at 8° has sp gr = 1.379 (Anthon A 24 211)

Sp gr of SrCl<sub>2</sub> + Aq

Pts SrCl <sub>2</sub> to 100 pts H <sub>2</sub> O	Sp gr	Pts SrCl <sub>2</sub> to 100 pts H <sub>2</sub> O	Sp gr
9.81	1.0823	41.04	1.3114
20.12	1.1632	51.69	1.3516
30.57	1.2401		

(Kremers, Pogg 99 444)

Sp gr of SrCl<sub>2</sub> + Aq at 15°

% SrCl <sub>2</sub>	Sp gr	% SrCl	Sp gr
5	1.0453	25	1.2580
10	1.0929	30	1.3220
15	1.1439	33	1.3633
20	1.1989		

(Gerlach, Z anal 8 283)

Sp gr of SrCl + Aq at 24.7° a=no of molecules in grms dissolved in 1,000 g

H<sub>2</sub>O, b=sp gr when a=SrCl<sub>2</sub>+6H<sub>2</sub>O, 1/2 mol SrCl<sub>2</sub>+6H<sub>2</sub>O=133.5 g, c=sp gr when a=SrCl<sub>2</sub>, 1/2 mol =79.5 g

a	b	c	a	b	c
1	1.063	1.067	7	1.304	1.401
2	1.118	1.130	8	1.330	
3	1.166	1.190	9	1.354	
4	1.207	1.247	10	1.376	
5	1.243	1.301	11	1.396	
6	1.275	1.352			

(Favre and Valsen, C R 79 968)

Sp gr of SrCl<sub>2</sub> + Aq at 18°

% SrCl	Sp gr	% SrCl	Sp gr
5	1.0443	20	1.2023
10	1.0932	22	1.2259
15	1.1456		

(Kohlrausch, W Ann 1879 1)

Sp gr of SrCl<sub>2</sub> + Aq at 0° S=pts SrCl<sub>2</sub> in 100 pts solution

S	Sp gr	S	Sp gr
31.8193	1.3609	18.2629	1.1915
27.7170	1.3086	12.9997	1.1284
23.2300	1.2515	6.7243	1.0637

(Charpy, A ch (6) 29 24)

Sat SrCl<sub>2</sub> + Aq boils at 114° (Kremers), 118.8° (Mulder), 117.45°, and contains 117.5 pts SrCl<sub>2</sub> to 100 pts H<sub>2</sub>O (Legrand), forms a crust at 115.5°, and contains 120.7 pts SrCl<sub>2</sub> to 100 pts H<sub>2</sub>O, highest temp observed, 119° (Gerlach, Z anal 26 436)

B-pt of SrCl<sub>2</sub> + Aq containing pts SrCl<sub>2</sub> to 100 pts H<sub>2</sub>O G=according to Gerlach (Z anal 26 442), L=according to Legrand (A ch (2) 59 436)

B pt	G	I	B pt	G	L
101°	11	16.7	110°	71.4	68.9
102	20.5	25.2	111	76.5	74.1
103	28.9	32.1	112	81.6	79.6
104	36.2	37.9	113	87	85.3
105	43.2	43.4	114	93.1	91.2
106	49.6	48.8	115	99.5	97.5
107	55.4	54.0	116	105.9	104.0
108	60.8	59.0	117	112.3	110.9
109	66.2	63.9	117.5		

Melts in its crystal H<sub>2</sub>O at 112° (Tilden, Chem Soc 45 409)

Sp gr of SrCl + Aq at 25°

Concentration of SrCl + Aq	Sp gr
1-normal	1.0676
1/2- "	1.0336
1/4- "	1.0171
1/8- "	1.0084

(Wagner, Z phys Ch 1890, 5 40)

SrCl<sub>2</sub> + Aq containing 3.24% SrCl<sub>2</sub> has sp gr 20°/20°=1.0284

SrCl<sub>2</sub> + Aq containing 7.08% SrCl<sub>2</sub> has sp gr 20°/20°=1.0638

(Le Blanc and Rohland, Z phys Ch 1896, 19 279)

Sp gr of $\text{SrCl}_2 + \text{Aq}$ at $20^\circ$	
g mols $\text{SrCl}_2$ per l	Sp gr
0 01	1 0012284
0 02937	1 0038396
0 03987	1 0053832
0 05017	1 007028
0 07077	1 009560
0 10	1 013205
0 25	1 034433
0 50	1 068379
0 75	1 101760
1 00	1 135423

(Jones and Pearce, Am Ch J 1907, 38 697)

Conc  $\text{HCl} + \text{Aq}$  ppts part of the  $\text{SrCl}_2$  from  $\text{SrCl}_2 + \text{Aq}$  (Hope)

Solubility of  $\text{SrCl}_2$  in  $\text{HCl} + \text{Aq}$  at  $0^\circ$   $\text{SrCl}_2 = \frac{1}{2}$  mols  $\text{SrCl}_2$  (in milligrammes) dissolved in 10 ccm of liquid,  $\text{HCl} =$  mols  $\text{HCl}$  (in milligrammes) dissolved in 10 ccm of liquid

$\text{SrCl}_2$	$\text{HCl}$	Sum of mols	Sp gr
55	0	55 0	1 334
48 2	6 1	54 3	1 3045
41 25	12 75	54 00	1 2695
30 6	23 3	53 9	1 220

(Engel, Bull Soc (2) 45 655)

Solubility of  $\text{SrCl}_2$  in  $\text{HCl} + \text{Aq}$  at  $0^\circ$

Mg mols per 10 cc solution		Sp gr of solution	G per 100 cc solution	
$\frac{\text{SrCl}_2}{2}$	$\text{HCl}$		$\text{SrCl}_2$	$\text{HCl}$
51 6	0	1 334	40 9	0 0
44 8	6 1	1 304	35 5	2 22
37 85	12 75	1 269	30 0	4 65
27 2	23 3	1 220	21 56	8 49
22 0	28 38	1 201	17 44	10 35
14 0	37 25	1 167	11 09	13 58
4 25	52 75	1 133	3 37	19 23

(Engel A ch 188b, (6) 13 376)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Sol in 6 pts alcohol of 0.83 sp gr at 1 (Vauquelin)

Sol in 24 pt absolute alcohol at 1, and in 19 pts at boiling (Bucholz) Sol in 20 pts of boiling alcohol

Anhydrous  $\text{SrCl}_2$  is sol in 111.6–116.4 pts alcohol of 99.3% at  $14.5^\circ$ , and in 26.2 pts of the same alcohol at boiling (Fresenius, A 59 127)

100 pts alcohol of given sp gr at  $0^\circ$  dissolve pts  $\text{SrCl}_2$  at  $18^\circ$

0 990	0 985	0 973	0 966	0 953 sp gr
49 81	47 0	39 6	35 9	30 4 pts $\text{SrCl}_2$
0 939	0 909	0 846	0 832 sp gr	
26 8	19 2	4 9	3 2 pts $\text{SrCl}_2$	

Insol in absolute alcohol (Gerardin, A ch (4) 5 156)

100 pts absolute methyl alcohol dissolve 63.3 pts  $\text{SrCl}_2 + 6\text{H}_2\text{O}$  at  $6^\circ$ , ethyl alcohol, 3.8 pts (de Bruyn, Z phys Ch 10 787)

Sl sol in boiling amyl alcohol (Browning, Sill Am J 144 459)

100 g 95% formic acid dissolve 23.8 g  $\text{SrCl}_2$  at room temp (Aschan, Ch Ztg 1913, 37 1117)

Absolutely insol in acetic ether (Cann, C R 102 363)

Very sl sol in acetone (Krug and M'Elroy)

Sol in acetone (Eidmann, C C 1899, II 1014)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Sl sol in anhydrous pyridine Sol in 97%, 95% and 93% pyridine +  $\text{Aq}$  (Kahlenberg, J Am Chem Soc 1908, 30 1107)

+  $2\text{H}_2\text{O}$  Tr pt from +  $6\text{H}_2\text{O}$  is  $61.5^\circ$  (Richards and Churchill, Z phys Ch 1899, 28 313)

+  $6\text{H}_2\text{O}$  See above

Strontium thallic chloride,  $\text{SrCl}_2, 2\text{TlCl}_3 + 6\text{H}_2\text{O}$

(Gewecke, A 1909, 366 223)

Strontium tin (stannous) chloride,  $\text{SrCl}_2, \text{SnCl}_2 + 4\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Poggiale, C R 20 1183)

Strontium tin (stannic) chloride

See Chlorostannate, strontium

Strontium uranium chloride,  $\text{SrCl}_2, \text{UCl}_4$

Decomp by  $\text{H}_2\text{O}$  (Aloy, Bull Soc 1899, (3) 21 265)

Strontium zinc chloride,  $\text{SrZnCl}_4 + 4\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Ephram, Z anorg 1910, 67 380)

Strontium chloride ammonia,  $\text{SrCl}_2, 8\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  (Rose, Pogg 20 155)

Strontium chloride hydrazine,  $\text{SrCl}_2, 2\text{N}_2\text{H}_4 + \text{H}_2\text{O}$

Hydroscopic (Franzen, Z anorg 1908, 60 289)

Strontium chloride hydroxylamine,  $2\text{SrCl}_2, 5\text{NH}_2\text{OH} + 2\text{H}_2\text{O}$

As Ca comp (Antonow, J Russ Phys Chem Soc 1905, 37 482)

Strontium hydrogen chloride hydroxylamine,  $2\text{SrCl}_2, 3\text{HCl}, 9\text{NH}_2\text{OH} + \text{H}_2\text{O}$

(Antonow, J Russ Phys Chem Soc 1905, 37 482)

Strontium chlorofluoride,  $\text{SrF}_2, \text{SrCl}_2$

Decomp by  $\text{H}_2\text{O}$ , by very dil  $\text{HCl}$ ,  $\text{HNO}_3$  or acetic acid, by hot dil or conc  $\text{H}_2\text{SO}_4$

Sol in conc HCl or HNO<sub>3</sub> Insol in, and not decomp by cold or boiling alcohol (Defacqz, A ch 1904, (8) 1 355)

### Strontium fluoride, SrF<sub>2</sub>

Somewhat sol in H<sub>2</sub>O (Fr Roder)  
1 l H<sub>2</sub>O dissolves 113.5 mg SrF<sub>2</sub> at 0.26°,  
117.3 mg at 17.4°, 119.3 mg at 27.4°  
(Kohlrausch, Z phys Ch 1908, 64 168)  
Insol in HF+Aq (Berzelius)  
Boiling HCl+Aq dissolves, sl attacked by boiling HNO<sub>3</sub>+Aq, decomp by hot H<sub>2</sub>SO<sub>4</sub> (Poulenc, C R 116 987)

### Strontium stannic fluoride

See Fluostannate, strontium

### Strontium titanium fluoride

See Fluotitanate, strontium

### Strontium fluoriodide, SrF, SrI<sub>2</sub>

Decomp by cold H<sub>2</sub>O, more rapidly by hot H<sub>2</sub>O. Decomp by dil HCl, dil HNO<sub>3</sub>, dil H<sub>2</sub>SO<sub>4</sub> or conc H<sub>2</sub>SO<sub>4</sub>, also by alcohol and by ether, if not absolute (Defacqz, A ch 1904, (8) 1 358)

### Strontium hydride, SrH

Decomp by H<sub>2</sub>O or HCl+Aq (Winkler, B 24 1976)

SrH<sub>2</sub> Decomp by H<sub>2</sub>O (Gautier, C R 1902, 134 100)

### Strontium hydroselenide

Sol in H<sub>2</sub>O

### Strontium hydrosulphide, SrS<sub>2</sub>H<sub>2</sub>

Sol in H<sub>2</sub>O, decomp by boiling

### Strontium hydroxide, SrO<sub>2</sub>H<sub>2</sub>, and +8H<sub>2</sub>O

Deliquescent

Sol in 50 pts cold and 2.4 pts boiling H<sub>2</sub>O (Bu cholz) in 50 pts H<sub>2</sub>O at 15.56° (Dalton) in 51.4 pts H<sub>2</sub>O at 15.56° and 2 pts at 17.7°  
at 15° and 2.4 pts at 100°  
at 18.7° (Abl)  
100 pts H<sub>2</sub>O at 20° dissolve 1.49 pts SrO (Bineau C R 41 509)

100 pts aqueous solution of SrO<sub>2</sub>H<sub>2</sub> contain pts SrO and pts SrO<sub>2</sub>H<sub>2</sub>+8H<sub>2</sub>O at t°

t°	Pts SrO	Pts SrO <sub>2</sub> H <sub>2</sub> +8H <sub>2</sub> O	t°	Pts SrO	Pts SrO <sub>2</sub> H <sub>2</sub> +8H <sub>2</sub> O
0	0.35	0.90	55	2.54	6.52
5	0.41	1.05	60	3.03	7.77
10	0.48	1.23	65	3.62	9.29
15	0.57	1.46	70	4.35	11.16
20	0.68	1.74	75	5.30	13.60
25	0.82	2.10	80	6.56	16.83
30	1.00	2.57	85	9.00	23.09
35	1.22	3.13	90	12.00	30.78
40	1.48	3.80	95	15.15	38.86
45	1.78	4.57	100	18.60	47.71
50	2.13	5.46			

(Scheibler, J pharm Chim 1883, (5) 8 540)

Sol in cold NH<sub>4</sub>Cl+Aq (Rose)

### Solubility in Sr(NO<sub>3</sub>)<sub>2</sub>+Aq at 25°

Sp gr 25°/25°	G SrO as Sr(OH) in 100 g H <sub>2</sub> O	G Sr(NO <sub>3</sub> ) <sub>2</sub> in 100 g H <sub>2</sub> O
1.481	0.0	79.27
*1.506	1.76	81.06
1.490	1.71	74.27
1.450	1.55	66.88
1.419	1.51	63.71
1.403	1.47	60.37
1.381	1.41	56.30
1.359	1.34	52.90
1.327	1.27	46.97
1.317	1.20	44.03
1.291	1.14	40.83
1.267	1.11	37.81
1.239	1.03	32.41
1.217	1.01	28.80
1.206	0.96	26.58
1.178	0.95	23.83
1.148	0.91	17.96
1.126	0.87	16.21
1.108	0.84	12.78
1.079	0.81	8.96
1.059	0.79	6.29
1.033	0.78	4.45

\*Solution is sat with respect to both substances

(Parsons and Perkins, J Am Chem Soc 1910, 32 1388)

Sol in methyl alcohol At room temp 1 l contains 31.5 g SrO (Neuberg and Rewald, Biochem Z 1908, 9 540)

Insol in acetone (Eidmann, C C 1899, II 1014)

Sol in an aqueous solution of cane sugar (Hunton, Phil Mag (3) 11 156)

### Solubility in H<sub>2</sub>O containing 10 g sugar at t°

t°	g SrO H+8H <sub>2</sub> O	t	g SrO <sub>2</sub> H <sub>2</sub> +8H <sub>2</sub> O
3	3.10	24	4.79
15	3.79	40	9.70

(Sidersky C C 1886 57)

+8H<sub>2</sub>O 0.0835 mol is sol in 1 l H<sub>2</sub>O at 25° (Rothmund, Z phys Ch 1909, 69 539)

### Solubility in organic compds +Aq at 25°

Solvent	Mol SrO H+8H <sub>2</sub> O sol in litre
water	0.0835
0.5-N methyl alcohol	0.0820
ethyl alcohol	0.0744
propyl alcohol	0.0708
tert amyl alcohol	0.0630
acetone	0.0692
ether	0.0645



Solubility in organic compds +Aq at 25° —  
*Continued*

Solvent	Mol $\text{SrO}_2\text{H}_2 + 8\text{H}_2\text{O}$ sol id 1 litre
0 5-N glycol	0 0922
" glycerine	0 1094
" mannitol	0 1996
" urea	0 0820
" ammonia	0 0785
" diethyl amine	0 0586
" pyridine	0 0694

(Rothmund, Z phys Ch 1909, 69 539)

Insol in acetone (Naumann, B 1904, 37 4329)

*See also Strontium oxide*

**Strontium iodide,  $\text{SrI}_2$ , and +6, or  $7\text{H}_2\text{O}$**

100 pts  $\text{H}_2\text{O}$  dissolve at

0° 20° 40° 70° 100°

164 179 196 250 370 pts  $\text{SrI}_2$

(Kremers, Pogg 103 65)

Sat aq solution contains at

—20° —10° —3° +7° 11° 18° 38°

60 0 60 3 62 2 63 0 63 4 63 5 64 8%  $\text{SrI}_2$ ,

52° 63° 77° 81° 97° 105° 120 175°

66 0 68 5 70 5 74 0 79 2 79 4 80 8 85 6%  $\text{SrI}_2$

(Étard, A ch 1894, (7) 2 543)

Sp gr of  $\text{SrI}_2 + \text{Aq}$  at 19.5° containing

5 10 20 30 %  $\text{SrI}_2$ ,

1 045 1 091 1 200 1 330

40 50 60 65 %  $\text{SrI}_2$

1 491 1 695 1 955 2 150

(Kremers, Pogg 103 67, calculated by  
Gerlach, Z anal 8 285)

Sat solution in abs ethyl alcohol contains  
at

—20° +4° 39° 82°

2 6 3 1 4 3 4 7%  $\text{SrI}_2$

(Étard, A ch 1894, (7) 2 565)

**Strontium periodide,  $\text{SrI}_3 + 15\text{H}_2\text{O}$**

(Mosnier, A ch 1897, (7) 12 399)

**$\text{SrI}_4$**  (Herz and Bulla, Z anorg 1911, 71 255)

**Strontium stannous iodide**

Very sol in  $\text{H}_2\text{O}$  (Boullay)

**Strontium zinc iodide,  $\text{SrZnI}_4 + 9\text{H}_2\text{O}$**

Hydroscopic (Ephraim, Z anorg 1910, 67 385)

**Strontium nitride,  $\text{Sr}_3\text{N}_2$**

Decomp  $\text{H}_2\text{O}$  violently, but not alcohol  
(Maquenne, A ch (6) 29 225)

**Strontium oxide,  $\text{SrO}$**

Decomp by  $\text{H}_2\text{O}$  to  $\text{SrO}_2\text{H}_2$ , which see

Sol in 160 pts  $\text{H}_2\text{O}$  at 15.56° (Dalton) in 50 pts at 100° (Dalton) in 130 pts at 20° (Bineau) in 40 pts cold and 20 pts hot  $\text{H}_2\text{O}$  (Dumas)

Very sl sol in alcohol Insol in ether

1 l methyl alcohol dissolves 11.2 g  $\text{SrO}$   
(Neuberg and Rewald, Biochem Z 1908, 9 540)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

Sol in cane sugar +Aq

Solubility in  $\text{H}_2\text{O}$  containing 10 g sugar at t°

t°	g $\text{SrO}$	t°	g $\text{SrO}$
8	1 21	24	1 87
15	1 48	40	3 55

(Sidersky, C C 1886 57)

*See also Strontium hydroxide*

**Strontium peroxide,  $\text{SrO}_2$**

Sl sol in  $\text{H}_2\text{O}$  Easily sol in acids and  $\text{NH}_4\text{Cl} + \text{Aq}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Conroy, Chem Soc (2) 11 812)

Insol in acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

**Strontium oxybromide,  $\text{SrBr}_2, \text{SrO} + 9\text{H}_2\text{O}$**

Not hygroscopic, sol in  $\text{H}_2\text{O}$  (Tassilly C R 1895, 120 1339)

**Strontium oxychloride,  $\text{SrCl}_2, \text{SrO} + 9\text{H}_2\text{O}$**

Very easily decomp by  $\text{H}_2\text{O}$  and alcohol  
(André, A ch (6) 3 76)

**Strontium oxyiodide,  $2\text{SrI}_2, 5\text{SrO} + 30\text{H}_2\text{O}$**

Not hygroscopic, sol in  $\text{H}_2\text{O}$  (Tassilly, C R 1895, 120 1339)

**Strontium oxysulphide,  $\text{Sr}_2\text{OS}_4 + 12\text{H}_2\text{O}$**

Decomp by  $\text{H}_2\text{O}$

Insol in alcohol, ether, and  $\text{CS}_2$  (Schöne Mixture of  $\text{SrS O}_3$  and  $\text{SrS}$ , (Geuther, A 224 178)

**Strontium phosphide,  $\text{Sr}_3\text{P}_2$**

*Crystallized* Sol in dil acids, insol in conc acids, decomp by  $\text{H}_2\text{O}$  Insol in organic solvents at ord temp (Jaboin, C R 1899, 129 764)

**Strontium selenide,  $\text{SrSe}$**

Sl sol in  $\text{H}_2\text{O}$  (Fabre, C R 102 1469)

**Strontium silicide,  $\text{SrSi}_2$**

Decomp by  $\text{H}_2\text{O}$  (Bradley, C N 1900, 82 150)

**Strontium sulphide, SrS**

Sol in  $H_2O$  with decomp into  $SrO_2H_2$  and  $SrS_2H_2$   
 Insol in acetone (Eldmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)  
 Insol in methyl acetate (Naumann, B 1909, 42 3790)

**Strontium tetrasulphide,  $SrS_4$** 

Very deliquescent, and sol in  $H_2O$  and alcohol Aqueous solution decomp on air  
 Cryst with 2, or  $6H_2O$  (Schone, Pogg 117 58)

**Strontium pentasulphide,  $SrS_5$** 

Known only in solution

**Strontium stannic sulphide**

See Sulphostannate, strontium

**Sulphalummic acid****Silver sulphaluminate,  $4Ag_2S, 5Al_2S$** 

(Camb, Real Ac Linc 1912, (5) 21, II 837)

**Sulphamic acid,  $HOSO_2NH_2$** 

See Amidosulphonic acid

**Ammonium sulphamate,  $2NH_3, SO_3$** 

(Woronin)  
 Is ammonium imidosulphonate, which see (Berglund)

**Ammonium sulphamate, acid,  $3NH_3, 2SO_3$** 

(Woronin)  
 Is basic ammonium imidosulphonate, which see (Berglund)

**Barium sulphamate, basic,  $2BaO, 3SO_3, 2NH_3$** 

Somewhat sol in  $H_2O$  easily in  $HCl + Aq$  (Jacquelin, Arch (3) 8 304)  
 $BaSO_6(NH_3)_2$  Sl sol in  $H_2O$  Decomp by heating with  $H_2O$  (Woronin, J B 1860 50)  
 Is barium imidosulphonate (Berglund)

**Sulphamide,  $SO(NH_2)_2$** 

Very sol in  $H_2O$  (Regnault, Arch 69 170, Mente, A 248 267)  
 Insol in alcohol, ether, etc (Traube, B 26 607)  
 Very sol in  $H_2O$   
 Sl sol in abs alcohol  
 Sl sol in dry ether (Divers and Ogawa, Chem Soc 1902, 81 504)  
 Very sol in liquid  $NH_3$  (Franklin and Stafford, Am Ch J 1902, 28 95)  
 Sol in alcohol, very sol in  $H_2O$  (Hantzsch, B 1901, 34 3436)

**Silver sulphamide,  $SO_2(NHAg)_2$** 

Sl sol in cold  $H_2O$  Sol in  $HNO_3$ , and  $(NH_4)_2CO_3 + Aq$  (Traube, B 26 607)  
 $3NH_3, 2SO_3$  (Jacquelin)  
 Is basic ammonium imidosulphonate, which see (Berglund)

**Sulphamidic acid**

(Fremy)

See Imidosulphonic acid

**Sulphaminoplatinous acid****Ammonium tetrasulphaminoplatinite,**

$[Pt(SO_3NH_2)_4](NH_4)_2 + 6H_2O$   
 Sl sol in cold  $H_2O$  (Ramberg, B 1912, 45 1512)

**Potassium —,  $[Pt(SO_3NH_2)_4]K_2 + 2H_2O$** 

Very sl sol in cold  $H_2O$  (Ramberg)

**Sodium —**

Easily sol in cold  $H_2O$  (Ramberg)

**Sulphammonic, and Metasulphammonic acids**

(Fremy)

See Nitrosulphonic acid

**Monosulphammonic acid**

(Claus)

See Amidosulphonic acid

**Disulphammonic acid**

(Claus)

See Imidosulphonic acid

**Trisulphammonic acid**

(Claus)

See Nitrosulphonic acid

**Tetrasulphammonic acid**

(Claus)

Does not exist See Nitrosulphonic acid

**Sulphammonium,  $S(NH_3)_2, 2NH_3$** 

Sol in liquid  $NH_3$   
 Sol in abs alcohol and anhydrous ether (Moissan, C R 1901, 132 517)

**Sulphantimonic acid****Sulphantimonates**

The alkali sulphantimonates are sol in  $H_2O$ , but the solutions decomp on the air, most of the other sulphantimonates are insol in  $H_2O$ , all sulphantimonates are insol in alcohol (Rammelsberg)

**Ammonium sulphantimonate,  $(\text{NH}_4)_3\text{SbS}_4$** 

Sol in  $\text{H}_2\text{O}$   
 Sol in dil acids with decomp (Stanek,  
 Z anorg 1898, 17 122)  
 $+4\text{H}_2\text{O}$  (Stanek)

Solubility of  $(\text{NH}_4)_3\text{SbS}_4 + 4\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	$\% (\text{NH}_4)_3\text{SbS}_4$	Solid phase
-19	9.9	Ice
-5	20.0	"
-8	30.2	"
-13.5	41.6	Ice + $(\text{NH}_4)_3\text{SbS}_4 \cdot 4\text{H}_2\text{O}$
0	41.6	$(\text{NH}_4)_3\text{SbS}_4 \cdot 4\text{H}_2\text{O}$
+20	47.7	"
30	54.5	"

(Donk, Chem Weekbl, 1908, 5 529)

Solubility of  $(\text{NH}_4)_3\text{SbS}_4$  in alcohol at  $10^\circ$   
 Solid phase,  $(\text{NH}_4)_3\text{SbS}_4 + 4\text{H}_2\text{O}$

$\% \text{C}_2\text{H}_5\text{OH}$	$\% (\text{NH}_4)_3\text{SbS}_4$	$\% \text{C}_2\text{H}_5\text{OH}$	$\% (\text{NH}_4)_3\text{SbS}_4$
0	43.2	43.1	8.7
5.1	35.9	53.1	4.1
19.1	23.1	93.3	0

(Donk, l c)

**Antimonyl sulphantimonate,  $(\text{SbO})_3\text{SbS}_4$** 

Sol in  $\text{HCl}$  (Rammelsberg, Pogg 1841,  
 52 236)

**Barium sulphantimonate,  $\text{Ba}_3(\text{SbS}_4) + 3\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  Insol in alcohol

**Barium potassium sulphantimonate,**

$\text{KBaSbS}_4 + 6\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$   
 Decomp by acids (Glatzel, Z anorg  
 1911, 72 100)

**Bismuth sulphantimonate**

Ppt

**Cadmium sulphantimonate**

Ppt (Rammelsberg, Pogg 52 236)

**Calcium sulphantimonate,  $\text{Ca}_3(\text{SbS}_4)_2$** 

Partially sol in  $\text{H}_2\text{O}$  Insol in alcohol

**Cobaltous sulphantimonate,  $\text{Co}_3(\text{SbS}_4)_2$** 

Ppt Decomp by  $\text{HCl} + \text{Aq}$  (Rammels-  
 berg, Pogg 52 236)

**Cupric sulphantimonate,  $\text{Cu}_3(\text{SbS}_4)_2$** 

Ppt (Rammelsberg, Pogg 52 226)

**Iron (ferrous) sulphantimonate**

Ppt

**Iron (ferric) sulphantimonate,  $\text{Fe}_2(\text{SbS}_4)_3$** 

(Rammelsberg, Pogg 52 234)

**Lead sulphantimonate,  $\text{Pb}_3(\text{SbS}_4)_2$** 

Ppt Decomp by  $\text{KOH} + \text{Aq}$  (Rammels-  
 berg, Pogg 52 223)

**Lithium sulphantimonate,  $\text{Li}_3\text{SbS}_4 + 8\frac{1}{2}\text{H}_2\text{O}$** 

100 g sat solution in  $\text{H}_2\text{O}$  contain 50.8,  
 anhyd  $\text{Li}_3\text{SbS}_4$

Solubility in alcohol at  $30^\circ$

$\% \text{alcohol}$	$\% \text{Li}_3\text{SbS}_4$	Solid phase
0	50.8	$\text{Li}_3\text{SbS}_4 \cdot 8\frac{1}{2}\text{H}_2\text{O}$
13.3	46.3	"
51.9	30.7	"
54.8	29.9	"
58.4	30.8	$\text{Li}_3\text{SbS}_4 \cdot 8\frac{1}{2}\text{H}_2\text{O} + \text{Li}_2\text{Sb}_2\text{O}_7$
58.6	32.3	"
65.26	29.31	$\text{Li}_2\text{Sb}_2\text{O}_7$
74.3	24.1	"
79.5	20.5	"

(Schrenemakers and Jacobs, Ch Weekl  
 1910, 72 213)

$+9\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Brinkman  
 Dissert 1891)

$+10\text{H}_2\text{O}$  Solubility of  $\text{Li}_3\text{SbS}_4 + 10\text{H}_2\text{O}$   
 $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	$\% \text{Li}_3\text{SbS}_4$	Solid phase
-17	7.1	Ice
-3.2	12.8	"
-5.1	17.5	"
-10.8	23.2	"
-15.9	28.5	"
-26.2	35.3	"
-42	40.4	Ice + $\text{Li}_3\text{SbS}_4 \cdot 10\text{H}_2\text{O}$
0	45.5	$\text{Li}_3\text{SbS}_4 \cdot 10\text{H}_2\text{O}$
+10	46.9	"
30	50.1	"
50	51.3	"

(Donk, Chem Weekbl 1908, 5 629)

At  $10^\circ$ , 100 g sat  $\text{Li}_3\text{SbS}_4 + 10\text{H}_2\text{O}$  in 11  
 $\%$  alcohol contain 41.8 g  $\text{Li}_3\text{SbS}_4$ , 26.2  
 alcohol, 36.5 g  $\text{Li}_3\text{SbS}_4$  (Donk, l c)

**Magnesium sulphantimonate,  $\text{Mg}_3(\text{SbO})_2$** 

Deliquescent Sol in  $\text{H}_2\text{O}$  Decomp  
 alcohol

**Mercurous sulphantimonate,  $(\text{Hg}_2)_3(\text{SbS}_4)_2$** 

Ppt

**Mercuric sulphantimonate,  $\text{Hg}_2(\text{SbS}_4)_2$** 

Ppt (Rammelsberg, Pogg 52 229)

**Mercuric sulphantimonate chloride,**  
 $\text{Hg}_3(\text{SbS}_4)_2, 3\text{HgCl}_2, 3\text{HgO}$

Insol in acids, except aqua regia (Rammelsberg)

**Nickel sulphantimonate,  $\text{Ni}_3(\text{SbS}_4)_2$**

Ppt Decomp by hot  $\text{HCl} + \text{Aq}$  (Rammelsberg, Pogg 52 226)

**Potassium sulphantimonate,  $\text{K}_3\text{SbS}_4$**

Sol in  $\text{H}_2\text{O}$

Solubility of  $\text{K}_3\text{SbS}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	% $\text{K}_3\text{SbS}_4$	Solid phase
- 1 3	9 5	Ice
- 2 6	17 1	
- 4	24 2	
- 7 2	35 4	
- 10 6	42 9	
- 13 5	48 8	"
- 18 5	52 6	
- 28 8	59 6	
- 34	62	
- 10	65 5	
- 4 5	69 1	Ice + $\text{K}_3\text{SbS}_4, 6\text{H}_2\text{O}$
0	75 4	
+ 10	76 2	$\text{K}_3\text{SbS}_4, 6\text{H}_2\text{O}$
30	77 1	$\text{K}_3\text{SbS}_4, 5\text{H}_2\text{O}$
50	77 7	"
80	79 2	$\text{K}_3\text{SbS}_4, 3\text{H}_2\text{O}$

(Donk, Chem Weekbl 1908, 5 529, 629, 767)

Solubility of  $\text{K}_3\text{SbS}_4$  in  $\text{KOH} + \text{Aq}$  at  $25^\circ$

% $\text{K}_3\text{SbS}_4$	% $\text{KOH}$	Solid phase
75	0	$\text{K}_3\text{SbS}_4, 5\text{H}_2\text{O}$
68 4	3 4	
56 8	11 0	$\text{K}_3\text{SbS}_4, 3\text{H}_2\text{O}$
50 9	16 1	
37 7	25 5	$\text{K}_3\text{SbS}_4$
19 8	40 5	
11 5	46 9	$\text{K}_3\text{SbS}_4 + \text{KOH}, 2\text{H}_2\text{O}$
9 4	49 9	
00 0	56 3	$\text{KOH}, 2\text{H}_2\text{O}$

(Donk)

Solubility of  $\text{K}_3\text{SbS}_4$  in alcohol + Aq at  $10^\circ$

% $\text{C}_2\text{H}_5\text{OH}$	% $\text{K}_3\text{SbS}_4$	Solid phase
94	0	$\text{K}_3\text{SbS}_4, 5\text{H}_2\text{O}$
90 5	0	
0 8	69 2	"
0	76 1	

\* Two liquid layers are formed

Composition of the liquid layers

Alcohol layer		$\text{H}_2\text{O}$ layer	
% $\text{C}_2\text{H}_5\text{OH}$	% $\text{K}_3\text{SbS}_4$	% alcohol	% $\text{K}_3\text{SbS}_4$
85	0	1 1	67 4
54 7	2 2	3 4	49 0
46 9	4 2	3 8	45 6
16	27 4		
		31 1	12 7

(Donk, l c)

+  $4\frac{1}{2}\text{H}_2\text{O}$  Deliquescent Sol in  $\text{H}_2\text{O}$ , more sol than the Na salt

+ 3, 5, and  $6\text{H}_2\text{O}$  See Donk above

$2\text{K}_2\text{S}, \text{Sb}_2\text{S}_3$  Decomp by cold  $\text{H}_2\text{O}$  (Ditte, C R 102 168)

$\text{K}_2\text{S}, 2\text{Sb}_2\text{S}_3 + 3\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Ditte)

$\text{K}_2\text{S}, \text{Sb}_2\text{S}_3$  Decomp by  $\text{H}_2\text{O}$  (Ditte)

$\text{K}_2\text{S}, 2\text{Sb}_2\text{S}_3$  (Ditte)

**Silver sulphantimonate,  $\text{Ag}_3\text{SbS}_4$**

Insol in  $\text{H}_2\text{O}$  or acids Decomp by  $\text{KOH} + \text{Aq}$  (Rammelsberg, Pogg 52 218)

**Sodium sulphantimonate,  $\text{Na}_3\text{SbS}_4 + 9\text{H}_2\text{O}$**

(Schrippe's salt) Sol in 29 pts  $\text{H}_2\text{O}$  at  $15^\circ$  Aqueous solution is precipitated by alcohol (Rammelsberg)

Sol in 3 pts cold  $\text{H}_2\text{O}$  (van den Corput)

Sol in 4 pts cold  $\text{H}_2\text{O}$  (Duflos)

Sol in 1 pt boiling  $\text{H}_2\text{O}$  (Duflos)

Solubility of  $\text{Na}_3\text{SbS}_4 + 9\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$t$	% $\text{Na}_3\text{SbS}_4$	Solid phase
- 0 1	0 5	Ice
- 0 65	4	
- 0 9	5 7	
- 1 26	7 8	
- 1 45	9 2	
- 1 75	11 2	"
0	11 3	
15	19 3	
30	27 1	
38	32	
49 6	38 9	$\text{Na}_3\text{SbS}_4, 9\text{H}_2\text{O}$
59 6	45	
69 6	50 7	
79 5	57 1	

(Donk, Chem Weekbl 1908, 5 529, 629, 767)

Solubility of $\text{Na}_3\text{SbS}_4 + \text{Na}_2\text{S}_2\text{O}_3$ in $\text{H}_2\text{O}$		
$\% \text{Na}_3\text{SbS}_4$	$\% \text{Na}_2\text{S}_2\text{O}_3$	Solid phase
$t^\circ = 10^\circ$		
11 8	0	$\text{Na}_3\text{SbS}_4 \cdot 9\text{H}_2\text{O}$
4 4	4 9	"
0 8	14 6	"
0 1	27 3	"
0 0	33 6	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
$t^\circ = 30^\circ$		
19 9	7 7	$\text{Na}_3\text{SbS}_4 \cdot 9\text{H}_2\text{O}$
12 5	16 4	"
4 2	37 7	"
1	43 8	"
1	47	"
1	47 8	$\text{Na}_3\text{SbS}_4 + \text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
0	45 8	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$

(Donk, l c)

Solubility of  $\text{Na}_3\text{SbS}_4$  in alcohol + Aq at  $t^\circ$   
Solid phase,  $\text{Na}_3\text{SbS}_4 + 9\text{H}_2\text{O}$

$t = 0$		$t = 30^\circ$		$t = 65$	
$\% \text{C}_2\text{H}_5\text{OH}$	$\% \text{Na}_3\text{SbS}_4$	$\% \text{C}_2\text{H}_5\text{OH}$	$\% \text{Na}_3\text{SbS}_4$	$\% \text{C}_2\text{H}_5\text{OH}$	$\% \text{Na}_3\text{SbS}_4$
0	11 8	5	19 3	0	47 9
3 7	8 2	10 3	14 6	4 7	39 3
12 7	3 2	24 8	6 4	8	36 5
29	0 9	46	1 2	* 54 1	4 1
60 8	0	76 2	0	81	0

\* Two layers are formed

Composition of above layers

Alcohol layer		H <sub>2</sub> O layer	
$\% \text{alcohol}$	$\% \text{Na}_3\text{SbS}_4$	$\% \text{alcohol}$	$\% \text{Na}_3\text{SbS}_4$
54 1	4 1	8 0	36 5
40 4	10 2	14 3	27 8
33 5	14 1	18 8	24 1
		27 2	18 0

(Donk, l c)

Solubility of  $\text{Na}_3\text{SbS}_4$  in methyl alcohol at  $t^\circ$   
Solid phase,  $\text{Na}_3\text{SbS}_4 + 9\text{H}_2\text{O}$

$t = 0^\circ$		$t = 30^\circ$	
$\% \text{CH}_3\text{OH}$	$\% \text{Na}_3\text{SbS}_4$	$\% \text{CH}_3\text{OH}$	$\% \text{Na}_3\text{SbS}_4$
3 4	8 6	0	27 1
15 5	2 8	18 1	12 8
23 1	2 1	33 1	5 8
50 3	0 3	65 7	0 1
57	0 1	84 2	0 1
81 7	0 05	91 2	1 2
92	0 2	94	3 9
95 9	2 0		

(Donk, l c)

Sodium sulphantimonate thiosulphate,  
 $\text{Na}_3\text{SbS}_4 \cdot 2\text{Na}_2\text{S}_2\text{O}_3 + 20\text{H}_2\text{O}$

Efflorescent, and decomp by  $\text{H}_2\text{O}$  (Unger, Arch Pharm (2) 147 193)

No double salt exists See Donk,  $\text{Na}_3\text{SbS}_4 + \text{Na}_2\text{S}_2\text{O}_3$  under  $\text{Na}_3\text{SbS}_4$

Strontium sulphantimonate

Sol in  $\text{H}_2\text{O}$ , pptd by alcohol

Uranium sulphantimonate

Ppt

Zinc sulphantimonate,  $\text{Zn}_3(\text{SbS}_4)_2$ 

Ppt Sol in hot  $\text{Na}_3\text{SbS}_4 + \text{Aq}$ , insol in  $\text{ZnSO}_4 + \text{Aq}$  Partially sol in  $\text{KOH} + \text{Aq}$  sol in hot  $\text{HCl} + \text{Aq}$  (Rammelsberg, Pogg 52 233)

Sulphantimonous acid

Ammonium metasulphantimonite,  $\text{NH}_4\text{SbS}_2$ 

Insol in  $\text{H}_2\text{O}$  (Rouget, C R 1898, 12 1145)

+  $2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  and alcohol

Decomp in the air (Stanck, Z anor 1898, 17 119)

Ammonium orthosulphantimonite,

 $(\text{NH}_4)_3\text{SbS}_3$ 

Easily decomp Stable only in presence of  $(\text{NH}_4)_2\text{S}$  Sol in  $\text{H}_2\text{O}$  Insol in alcohol by which it is pptd from aqueous solution (Pouget, A ch 1899, (7) 18 536)

Ammonium parasulphantimonite,

 $(\text{NH}_4)_2\text{Sb}_2\text{S}_7$ 

Stable in the air

Insol in  $\text{H}_2\text{O}$ 

Decomp by acids (Stanek, Z anor 1898, 17 120)

Stable, cryst from hot solutions (Pouget, C R 1898, 126 1145)

**Ammonium silver orthosulphantimonite,**  
 $\text{NH}_4\text{Ag}_2\text{SbS}_3$ Decomp by  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 551)**Barium metasulphantimonite,**  $\text{BaSb}_2\text{S}_4$   
 $+4\frac{1}{2}\text{H}_2\text{O}$ Insol in  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 541)**Barium orthosulphantimonite,**  $\text{Ba}_3\text{Sb}_2\text{S}_6$   
 $+8\text{H}_2\text{O}$ Decomp in the air and by  $\text{H}_2\text{O}$  Somewhat sol in  $\text{BaS}+\text{Aq}$  (Pouget, C R 1898, 126 1792)**Barium pyrosulphantimonite,**  $\text{Ba}_2\text{Sb}_2\text{S}_5$   
 $+8\text{H}_2\text{O}$ Decomp by  $\text{H}_2\text{O}$   
Nearly insol in  $\text{BaS}+\text{Aq}$  (Rouget)**Barium sulphantimonite,**  $\text{Ba}_3\text{Sb}_4\text{S}_9+10\text{H}_2\text{O}$ 

Pptd from aq solution of ortho and pyrobarium salts (Pouget)

 $\text{Ba}_3\text{Sb}_4\text{S}_{11}+16\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 538)**Calcium sulphantimonite basic,**  $\text{Ca}(\text{OH})\text{SbS}_2$ Insol in  $\text{H}_2\text{O}$ Sol in conc  $\text{HCl}$  (Pouget, A ch 1899, (7) 18 544)**Calcium pyrosulphoantimonite,**  $\text{Ca}_2\text{Sb}_2\text{S}_5$   
 $+15\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  without decomp (Pouget, C R 1898, 126 1793)**Cobaltous orthosulphantimonite,**  $\text{Co}_3\text{Sb}_2\text{S}_6$ 

Ppt (Pouget, A ch 1899, (7) 18 554)

**Cuprous metasulphantimonite,**  $\text{CuSbS}_2$ Sol in mixture of  $\text{HNO}_3$  and tartaric acid with separation of SInsol in  $\text{NH}_4\text{OH}+\text{Aq}$  Decomp by hot  $\text{KOH}$  and alkali sulphides  $+\text{Aq}$  (Sommerlad, Z anorg 1898, 18 430)Min *Wolfberite* Sol in  $\text{HNO}_3+\text{Aq}$  with separation of S and Sb  $\text{O}_3$ **Cuprous orthosulphantimonite,**  $\text{Cu}_3\text{SbS}_3$ 

(Sommerlad, Z anorg 1898, 18 432)

Ppt Insol in  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 556)**Cuprous sulphantimonite,**  $\text{Cu}_2\text{Sb}_4\text{S}_7$ Min *Guejarite***Cupric orthosulphantimonite,**  $\text{Cu}_3\text{Sb}_2\text{S}_6$ 

Ppt (Pouget, A ch 1899, (7) 18 557)

**Cuprous lead sulphantimonite,**  $\text{Cu}_3\text{SbS}_3$ ,  
 $2\text{Pb}_3\text{SbS}_3$ Min *Boironite* Decomp by  $\text{HNO}_3+\text{Aq}$ , and aqua regia**Cuprous potassium orthosulphantimonite,**  
 $\text{Cu}_2\text{KSbS}_3$ Ppt, easily decomp by  $\text{H}_2\text{O}$  (Pouget, C R 1899, 129 104) $+3\text{H}_2\text{O}$  Ppt decomp by  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 556)**Iron (ferrous) orthosulphantimonite,**  
 $\text{Fe}_3(\text{SbS}_3)_2$ Ppt (Pouget, A ch 1899, (7) 18 554)  
Min *Berthierite* Sl sol in  $\text{HCl}+\text{Aq}$ , easily sol in aqua regia**Lead orthosulphantimonite,**  $\text{Pb}_3(\text{SbS}_3)_2$ Ppt Very sl sol in  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 553)Min *Boulangerite* Completely sol in hot  $\text{HCl}+\text{Aq}$ , decomp by  $\text{HNO}_3+\text{Aq}$ **Lead sulphantimonite**Sol in boiling conc  $\text{HNO}_3+\text{Aq}$  (Fournet) $\text{Pb}(\text{SbS}_2)_2$  Min *Zinkenite* Decomp by hot  $\text{HCl}+\text{Aq}$  $4\text{PbS}$ ,  $\text{Sb}_2\text{S}_3$  Min *Plagionite*  
 $2\text{PbS}$ ,  $\text{Sb}_2\text{S}_3$  Min *Jamesonite* Decomp by hot  $\text{HCl}+\text{Aq}$  $4\text{PbS}$ ,  $\text{Sb}_2\text{S}_3$  Min *Meneghinite*  
 $5\text{PbS}$ ,  $\text{Sb}_2\text{S}_3$  Min *Geokronite*  
 $6\text{PbS}$ ,  $\text{Sb}_2\text{S}_3$  Min *Kibirilenite* (?)**Lead potassium orthosulphantimonite,**  
 $\text{PbKSbS}_3$ Very sl sol in  $\text{H}_2\text{O}$ Decomp by  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 554)**Lead silver sulphantimonite,**  $(\text{Ag}_2, \text{Pb})_3\text{Sb}_4\text{S}_{11}$   
Min *Freieslebenite***Lithium orthosulphantimonite,**  $\text{Li}_3\text{SbS}_3$   
 $+3\text{H}_2\text{O}$ 

Very deliquescent

Very sl sol in  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 530)**Lithium parasulphantimonite,**  
 $\text{Li Sb}_4\text{S}_7+3\text{H}_2\text{O}$ 

Ppt (Pouget, A ch 1899, (7) 18 531)

**Lithium silver orthosulphantimonite,**  
 $\text{LiAg}_2\text{SbS}_3$ Decomp by  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 551)**Manganous orthosulphantimonite,**  $\text{Mn}_3\text{Sb}_2\text{S}_6$ Ppt Sl sol in  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 553)**Manganous potassium orthosulphantimonite,**  
 $\text{MnKSbS}_3$ Sl sol in  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 553)

**Nickel orthosulphantimonite,  $\text{Ni}_3\text{Sb}_2\text{S}_6$** 

Ppt (Pouget, A ch 1899, (7) 18 554)

**Potassium metasulphantimonite,  $\text{KSbS}_2$** Insol in cold  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 513) $+1\frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , but decomp quicklySol in  $\text{H}_2\text{O}$  (Stanek, Z anorg 1898, 17 119)**Potassium orthosulphantimonite,  $\text{K}_3\text{SbS}_3$** 

Very deliquescent

Very sol in  $\text{H}_2\text{O}$ 

Decomp by acids (Pouget, A ch 1899, (7) 18 518)

**Potassium sulphantimonite,  $\text{K}_2\text{Sb}_4\text{S}_7+3\text{H}_2\text{O}$** Sl sol in  $\text{H}_2\text{O}$  and not decomp thereby (Pouget, A ch 1899, (7) 18 522)

Decomp in the air

Sol in  $\text{K}_2\text{S}+\text{Aq}$  (Stanek, Z anorg 1898, 17 120) $2\text{K}_2\text{S}, \text{Sb}_2\text{S}_3$  Sol in  $\text{H}_2\text{O}$  (Ditte, C R 102 68) $x\text{K}_2\text{S}, y\text{Sb}_2\text{S}_3$  Deliquescent When  $\text{K}_2\text{S}$  is in excess, sol in  $\text{H}_2\text{O}$ , when  $\text{Sb}_2\text{S}_3$  is in excess, partially sol Aqueous solution is decomp by all acids, even  $\text{CO}_2$ , and by  $\text{K}_2\text{CO}_3$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{NaHCO}_3$ ,  $\text{KHCO}_3$ ,  $\text{NH}_4\text{HCO}_3+\text{Aq}$  Insol in absolute alcohol (Kohl)**Potassium hydrogen sulphantimonite,  $\text{KHSb}_4\text{S}_7$**  $\text{KHSb}_4\text{S}_7$ 

(Pouget, A ch 1899, (7) 18 522)

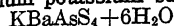
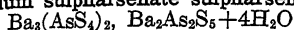
**Potassium silver orthosulphantimonite,  $\text{AgKSbS}_3$**  $\text{AgKSbS}_3$ Decomp by boiling  $\text{H}_2\text{O}$  (Pouget, C R 1897, 124 1519)**Potassium zinc orthosulphantimonite,  $\text{KZnSbS}_3$**  $\text{KZnSbS}_3$ Decomp by  $\text{H}_2\text{O}$  (Pouget, A ch 1899, (7) 18 552)**Silver orthosulphantimonite,  $\text{Ag}_3\text{SbS}_3$** Ppt Sl sol in  $\text{H}_2\text{O}$  (Pouget, A ch 1899 (7) 18 547)Min *Pyrrargyrite* Sol in  $\text{HNO}_3+\text{Aq}$  with residue of S and  $\text{Sb}_2\text{O}_3$   $\text{KOH}+\text{Aq}$  dissolves out Sb  $\text{S}_3$ **Silver sulphantimonite** $\text{AgSbS}_3$  Min *Margaryrite* $5\text{AgS}, \text{SbS}_3$  Min *Stephanite* Easily decomp by warm  $\text{HNO}_3+\text{Aq}$  $12\text{AgS}, \text{SbS}_3$  Min *Polyargyrite***Silver sodium orthosulphantimonite,  $\text{AgNaSbS}_3$**  $\text{AgNaSbS}_3$ Decomp by  $\text{H}_2\text{O}$  Pouget, A ch 1899, (7) 18 551)**Sodium metasulphantimonite,  $\text{NaSbS}_2$** Deliquescent Decomp by hot  $\text{H}_2\text{O}$  When  $\text{Na}_2\text{S}$  is in excess, sol in  $\text{H}_2\text{O}$ , but partially sol if  $\text{Sb}_2\text{S}_3$  is in excess (Unger Arch Pharm (2) 148 1)Ppt Insol in  $\text{H}_2\text{O}$  (Pouget, C R 1898 126 1145)**Sodium orthosulphantimonite,  $\text{Na}_3\text{SbS}_3$**  $+9\text{H}_2\text{O}$ Decomp in solution in  $\text{H}_2\text{O}$  (Pouget C R 1898, 126 1144)**Sodium sulphantimonite,  $\text{Na}_2\text{Sb}_4\text{S}_7+2\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  (Pouget, C R 1898, 126 1145) $\text{Na}_2\text{SbS}_3$  (Pouget, C R 1898, 126 1144  $4\text{Na}_2\text{S}, 3\text{Sb}_2\text{S}_3+3\text{H}_2\text{O}$  Permanent, so in  $\text{H}_2\text{O}$  Insol in alcohol and ether (Kohl**Strontium orthosulphantimonite,  $\text{Sr}_3\text{SbS}_3$**  $+10\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  (Pouget, C R 1898, 126 1793)**Strontium pyrosulphantimonite,  $\text{Sr}_2\text{Sb}_2\text{S}_5$**  $+15\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  without essential decomp (Pouget, C R 1898, 126 1793)**Zinc orthosulphantimonite,  $\text{Zn}_3\text{SbS}_3$** 

Ppt (Pouget, A ch 1899, (7) 18 552)

**Orthosulpharsenic acid,  $\text{H}_3\text{AsS}_4$** Ppt Loses  $\text{H}_2\text{S}$  by prolonged boiling wth  $\text{H}_2\text{O}$  (Nilson, J pr (2) 14 145)

See also Sulphoxyarsenic acid

**Ammonium sulpharsenate,  $(\text{NH}_4)_4\text{As}_2\text{S}_7$** Known only in solution in  $\text{H}_2\text{O}$  Decomp on boiling into— $\text{NH}_4\text{AsS}_3$  Sol in alcohol $(\text{NH}_4)_3\text{AsS}_4$  Sol in  $\text{H}_2\text{O}$  Precipitate by alcohol $(\text{NH}_4)_2\text{S}, 12\text{As}_2\text{S}_5$  Ppt Insol in  $\text{H}_2\text{O}$ **Ammonium magnesium sulpharsenate,  $(\text{NH}_4)_2\text{S}, \text{MgS}, \text{As}_2\text{S}_5$**  $(\text{NH}_4)_2\text{S}, \text{MgS}, \text{As}_2\text{S}_5$ **Ammonium sodium sulpharsenate,  $(\text{NH}_4)_3\text{AsS}_4, \text{Na}_3\text{AsS}_4$**  $(\text{NH}_4)_3\text{AsS}_4, \text{Na}_3\text{AsS}_4$ Much more sol in  $\text{H}_2\text{O}$  than  $\text{Na}_3\text{AsS}_4$ , sol in cold, more sol in hot alcohol (Bezelius)**Barium sulpharsenate,  $\text{Ba}(\text{AsS}_3)_2$** Sol in  $\text{H}_2\text{O}$  and alcohol Decomp by evaporation $\text{Ba}_2\text{As}_2\text{S}_7$  Sol in  $\text{H}_2\text{O}$  in all proportions with decomp Decomp by alcohol $\text{Ba}_3(\text{AsS}_4)_2$  Sol in  $\text{H}_2\text{O}$  Insol in alcohol $\text{BaS}, 3\text{As}_2\text{S}_5$  Ppt Insol in  $\text{H}_2\text{O}$

**Barium potassium sulpharsenate,**Easily sol in  $\text{H}_2\text{O}$ Decomp by acids with separation of  $\text{As}_2\text{S}_5$   
(Glatzel, Z anorg 1911, 71 209)**Barium sulpharsenate sulpharsenite,**Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$   
(Nilson)**Bismuth sulpharsenate,  $2\text{Bi}_2\text{S}_3, 3\text{As}_2\text{S}_5$** Sol in  $\text{Na}_3\text{AsS}_4 + \text{Aq}$  $\text{Bi}_2\text{S}_3, 3\text{As}_2\text{S}_5$  As above (Berzelius)**Cadmium sulpharsenate**

Ppt (Berzelius, Pogg 7 88)

**Calcium sulpharsenate,  $\text{Ca}_2\text{As}_2\text{S}_7$** Sol in  $\text{H}_2\text{O}$  and alcohol $\text{Ca}_3(\text{AsS}_4)_2$  Easily sol in  $\text{H}_2\text{O}$  Insol in  
alcohol $+10\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Nilson, J  
pr (2) 14 169) $5\text{CaS}, 2\text{As}_2\text{S}_5 + 6\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$   
(Nilson, J pr (2) 14 163)**Cerous sulpharsenate,  $\text{Ce}_2\text{As}_2\text{S}_7$** 

Ppt

 $\text{Ce}_3(\text{AsS}_4)_2$  Ppt $\text{Ce}_4(\text{As}_2\text{S}_7)_3$  Ppt**Cobaltous sulpharsenate,  $\text{Co}_2\text{As}_2\text{S}_7$** Ppt Sol in excess of sodium sulpharsen-  
ate + Aq**Cuprous sulpharsenate,  $\text{Cu}_3\text{AsS}_4$** 

Ppt (Preis, A 257 201)

Min *Enargite Clarite* Not wholly de-  
comp by  $\text{HCl} + \text{Aq}$  Sol in  $\text{HCl} + \text{Aq}$  with  
residue of  $\text{As}_2\text{O}_3$  Not attacked by  $\text{KOH} + \text{Aq}$ **Cupric sulpharsenate,  $\text{Cu}_2\text{As}_2\text{S}_7$** Ppt Sol in  $(\text{NH}_4)_2\text{S} + \text{Aq}$  Decomp by  
 $\text{NH}_4\text{OH} + \text{Aq}$  (Berzelius) $\text{Cu}_3(\text{AsS}_4)$  Ppt (Preis, A 257 201)**Glucinum sulpharsenate**Sl sol in  $\text{H}_2\text{O}$ **Gold sulpharsenate,  $\text{AuAsS}_4$** Sol in pure  $\text{H}_2\text{O}$  Insol in  $\text{Na}_3\text{AsS}_4 + \text{Aq}$  $2\text{Au}_2\text{S}_3, 3\text{As}_2\text{S}_5$  Sol in  $\text{H}_2\text{O}$  (Berzelius)**Iron (ferrous) sulpharsenate,  $\text{Fe}_2\text{As}_2\text{S}_7$** Ppt Sol in  $\text{Na}_3\text{AsS}_4 + \text{Aq}$  (Berzelius)**Iron (ferric) sulpharsenate,  $\text{Fe}_4(\text{As}_2\text{S}_7)_3$** Ppt Sol in  $\text{Na}_3\text{AsS}_4 + \text{Aq}$  (Berzelius)**Lead sulpharsenate,  $\text{Pb}_2\text{As}_2\text{S}_7$** 

Ppt (Berzelius)

 $\text{Pb}_3(\text{AsS}_4)_2$  Ppt**Lithium sulpharsenate,  $\text{Li}_3\text{AsS}_4$** Easily sol in hot, less sol in cold  $\text{H}_2\text{O}$   
Insol in alcohol $\text{Li}_4\text{As}_2\text{S}_7$  Completely sol in  $\text{H}_2\text{O}$  De-  
comp by alcohol $\text{LiAsS}_3$  Known only in acid solution**Magnesium sulpharsenate,  $\text{Mg}_2\text{As}_2\text{S}_7$** Sol in all proportions of  $\text{H}_2\text{O}$ , and in al-  
cohol $\text{Mg}_3(\text{AsS}_4)_2$  Sol in  $\text{H}_2\text{O}$  Decomp  
alcohol $3\text{MgS}, \text{As}_2\text{S}_5$  Nearly insol in  $\text{H}_2\text{O}$  $5\text{MgS}, 2\text{As}_2\text{S}_5 + 15\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$   
(Nilson)**Manganous sulpharsenate,  $\text{Mn}_2\text{As}_2\text{S}_7$** Sl sol in  $\text{H}_2\text{O}$  $\text{Mn}_3(\text{AsS}_4)_2$  Permanent Sl sol in  $\text{H}_2\text{O}$  $6\text{MnS}, \text{As}_2\text{S}_5$  Sl sol in  $\text{H}_2\text{O}$ **Mercurous sulpharsenate,  $(\text{Hg}_2)_2\text{As}_2\text{S}_7$** 

Ppt

**Mercuric sulpharsenate,  $\text{Hg}_2\text{As}_2\text{S}_7$** 

Ppt (Berzelius, Pogg 7 29)

 $\text{Hg}_3(\text{AsS}_4)_2$  Ppt (Preis, A 257 200)**Nickel sulpharsenate,  $\text{Ni}_3(\text{AsS}_4)_2$** Ppt Not decomp by  $\text{HCl} + \text{Aq}$  Sol in  
 $\text{Na}_3\text{AsS}_4 + \text{Aq}$  (Berzelius) $2\text{NiS}, \text{As}_2\text{S}_5$  As above**Potassium sulpharsenate,  $\text{KAsS}_3$** 

Known only in alcoholic solution

 $\text{K}_4\text{As}_2\text{S}_7$  Deliquescent Sol in  $\text{H}_2\text{O}$ , from  
which alcohol ppts  $\text{K}_3\text{AsS}_4$  $\text{K}_3\text{AsS}_4$  Deliquescent Very sol in  $\text{H}_2\text{O}$ ,  
from which it is precipitated by alcohol $+ \text{H}_2\text{O}$  Very deliquescent (Nilson, J  
pr (2) 14 159)**Potassium sodium sulpharsenate**Sol in  $\text{H}_2\text{O}$ **Silver sulpharsenate,  $\text{Ag}_3\text{AsS}_4$** 

Ppt (Berzelius, Pogg 7 29)

 $\text{Ag}_2\text{As}_2\text{S}_7$  Ppt**Sodium sulpharsenate,  $\text{NaAsS}_3$** 

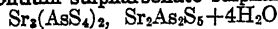
Known only in alcoholic solution

 $\text{Na}_4\text{AsS}_7$  Sol in  $\text{H}_2\text{O}$  Alcohol ppts $\text{Na}_3\text{AsS}_4$  from  $\text{H}_2\text{O}$  solution $\text{Na}_3\text{AsS}_4 + 7\frac{1}{2}\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$ ,  
from which it is precipitated by alcohol $+ 8\text{H}_2\text{O}$  Insol in alcohol, very sol in  
 $\text{H}_2\text{O}$  (McCay, Z anal 1895, 34 726) $+ 9\text{H}_2\text{O}$  (Nilson, J pr (2) 14 160) $\text{Na}_2\text{S}, 12\text{As}_2\text{S}_5$  (?) Insol in  $\text{H}_2\text{O}$ **Sodium zinc sulpharsenate,  $\text{NaZnAsS}_4 + 4\text{H}_2\text{O}$** Sol in hot  $\text{H}_2\text{O}$  with decomp (Preis, A  
257 202)



**Strontium sulpharsenate,  $\text{Sr}_3(\text{AsS}_4)_2$** 

Easily sol in  $\text{H}_2\text{O}$ , insol in alcohol  
 $\text{Sr}_2\text{As}_2\text{S}_7$  Easily sol in  $\text{H}_2\text{O}$ , from which  
 alcohol ppts  $\text{Sr}_3(\text{AsS}_4)_2$

**Strontium sulpharsenate sulpharsenite,**

Easily sol in  $\text{H}_2\text{O}$  (Nilson, J pr (2) 14  
 162)

**Thallos sulpharsenate,  $\text{Ti}_3\text{AsS}_4$** 

Not decomp by  $\text{H}_2\text{O}$  Decomp by dil  
 acids Insol in dil alkali sulphides Par-  
 tially decomp by boiling with a conc solu-  
 tion of sodium sulphide (Hawley, J Am  
 Chem Soc 1907, 29 1013)

**Tin (stannous) sulpharsenate**

Ppt

**Tin (stannic) sulpharsenate**

Ppt

**Uranic sulpharsenate,  $2\text{U}_2\text{S}_5, \text{As}_2\text{S}_5$** 

Ppt Sol in  $\text{Na}_2\text{AsS}_4 + \text{Aq}$

**Zinc sulpharsenate,  $\text{Zn}_3(\text{AsS}_4)_2$** 

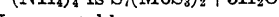
Ppt (Berzelius)

$2\text{ZnS}, \text{As}_2\text{S}_5$  Ppt (Berzelius)

$\text{ZnS}, \text{As}_2\text{S}_5$  (Wohler)

**Disulpharsenic acid**

See Disulphoxyarsenic acid

**Sulpharseniosulphomolybdic acid****Ammonium sulpharseniosulphomolybdate,**

Very unstable

Sol in  $\text{H}_2\text{O}$  with decomp (Weinland, Z  
 anorg 1897, 15 49)

**Barium —,  $\text{Ba}_4\text{As}_2\text{S}_7(\text{MoS}_3)_2 + 14\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  with decomp (Weinland)

**Potassium —,  $\text{K}_4\text{AsS}_3(\text{MoS}_3) + 4\text{H}_2\text{O}$** 

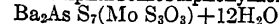
(Weinland)

$\text{K}_4\text{AsS}_3(\text{MoS}_3) + 8\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$   
 Decomp by mineral acids Insol in alcohol  
 (Weinland)

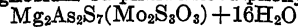
**Sodium —,  $\text{NaAsS}_3(\text{MoS}_3) + 6\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  Easily sol in dil  $\text{NaOH}$   
 and  $\text{NH}_3 + \text{Aq}$  (Weinland)

$\text{Na}_4\text{AsS}_7(\text{MoS}_3) + 14\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$   
 Decomp by mineral acids (Weinland)

**Sulpharseniosulphoxymolybdic acid****Barium sulpharseniosulphoxymolybdate,**

Sol in  $\text{H}_2\text{O}$  (Weinland, Z anorg 1897,  
 15 60)

**Magnesium sulpharseniosulphoxymolybdate,**

Very sol in  $\text{H}_2\text{O}$  (Weinland)

**Potassium —,  $\text{KAsS}_3(\text{MoSO}_2) + 2\frac{1}{2}\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  with decomp (Weinland)

$\text{K}_4\text{As}_2\text{S}_7(\text{Mo}_2\text{S}_3\text{O}_3) + 6\text{H}_2\text{O}$  Very sol  
 $\text{H}_2\text{O}$  (Weinland)

$+ 10\text{H}_2\text{O}$  (Weinland)

**Sodium —,  $\text{NaAsS}_3(\text{MoSO}_2) + 5\text{H}_2\text{O}$** 

Sl sol in cold, very sol in hot  $\text{H}_2\text{O}$  (Wein-  
 land)

$\text{Na}_4\text{As}_2\text{S}_7(\text{Mo}_2\text{S}_3\text{O}_3) + 15\text{H}_2\text{O}$  Very so  
 in  $\text{H}_2\text{O}$  (Weinland)

**Sulpharsenious acid****Ammonium sulpharsenite,  $\text{NH}_4\text{As}_2\text{S}_5 + 2\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  Ppt Sol in  $\text{KOH}$  ( $\text{NH}_4\text{OH} + \text{Aq}$  Sl attacked by boiling  $\text{HCl}$   
 Aq (Nilson, J pr (2) 14 42)

$(\text{NH}_4)_4\text{As}_2\text{S}_5 = 2(\text{NH}_4)_2\text{S}, \text{As}_2\text{S}_5$  Sol  
 $\text{H}_2\text{O}$ , from which alcohol ppts  $(\text{NH}_4)_3\text{AsS}_3$   
 $(\text{NH}_4)_2\text{AsS}_2 = 3(\text{NH}_4)_2\text{S}, \text{As}_2\text{S}_3$  Decom,  
 on air, sol in  $\text{H}_2\text{O}$  Insol in alcohol  
 $(\text{NH}_4)_5\text{As}_2\text{S}_{10}$  Sol in  $\text{H}_2\text{O}$  (Nilson,  
 pr (2) 14 160)

**Barium sulpharsenite,  $\text{Ba}_2\text{As}_2\text{S}_5$** 

Sl sol in  $\text{H}_2\text{O}$  Decomp by alcohol  
 $+ 5\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Nilson, J p  
 (2) 14 46)

$+ 15\text{H}_2\text{O}$  Sl sol in cold  $\text{H}_2\text{O}$  (Nilson  
 $\text{Ba}_3(\text{AsS}_3)_2$  Sl sol in  $\text{H}_2\text{O}$  Precipitate  
 by alcohol

$+ 14\text{H}_2\text{O}$  Sl sol in cold, easily in h  
 $\text{H}_2\text{O}$  (Nilson)

$\text{Ba}(\text{AsS}_2)_2 + 2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Ni-  
 son, J pr (2) 14 44)

$\text{BaAs}_{12}\text{S}_{19}$  Insol in  $\text{HCl} + \text{Aq}$  (Nilson)

**Bismuth sulpharsenite,  $2\text{Bi}_2\text{S}_3, \text{As}_2\text{S}_3$** 

Ppt

**Cadmium sulpharsenite**

Ppt (Berzelius, Pogg 7 146)

**Calcium sulpharsenite,  $\text{Ca}_2\text{As}_2\text{S}_5$** 

Sol in  $\text{H}_2\text{O}$ , from which alcohol ppt  
 $\text{Ca}_3(\text{AsS}_3)_2$

$\text{Ca}_3(\text{AsS}_3)_2$  Sol in  $\text{H}_2\text{O}$

$+ 15\text{H}_2\text{O}$  Precipitated by alcohol

$\text{Ca}(\text{AsS}_2)_2 + 10\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Nilso  
 J pr (2) 14 54)

$\text{CaAs}_9\text{S}_{13} + 10\text{H}_2\text{O}$  (?) Insol in cold  $\text{H}_2$   
 Decomp by hot  $\text{H}_2\text{O}$  (Nilson)

$\text{CaAs}_{12}\text{S}_{18} + 10\text{H}_2\text{O}$  (?) Sl sol in hot  $\text{H}_2$   
 (Nilson)

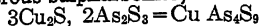
$\text{Ca}_7\text{As}_2\text{S}_{10} + 25\text{H}_2\text{O}$  Sl sol in cold or h  
 $\text{H}_2\text{O}$  (Nilson)

**Cerous sulpharsenite,  $\text{Ce}_2\text{As}_2\text{S}_5$** 

Ppt

**Chromic sulpharsenite,  $2\text{Cr}_2\text{S}_3, 3\text{As}_2\text{S}_3$** Ppt Insol in  $\text{Na}_2\text{S} + \text{Aq}$ **Cobaltous sulpharsenite,  $2\text{CoS}, \text{As}_2\text{S}_3$** 

Ppt Sol in excess of sodium sulpharsenite + Aq

**Cuprous sulpharsenite,**Min *Bunnite* Decomp by hot acids and  $\text{KOH} + \text{Aq}$  $2\text{Cu}_2\text{S}, \text{As}_2\text{S}_3 = \text{Cu}_4\text{As}_2\text{S}_5$  Decomp by acids,  $\text{KOH}$  and  $\text{K}_2\text{S} + \text{Aq}$  (Sommerlad, Z anorg 1898, 18 434)**Cupric sulpharsenite,  $\text{Cu}_2\text{AsS}_3$** Insol in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$  Sol in  $\text{Na}_3\text{AsS}_5 + \text{Aq}$   
 $\text{Cu}_2\text{As}_2\text{S}_5$  Ppt (Berzelius)**Glucinum sulpharsenite,  $2\text{GlS}, \text{As}_2\text{S}_3$** Ppt Sol in acids, partly sol in  $\text{NH}_4\text{OH} + \text{Aq}$ **Gold sulpharsenite,  $2\text{Au}_2\text{S}_3, 3\text{As}_2\text{S}_3$** 

Ppt (Berzelius)

**Iron (ferrous) sulpharsenite**Ppt Sol in  $\text{Na}_3\text{AsS}_5 + \text{Aq}$  (Berzelius)**Iron (ferric) sulpharsenite**Ppt Sol in excess of a ferric salt, or  $\text{Na}_3\text{AsS}_5 + \text{Aq}$  (Berzelius)**Lead sulpharsenite,  $\text{Pb}_2\text{As}_2\text{S}_3$** Ppt Min *Dufrenoyite* $\text{Pb}(\text{AsS}_2)_2 = \text{PbS}, \text{As}_2\text{S}_3$  Min *Sartorite* $\text{Pb}_4\text{As}_2\text{S}_7$  Min *Jordanite***Lithium sulpharsenites**

Resemble K salts

**Magnesium sulpharsenite,  $\text{Mg}_2\text{As}_2\text{S}_5$** Almost completely sol in  $\text{H}_2\text{O}$  Easily sol in alcohol (Berzelius) $+ 8\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Nilson) $\text{Mg}(\text{AsS}_2)_2 + 5\text{H}_2\text{O}$  Slowly sol in both cold and hot  $\text{H}_2\text{O}$  (Nilson, J pr (2) 14 59) $\text{Mg}_3(\text{AsS}_2)_2 + 9\text{H}_2\text{O}$  (Nilson)**Manganous sulpharsenite,  $\text{Mn}_2\text{As}_2\text{S}_5$** Ppt Decomp by  $\text{HCl} + \text{Aq}$ **Mercurous sulpharsenite,  $(\text{Hg}_2)_2\text{As}_2\text{S}_5$** 

Ppt (Berzelius)

**Mercuric sulpharsenite,  $\text{Hg}_2\text{As}_2\text{S}_5$** 

Ppt

 $\text{Hg}(\text{AsS}_2)_2$  Ppt (Berzelius, Pogg 7 149)**Nickel sulpharsenite,  $\text{Ni}_3(\text{AsS}_2)_2$** 

Ppt (Berzelius)

**Platinum sulpharsenite,  $\text{Pt}_2\text{As}_2\text{S}_5$** 

Ppt

**Potassium sulpharsenite,  $\text{K}_4\text{As}_2\text{S}_5$** Decomp by  $\text{H}_2\text{O}$  or alcohol (Berzelius)  
 $\text{K}_2\text{AsS}_3$  Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Berzelius) $\text{K}_2\text{As}_4\text{S}_7$  Sol in  $\text{H}_2\text{O}$  and alcohol (Berzelius) $\text{K}_2\text{As}_2\text{S}_2$  Decomp by  $\text{H}_2\text{O}$  (Berzelius) $+ 2\frac{1}{2}\text{H}_2\text{O}$  Not wholly sol in  $\text{H}_2\text{O}$  (Nilson, J pr (2) 14 30) $\text{K AsS}_3 + 8\text{H}_2\text{O}$  (Nilson) $\text{KAs}_3\text{S}_5 + \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Slowly attacked by hot  $\text{HCl} + \text{Aq}$  Sol in  $\text{KOH} + \text{Aq}$  (Nilson)**Silver sulpharsenite,  $12\text{Ag}_2\text{S}, \text{As}_2\text{S}_3$** 

Ppt (Sommerlad, Z anorg 1898, 18 428)

 $5\text{Ag}_2\text{S}, \text{As}_2\text{S}_3 = \text{Ag}_5\text{AsS}_4$  (Sommerlad) $\text{Ag}_3\text{AsS}_3$  Min *Proustite* Sol in  $\text{HNO}_3 + \text{Aq}$   $\text{KOH} + \text{Aq}$  dissolves out  $\text{Sb}_2\text{S}_3$  (Senarmont, A ch (3) 32 129, Wohler, A 27 159) $2\text{Ag}_2\text{S}, \text{As}_2\text{S}_3$  Partially sol in  $\text{HNO}_3 + \text{Aq}$  (Berzelius) $\text{AgAsS}_2$  (Berzelius, Pogg 7 150)**Sodium sulpharsenite,  $\text{NaAsS}_2 + \frac{1}{2}\text{H}_2\text{O}$** Attacked by  $\text{HCl} + \text{Aq}$  with difficulty (Nilson, J pr (2) 14 37) $+ 1\frac{1}{2}\text{H}_2\text{O}$  Forms coagulum with cold, sol in hot  $\text{H}_2\text{O}$  (Nilson) $\text{Na}_2\text{As}_4\text{S}_6 + 6\text{H}_2\text{O}$  Sol in much  $\text{H}_2\text{O}$ , not easily decomp by  $\text{HCl} + \text{Aq}$  (Nilson) $\text{NaAs}_3\text{S}_5 + 4\text{H}_2\text{O}$  Ppt (Nilson, J pr (2) 14 3)**Strontium sulpharsenite,  $3\text{SrS}, \text{As}_2\text{S}_3 + 15\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O} + \text{Aq}$  insol in alcohol (Voigt and Gottling) $2\text{SrS}, \text{As}_2\text{S}_3$  Sol in  $\text{H}_2\text{O}$ , decomp by alcohol $+ 15\text{H}_2\text{O}$  (Nilson, J pr (2) 14 53) $\text{Sr}(\text{AsS}_2)_2 + 2\frac{1}{2}\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Nilson)**Thallous sulpharsenite,  $11\text{AsS}_2$** Ppt Decomp by  $\text{KOH} + \text{Aq}$  (Gunning, J B 1868 247)Above compound is a mixture of  $\text{As}_2\text{S}_3$  and  $\text{Tl}_2\text{S}$  (Hawley, J Am Chem Soc 1907, 29 1012)Min *Lorandite* (Kuenner and Loezka, C C 1904, II 844)**Tin (stannous) sulpharsenite,  $\text{Sn}_2\text{AsS}_4$** 

Ppt

**Tin (stannic) sulpharsenite  $\text{SnAsS}_5$** 

Ppt (Berzelius, Pogg 7 147)

**Uranic sulpharsenite,  $2\text{U}_2\text{S}_3, \text{As}_2\text{S}_3$** 

Ppt

**Zinc sulpharsenite**

Ppt (Berzelius, Pogg 7 145)

**Zirconium sulpharsenite,  $2Zr_2S_3, As_2S_3$** Ppt Insol in solutions of alkali sulpharsenites Sl sol in  $Na_2S$  Aq Not decomp by acids (Berzelius)**"Sulphatammon,"  $2NH_3, SO_3$** 

(Rose)

Is ammonium imidosulphonate, which see (Berglund)

**"Parasulphatammon,"  $3NH_3, 2SO_3$** 

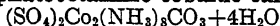
(Rose)

Is basic ammonium imidosulphonate, which see (Berglund)

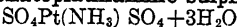
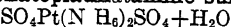
**Sulphatiodic acid****Potassium sulphatiodate,  $K_2HO_3SiO_4$  or  $KIO_3, KHSO_4$** 

Decomp by H O (Blomstrand, J pr (2) 40 317)

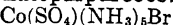
See Iodate sulphate, potassium

**Sulphatooctamine cobaltic carbonate**Sol in  $H_2O$  (Vortmann and Blasberg, B 22 2650) $(SO_4)_3Co(NH_3)_3(CO_3)_2 + 3H_2O$  Sol in H O (V and B)

See Carbonatotetramine cobaltic sulphate (Jorgensen)

**Sulphatoplatinamine sulphate,**Easily sol in H O Sol in  $H_2SO_4 + Aq$ **Sulphatoplatindiamine sulphate,**

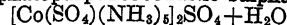
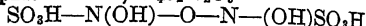
Insol in H O

**Sulphatopurplecobaltic bromide,**

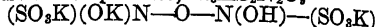
Sol in H O, from which it is precipitated by conc HBr + Aq (Jorgensen, J pr (2) 25 94)

— carbonate,  $[(SO_4)Co(NH_3)_3]_2CO_3 + 4H_2O$ 

Sol in H O (Vortmann and Blasberg, B 22 2648)

— chloroplatinate,  $2Co(SO_4)(NH_3)_3Cl, PtCl_4 + 2H_2O$ Sl sol in cold  $H_2O$  (Jorgensen)— nitrate,  $Co(SO_4)(NH_3)_3(NO_3)$ Somewhat sl sol in cold  $H_2O$  (Jorgensen)**Sulphatopurplecobaltic sulphate,**Very easily sol in  $H_2O$  (Jorgensen, J pr (2) 25 94) $Co(SO_4)(NH_3)_3(HSO_4) + 2H_2O$  Sol about 25 pts of cold  $H_2O$  Sol in dil, insol in conc  $NH_4OH + Aq$  (Jorgensen)**Sulphazic acid,  $H_4S_2N_2O_6 =$** 

Known only in its salts (Raschig, A 241 161)

**Potassium sulphazate,  $K_3HS_2N_2O_6 =$** Sol in  $H_2O$ , but decomp on standing (Raschig, A 241 161)**Sulphazidic acid**

(Fremy)

See Hydroxylamine monosulphonic acid.

**Sulphazilnic acid**

See Oxysulphazotic acid

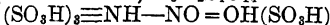
**Metasulphazilnic acid**

See Trisulphoxyazotic acid

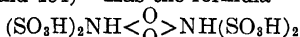
**Sulphazinous acid**

(Fremy)

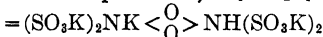
See Dihydroxylamine sulphonic acid

**Sulphazotic acid,  $H_6N_2S_4O_{14} =$** 

Known only in its salts (Claus, A 158 52 and 194) Has the formula



(Raschig, A 241 161)

**Lead potassium sulphazotate**Insol in cold, decomp by hot  $H_2O$  Insol in alcohol and ether (Fremy, A ch (3) 15 439)**Potassium sulphazotate,  $K_3HN_2S_4O_{14} + H_2C$** Very sol in hot, less in cold  $H_2O$  (Raschig, A 241 161) Decomp gradually by boiling (Claus) Insol in alcohol or ether (Fremy, A ch (3) 15 428)True composition is  $HON(SO_3K)_2KON(SO_3K)_2 + H_2O$  Potassium hydroxylamine disulphonate (Divers and Haga Chem Soc 1900, 77 432)

Forms basic salt

 $(SO_3K)_2NK < \overset{O}{\parallel} > NK(SO_3K)_2$ , which is easily sol and decomp by  $H_2O$  (Raschig)**Potassium sodium sulphazotate,**Quite easily sol in  $H_2O$  (Raschig, A 241 161)

**Disulphhydroxyazotic acid**,  $\text{ONH}(\text{SO}_2\text{H})_2$ 

Known only in its salts (Claus, A 158 52 and 194) Correct composition is hydroxylamine sulphonic acid  $\text{HON}(\text{SO}_2\text{H})_2$ , which see (Raschig, A 241 161)

**Sulphhydroxylamic acid**

(Claus)

See Hydroxylamine monosulphonic acid

**Disulphhydroxyazotic acid**

(Claus)

See Hydroxylamine disulphonic acid

**Sulphides**

The sulphides of the alkali metals are sol in  $\text{H}_2\text{O}$ , those of the alkali-earth metals are much less sol, and are decomp upon solution into hydrosulphide and hydroxide

The other sulphides are insol in  $\text{H}_2\text{O}$

For each sulphide, see under the respective element

**Sulphimide**,  $\text{SO}_2\text{NH}$ 

See Imidosulphamide

**Trisulphimide**,  $\text{OHSO} \begin{smallmatrix} \text{NSO OH} \\ \text{NSO OH} \end{smallmatrix} \text{N}$   
( $\text{SO}_2\text{NH}$ )<sub>3</sub>

Sol in methyl alcohol, sl sol in ether, insol in chloroform and benzene (Hantzsch B 1901, 34 3440)

**Ammonium sulphimide**,  $\text{SO}_2\text{N}(\text{NH}_4)$ 

Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Traube)

**Barium** —,  $(\text{SO}_2\text{N})_2\text{Ba} + 2\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  (Traube)

**Potassium** —,  $\text{SO}_2\text{N}_\text{K}$ 

Not very sol in  $\text{H}_2\text{O}$

**Silver** —,  $\text{SO}_2\text{N}_\text{Ag}$ 

Sol in 500–600 pts cold, more easily in hot  $\text{H}_2\text{O}$  Sol in acids

**Sodium** —,  $\text{SO}_2\text{NNa}$ 

Very sol in  $\text{H}_2\text{O}$

**“Sulphitammon,”**  $\text{NH}_3$ ,  $\text{SO}_2$ 

See Thionamic acid

**Sulphobismuthous acid****Cuprous sulphobismuthite**,  $\text{AuBiS}_2$ 

Min *Emplectite* Sol in  $\text{HNO}_3 + \text{Aq}$   
 $\text{Cu}_3\text{Bi}_4\text{S}_9$  Min *Klaprothite* Completely sol in  $\text{HCl} + \text{Aq}$   
 $\text{Cu}_2\text{BiS}_3$  Min *Wittichenite* Sol in  $\text{HCl} + \text{Aq}$  and in  $\text{HNO}_3 + \text{Aq}$

**Cuprous lead sulphobismuthite**,  $\text{Cu}_2\text{S}$ ,  $2\text{PbS}$ ,  $\text{Bi}_2\text{S}_3$ 

Min *Patrinite*

Sol in  $\text{HNO}_3 + \text{Aq}$  with residue of S and  $\text{PbSO}_4$

**Lead** —,  $2\text{PbS}$ ,  $\text{Bi}_2\text{S}_3$ 

Min *Cosalite*

$2\text{PbS}$ ,  $3\text{Bi}_2\text{S}_3$  Min *Chvanatite*

**Potassium** —,  $\text{KBiS}$ 

Decomp by  $\text{H}_2\text{O}$

Sol in  $\text{HCl} + \text{Aq}$  (Schneider, Pogg 1869, 136 464)

**Metasulphoboric acid**,  $\text{B}_2\text{S}_3\text{H}_2$ 

Decomp by  $\text{H}_2\text{O}$  and alcohol

1 pt is sol in 5 pts benzene

1 pt is “ “ 5 “  $\text{CS}_2$

Very sl sol in  $\text{CS}_2$  at  $-20^\circ$   
1901, 34 401)

**Sulphocarbonic acid****Ammonium cuprous sulphocarbonate**,  $\text{CS}_3\text{CuNH}_4$ 

This salt was formerly described as cupric sulphocarbonate ammonia,  $\text{CS}_3\text{Cu}$ ,  $\text{NH}_3$  (Hofmann, B 1903, 36 1146)

**Cuprous potassium sulphocarbonate**,  $\text{CS}_3\text{CuK}$ 

Nearly insol in cold  $\text{H}_2\text{O}$

Somewhat sol in hot  $\text{H}_2\text{O}$ ,  $\text{NaOH}$  and  $\text{NH}_4\text{OH} + \text{Aq}$  (Hofmann)

**Cupric sulphocarbonate ammonia**,  $\text{CS}_3\text{Cu}$ ,  $\text{NH}_3$ 

Very sl sol in strong  $\text{NH}_4\text{OH} + \text{Aq}$ , insol in cold  $\text{H}_2\text{O}$ , sl sol in hot  $\text{H}_2\text{O}$  (Hofmann, Z anorg 1897, 14 295)

Is ammonium cuprous sulphocarbonate (Hofmann, B 1903, 36 1146)

**Cuprous sulphocarbonate potassium cyanide**,  $\text{CS}_3\text{Cu}$ ,  $2\text{KCN} + 2\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  and dil alkalis on warming (Hofmann, B 1903, 36 1148)

**Zinc sulphocarbonate ammonia**,  $\text{CS}_3\text{Zn}$ ,  $2\text{NH}_3$ 

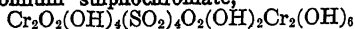
Ppt (Hofmann, Z anorg 1897, 14 277)

**Sulphochromic acid**,  $\text{H}_2\text{CrO}_4$ ,  $\text{SO}_3$  (?)

Sol in  $\text{H}_2\text{O}$  (Bolley, A 56 113)

$(\text{SO}_3)_4\text{Cr}_2\text{O}_2(\text{OH})_2$  Sol in  $\text{H}_2\text{O}$  All salts even alkali salts are insol in  $\text{H}_2\text{O}$  (Recoura, Bull Soc 1896, (3) 15 315)

$[\text{Cr}_2\text{O}_2(\text{OH})_4(\text{SO}_3)_2\text{O}_3]$ ,  $\text{Cr}_2\text{O}(\text{OH})_2(\text{SO}_3)_3$   
 $(\text{OH})(\text{OH})_2$  Sol in  $\text{H}_2\text{O}$  (Wyruboff, Bull Soc 1902, (3) 27 721)

**Chromium sulphochromate,**

Ppt, decomp by boiling  $\text{H}_2\text{O}$  (Wyrouboff, Bull Soc 1902, (3) 27 720)

**Sulphochromous acid****Ferrous sulphochromite,  $\text{FeCrS}_4$** 

Insol in  $\text{H}_2\text{O}$ , and nearly so in  $\text{HCl} + \text{Aq}$  (Groger, W A B 81, 2 531)

**Manganous —,  $\text{MnCrS}_4$** 

Insol in  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq}$  (Groger)

**Potassium —,  $\text{K}_2\text{Cr}_2\text{S}_4$** 

Insol in  $\text{H}_2\text{O}$  and in hot  $\text{HCl} + \text{Aq}$   
Easily sol in aqua regia Slowly sol in cold, rapidly sol in hot dil  $\text{HNO}_3 + \text{Aq}$  (Milbauer, Z anorg 1904, 42 443)

$\text{K}_2\text{Cr}_2\text{S}_7$  Stable in the air, sol in  $\text{HNO}_3$  and aqua regia with decomp (Schneider, J pr 1897, (3) 56 407)

**Silver —,  $\text{Ag}_2\text{Cr}_2\text{S}_4$** 

Not attacked by  $\text{HCl} + \text{Aq}$  even on heating  
Decomp by conc  $\text{HNO}_3$  (Schneider, J pr 1897, (2) 56 401)

**Sodium —,  $\text{NaCr}_2\text{S}_4$** 

Insol in  $\text{H}_2\text{O}$  Sl attacked by dil  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$  Sol in cold conc  $\text{HNO}_3$  or aqua regia Sol in hot dil  $\text{HNO}_3 + \text{Aq}$  (Groger)

Sol in acids with decomp (Schneider, J pr 1897, (3) 56 415)

**Zinc —,  $\text{ZnCr}_2\text{S}_4$** 

Insol in  $\text{H}_2\text{O}$ , sol in traces in boiling conc  $\text{HCl}$  or dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ , sol in  $\text{HNO}_3 + \text{Aq}$  (Groger, W A B 81, 2 531)

**Sulphocyanhydric acid,  $\text{HSCN}$** 

Sol in  $\text{H}_2\text{O}$

Sat  $\text{HSCN} + \text{Aq}$  has sp gr = 1.022 (Porrett, 1814)  $\text{HSCN} + \text{Aq}$  containing 12.7%  $\text{HSCN}$  has sp gr 1.040 at  $12.7^\circ$  (Hermes, Z Ch 1866 417)

**Sulphocyanides**

Most sulphocyanides are sol in  $\text{H}_2\text{O}$ , but  $\text{Cu}$ ,  $\text{Pb}$ ,  $\text{Hg}$ , and  $\text{Ag}$  sulphocyanides are insol

**Aluminum sulphocyanide,  $\text{Al(SCN)}_3$** 

Known only in solution

$\text{Al(SCN)}_3(\text{OH})_4$  Known only in solution (Suda)

**Aluminum potassium sulphocyanide,**

Very hygroscopic

Sol in  $\text{H}_2\text{O}$  and alcohol (Rosenheim, Z anorg 1901, 27 302)

**Ammonium sulphocyanide,  $\text{NH}_4\text{SCN}$** 

Deliquescent, and very sol in  $\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve 128.1 pts at  $0^\circ$  and 162.2 pts at  $20^\circ$

$\text{NH}_4\text{SCN} + \text{Aq}$  sat at ord temp has density of 1.138 and 100 cc contains 69.16 g  $\text{NH}_4\text{SCN}$  (Klasen, J pr 1887, (2) 36 67)

By dissolving 90 g  $\text{NH}_4\text{SCN}$  in 90 g  $\text{H}_2\text{O}$  at  $17^\circ$ , the temp falls to  $-12^\circ$  (Clowes, Z Ch 1866 190)

133 pts  $\text{NH}_4\text{SCN} + 100$  pts  $\text{H}_2\text{O}$  at  $13.2^\circ$  lower the temp  $31.2^\circ$  (Rudorff, B 2 68)

Sol in liquid  $\text{SO}_2$  (Walden, B 1899, 32 2864)

Difficultly sol in  $\text{AsBr}_3$  (Walden, Z anorg 1902, 29 374)

Very easily sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 826)

Easily sol in alcohol

Easily sol in acetone (Krug and M'Elroy)

Sl sol in benzonitrile (Naumann, B 1914, 47 1369)

Sol in methyl acetate (Naumann, B 1909, 42 3789)

Difficultly sol in ethyl acetate (Naumann, B 1910, 43 314)

**Ammonium bismuth sulphocyanide,**

As K salt (Rosenheim and Vogelgesang Z anorg 1906, 48 215)

**Ammonium cadmium sulphocyanide,**

Somewhat deliquescent

Melts in crystal  $\text{H}_2\text{O}$  at  $25^\circ$

Insol in alcohol (Grossmann, B 1902 35 2667)

**Ammonium cadmium molybdenyl sulphocyanide,  $\text{NH}_4\text{SCN} \cdot \text{Cd(SCN)}_2$** 

(Maas and Sand, B 1908, 41 1513)

**Ammonium cobaltous sulphocyanide,**

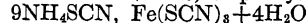
Decomp in moist air

Cannot be recryst from  $\text{H}_2\text{O}$  (Treadwell Z anorg 1901, 26 109)

$+ 4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

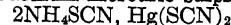
Sol in methyl, ethyl and amyl alcohol in acetone and in ether  $+ \text{Aq}$

Can be recryst from  $\text{H}_2\text{O}$  or alcohol without decomp (Rosenheim and Cohn, Z anorg 1901, 27 289)

**Ammonium iron (ferric) sulphocyanide,**

Deliquescent, and sol in  $\text{H}_2\text{O}$  (Kruss and Morah, A 260 207)

$3\text{NH}_4\text{SCN} \cdot \text{Fe(SCN)}_3$  Extremely deliquescent

**Ammonium mercuric sulphocyanide,**

Easily sol in  $\text{H}_2\text{O}$  (Fleischer, A 179 228)

$\text{NH}_4\text{Hg}(\text{SCN})_2$  Insol in cold, sol in hot  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1901, 27 284)

**Ammonium molybdenyl sulphocyanide,**  
 $3\text{NH}_4\text{SCN}$ ,  $\text{Mo}(\text{OH})(\text{SCN})_3 + 3\text{H}_2\text{O}$   
 (Sand and Maas, B 1907, 40 4507)

**Ammonium nickel sulphocyanide,**  
 $(\text{NH}_4)_4\text{Ni}(\text{SCN})_6 + 4\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  with decomp  
 Sl sol in cold, easily sol in hot alcohol  
 (Rosenheim, Z anorg 1901, 27 292)

**Ammonium silver sulphocyanide,**  $\text{NH}_4\text{SCN}$ ,  
 $\text{AgSCN}$   
 Decomp by  $\text{H}_2\text{O}$

**Ammonium vanadium sulphocyanide,**  
 $\text{V}(\text{SCN})_3$ ,  $3\text{NH}_4\text{SCN} + 4\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$ , sol in alcohol, sl sol in ether  
 (Ciocci, Z anorg 1898, 19 311)

**Ammonium vanadyl sulphocyanide,**  
 $(\text{NH}_4)_2\text{VO}(\text{SCN})_4 + 5\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$ , alcohol, ether, acetone, amyl  
 alcohol and ethyl acetate (Koppel, Z  
 anorg 1903, 36 290)

**Ammonium zinc sulphocyanide,**  
 $(\text{NH}_4)_2\text{Zn}(\text{SCN})_4 + 3\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  and in alcohol (Walden,  
 Z anorg 1900, 23 374)  
 $+ 4\text{H}_2\text{O}$  Easily sol in cold  $\text{H}_2\text{O}$ , acetone,  
 alcohols and ether (Rosenheim and Huld-  
 schunsky, B 1901, 34 3913)

**Ammonium sulphocyanide mercuric bromide,**  
 $\text{NH}_4\text{SCN}$ ,  $\text{HgBr}_2$   
 Very sol in  $\text{H}_2\text{O}$   
 Sol in alcohol (Grossmann, B 1902, 35  
 2945)  
 $2\text{NH}_4\text{SCN}$ ,  $\text{HgBr}_2 + \text{H}_2\text{O}$  Somewhat de-  
 liquescent  
 Very sol in  $\text{H}_2\text{O}$   
 Sol in alcohol (Grossmann)

**Arsenic sulphocyanide,**  $\text{As}(\text{SCN})_3$   
 Decomp by  $\text{H}_2\text{O}$  Insol in all ordinary  
 solvents (Miguel A ch (5) 11 341)

**Barium sulphocyanide,**  $\text{Ba}(\text{SCN})_2 + 2\text{H}_2\text{O}$   
 Deliquescent Easily sol in  $\text{H}_2\text{O}$  and  
 alcohol Boiling solution in alcohol contains  
 32.8% anhydrous salt Solution sat at  $20^\circ$   
 contains 30% (Tscherniak, B 16 349)  
 Cryst with  $3\text{H}_2\text{O}$  (Tscherniak, B 25  
 2627)

**Barium cadmium sulphocyanide,**  
 $4\text{Ba}(\text{SCN})_2$ ,  $\text{Cd}(\text{SCN})_2 + 10\text{H}_2\text{O}$   
 Deliquescent (Grossmann, B 1902, 36  
 2669)

**Barium caesium cuprous sulphocyanide,**  
 $\text{Ba}(\text{SCN})_2$ ,  $3\text{CsSCN}$ ,  $2\text{CuSCN}$   
 Rapidly decomp by  $\text{H}_2\text{O}$  (Wells, Am  
 Ch J 1902, 28 273)

**Barium caesium silver sulphocyanide,**  
 $\text{Ba}(\text{SCN})_2$ ,  $3\text{CsSCN}$ ,  $2\text{AgSCN}$   
 100 pts  $\text{H}_2\text{O}$  dissolve 92 pts at  $19^\circ$   
 Decomp by much  $\text{H}_2\text{O}$  (Wells, Am Ch  
 J 1902, 28 272)

**Barium cobaltous sulphocyanide,**  
 $\text{BaCo}(\text{SCN})_4 + 8\text{H}_2\text{O}$   
 Ppt (Rosenheim, Z anorg 1901, 27  
 290)

**Barium mercuric sulphocyanide,**  
 $\text{BaHg}(\text{SCN})_4$   
 Very sol in  $\text{H}_2\text{O}$  and in alcohol (Rosen-  
 heim, Z anorg 1901, 27 286)  
 $\text{BaHg}(\text{SCN})_4 + 2\text{H}_2\text{O}$  Ppt Nearly in-  
 sol in cold, easily sol in hot  $\text{H}_2\text{O}$  (Rosen-  
 heim)

**Barium potassium silver sulphocyanide,**  
 $\text{Ba}(\text{SCN})_2$ ,  $4\text{KSCN}$ ,  $2\text{AgSCN} + \text{H}_2\text{O}$   
 Very sol in a little  $\text{H}_2\text{O}$  Decomp by  
 much  $\text{H}_2\text{O}$  (Wells, Am Ch J 1902, 28  
 283)

**Barium rubidium silver sulphocyanide,**  
 $\text{BaRb}_2\text{Ag}_2(\text{SCN})_6 + 2\text{H}_2\text{O}$   
 Very sol in  $\text{H}_2\text{O}$  (Wells, Am Ch J  
 1903, 30 186)  
 $\text{BaRb}_4\text{Ag}_2(\text{SCN})_8 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$   
 (Wells)

**Barium silver sulphocyanide,**  $\text{Ba}(\text{SCN})_2$ ,  
 $2\text{AgSCN} + 2\text{H}_2\text{O}$   
 Stable in the air (Wells, Am Ch J  
 1902, 28 269)

**Barium zinc sulphocyanide,**  $\text{BaZn}(\text{SCN})_4$ ,  
 $+ 3\text{H}_2\text{O}$   
 Easily sol in alcohol (Walden, Z anorg  
 1900, 23 374)

**Barium sulphocyanide mercuric bromide,**  
 $\text{Ba}(\text{SCN})_2$ ,  $2\text{HgBr}_2 + 5\text{H}_2\text{O}$   
 Very sol in  $\text{H}_2\text{O}$  (Grossmann, Z anorg  
 1903, 37 420)

**Bismuth sulphocyanide, basic,**  
 $\text{Bi}(\text{OH})(\text{SCN}) + 5\text{H}_2\text{O}$   
 (Rosenheim and Vogelgesang, Z anorg  
 1906, 48 214)  
 $\text{Bi}(\text{SCN})_3$ ,  $2\text{Bi}_2\text{O}_3$  Insol in  $\text{H}_2\text{O}$ , but  
 when recently pptd decomp by boiling  
 therewith Insol in  $\text{HSCN} + \text{Aq}$  (Meitzen-  
 dorf)

**Bismuth sulphocyanide,**  $\text{Bi}(\text{SCN})_3$   
 Insol or sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$ ,  
 $\text{HCl}$ , and  $\text{HSCN} + \text{Aq}$  (Meitzendorf, Pogg  
 56 83)

Decomp by cold  $\text{H}_2\text{O}$  (Bender, B 20 723)

+14 $\text{H}_2\text{O}$  Extremely deliquescent  
Decomp by  $\text{H}_2\text{O}$  (Rosenheim and Vogelgesang, Z anorg 1906, 48 214)

**Bismuth potassium sulphocyanide,**  
 $\text{K}_3\text{Bi}(\text{SCN})_6$

Decomp by  $\text{H}_2\text{O}$  (Rosenheim and Vogelgesang, Z anorg 1906, 48 215)

Not hygroscopic

Decomp by  $\text{H}_2\text{O}$

Easily sol in alcohol (Vanino, Z anorg 1901, 28 220)

$\text{Bi}(\text{SCN})_3$ , 9KSCN Very hygroscopic

Decomp by  $\text{H}_2\text{O}$

Sol in alcohol (Vanino, Z anorg 1901, 28 221)

**Bismuth sodium sulphocyanide,**  
 $\text{Na}_3\text{Bi}(\text{SCN})_6$

As K salt (Rosenheim and Vogelgesang, Z anorg 1906, 48 215)

**Boron sulphocyanide, B(SCN)<sub>3</sub>**

Sol in benzene and ether (Cocksedge, Chem Soc 1908, (2) 93 217)

**Cadmium sulphocyanide, Cd(SCN)<sub>2</sub>**

Sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  with combination

**Cadmium caesium sulphocyanide,**  
 $\text{CsCd}(\text{SCN})_3$

Recryst from  $\text{H}_2\text{O}$  (Wells, Am Ch J 1903, 30 148)

$\text{Cs}_2\text{Cd}(\text{SCN})_6 + 2\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$   
Can be recryst from conc solution but decomp on dilution to  $\text{CsCd}(\text{SCN})_3$  (Wells)

**Cadmium caesium silver sulphocyanide,**  
 $\text{Cs}_2\text{CdAg}(\text{SCN})_5$

(Wells)

+2 $\text{H}_2\text{O}$  (Wells)

(s  $\text{CdAg}_4(\text{SCN})_8 + 2\text{H}_2\text{O}$  (Wells)

$\text{Cs}_4\text{Cd}_3\text{Ag}_{10}(\text{SCN})_{18} + 6\text{H}_2\text{O}$  (Wells)

**Cadmium mercuric sulphocyanide, Cd(SCN)<sub>2</sub>, Hg(SCN)<sub>2</sub>**

Very sol in hot  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1903, 37 414)

**Cadmium molybdenum sulphocyanide,**  
 $\text{Cd}(\text{SCN})_2, \text{Mo}(\text{SCN})_4 + 2\text{H}_2\text{O}$

(Maas and Sand, B 1908, 41 1513)

+3 $\text{H}_2\text{O}$  (Maas and Sand)

**Cadmium molybdenyl potassium sulphocyanide, KSCN, 4Cd(SCN)<sub>2</sub>, 3Mo(OH)(SCN)<sub>3</sub> + 18H<sub>2</sub>O**

(Mass and Sand, B 1908, 41 1513)

**Cadmium molybdenyl sulphocyanide ammonia, 3Cd(SCN)<sub>2</sub>, 2Mo(OH)(SCN) 13NH<sub>3</sub>**

(Mass and Sand, B 1908, 41 1512)

+2 $\text{H}_2\text{O}$  (Maas and Sand)

**Cadmium potassium sulphocyanide,**  
 $\text{K}_2\text{Cd}(\text{SCN})_4 + 2\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Grossmann, B 190, 35 2668)

**Cadmium rubidium sulphocyanide,**  
 $\text{Rb}_2\text{Cd}(\text{SCN})_4 + 2\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Grossmann, B 190, 35 2668)

**Cadmium sodium sulphocyanide,**  
 $\text{NaCd}(\text{SCN})_3 + 3\text{H}_2\text{O}$

(Grossmann, B 1902, 35 2668)

**Cadmium sulphocyanide ammonia, Cd(SCN)<sub>2</sub>, NH<sub>3</sub>**

Decomp by  $\text{H}_2\text{O}$  (Grossmann, B 190, 35 2666)

$\text{Cd}(\text{SCN})_2, 2\text{NH}_3$  Decomp by pure  $\text{H}_2\text{C}$  (Grossmann)

**Cadmium sulphocyanide ammonium bromide**  
 $\text{Cd}(\text{SCN})_2, \text{NH}_4\text{Br} + \text{H}_2\text{O}$

Can be recryst from  $\text{H}_2\text{O}$  Decomp in dil solution (Grossmann, Z anorg 190, 37 425)

$\text{Cd}(\text{SCN})_2, 2\text{NH}_4\text{Br}$  Easily splits o  $\text{NH}_4\text{Br}$  (Grossmann)

**Cadmium sulphocyanide ammonium chloride**  
 $\text{Cd}(\text{SCN})_2, 2\text{NH}_4\text{Cl}$

Can be recryst from  $\text{H}_2\text{O}$  Decomp in dil solution (Grossmann, Z anorg 1903, 3, 423)

**Cadmium sulphocyanide potassium bromide**  
 $\text{Cd}(\text{SCN})_2, \text{KBr} + \text{H}_2\text{O}$

Recryst from  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1903, 37 425)

$\text{Cd}(\text{SCN})_2, 2\text{KBr}$  Recryst from  $\text{H}_2\text{C}$  (Grossmann)

**Cadmium sulphocyanide potassium chloride**  
 $\text{Cd}(\text{SCN})_2, 2\text{KCl}$

Recryst from  $\text{H}_2\text{O}$  Decomp in dil solution (Grossmann, Z anorg 1903, 37 423)

**Cadmium sulphocyanide potassium iodide**  
 $\text{Cd}(\text{SCN})_2, 2\text{KI}$

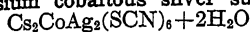
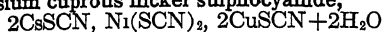
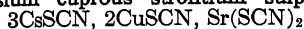
Recryst from  $\text{H}_2\text{O}$  (Grossmann)

**Cæsium calcium silver sulphocyanide,**  
 $2\text{CsSCN}, \text{Ca}(\text{SCN})_2, 2\text{AgSCN} + 2\text{H}_2\text{O}$

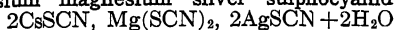
Recryst from  $\text{H}_2\text{O}$  (Wells, Am Ch 1902, 28 275)

**Cæsium chromium sulphocyanide***See* Chromisulphocyanide, cæsium**Cæsium cobaltous sulphocyanide,**

Stable in the air (Shinn and Wells, Am Ch J 1903, 29 476)

**Cæsium cobaltous silver sulphocyanide,**Slowly attacked by  $\text{H}_2\text{O}$ , decomp by boiling  $\text{H}_2\text{O}$ . Very sl sol in  $\text{CsSCN}$  or  $\text{Co}(\text{SCN})_2$  + Aq (Shinn and Wells, Am Ch J 1903, 29 478)**Cæsium cuprous sulphocyanide,  $\text{CsSCN}$ ,  $\text{CuSCN}$**  $\text{H}_2\text{O}$  separates  $\text{CuSCN}$  (Roberts, Am Ch J 1902, 28 262)**Cæsium cuprous nickel sulphocyanide,**Sl sol in  $\text{H}_2\text{O}$  (Roberts and Wells, Am Ch J 1902, 28 277)**Cæsium cuprous strontium sulphocyanide,**

As Ba salt (Wells, Am Ch J 1902, 28 275)

**Cæsium magnesium silver sulphocyanide,**

As Ca comp (Wells, Am Ch J 1902, 28 275)

**Cæsium manganous silver sulphocyanide,**Rather sl sol in  $\text{H}_2\text{O}$  (Wells)**Cæsium mercuric sulphocyanide,  $\text{CsSCN}$ ,  $\text{Hg}(\text{SCN})_2$** Sl sol in hot  $\text{H}_2\text{O}$  (Bristol and Wells, Am Ch J 1902, 28 260)**Cæsium mercuric sulphocyanide,  $2\text{CsSCN}$ ,  $\text{Hg}(\text{SCN})_2 + \text{H}_2\text{O}$** Moderately sol in  $\text{H}_2\text{O}$ , especially when warm. Recryst without decomp (Bristol and Wells, Am Ch J 1902, 28 260)**Cæsium nickel silver sulphocyanide,**Slowly decomp by hot  $\text{H}_2\text{O}$  (Wells, Am Ch J 1902, 28 277)**Cæsium silver sulphocyanide,  $\text{CsSCN}$ ,  $\text{AgSCN}$** 

Easily forms supersat solution (Wells, Am Ch J 1902, 28 264)

 $2\text{CsSCN}, \text{AgSCN}$  Stable in the air (Wells) $3\text{CsSCN}, \text{AgSCN}$  Stable in the air (Wells)**Cæsium silver strontium sulphocyanide,**

As Ba comp (Wells)

**Cæsium silver zinc sulphocyanide,**

(Wells)

 $\text{Cs}_2\text{ZnAg}(\text{SCN})_5$  Ppt Stable in the air (Wells) $\text{CsZn}_2\text{Ag}_3(\text{SCN})_8$  Decomp by cold, more rapidly by hot  $\text{H}_2\text{O}$  (Wells) $\text{CsZn}_2\text{Ag}_4(\text{SCN})_9$  Slowly decomp by  $\text{H}_2\text{O}$  (Wells)**Cæsium zinc sulphocyanide,  $\text{Cs}_2\text{Zn}(\text{SCN})_4 + 2\text{H}_2\text{O}$** Moderately sol in  $\text{H}_2\text{O}$  and can be recryst therefrom (Wells)**Calcium sulphocyanide,  $\text{Ca}(\text{SCN})_2 + 3\text{H}_2\text{O}$** Deliquescent Very sol in  $\text{H}_2\text{O}$  and alcohol**Calcium silver sulphocyanide,  $\text{Ca}(\text{SCN})_2$ ,  $2\text{AgSCN} + 2\text{H}_2\text{O}$** 

(Wells)

**Calcium stannic sulphocyanide,  $\text{CaSn}(\text{SCN})_6 + 7\text{H}_2\text{O}$** Very sol in  $\text{H}_2\text{O}$  Can be recryst therefrom Sol in alcohol and acetone (Weinland and Bames, Z anorg 1909, 62 258)**Cerous sulphocyanide,  $\text{Ce}(\text{SCN})_3 + 7\text{H}_2\text{O}$** Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol (John, Bull Soc (2) 21 534)**Chromous sulphocyanide with  $\text{MSCN}$** *See* Chromosulphocyanide, M**Chromic sulphocyanide,  $\text{Cr}(\text{SCN})_3$** Deliquescent, and sol in  $\text{H}_2\text{O}$ 

Somewhat sol in organic solvents (Speransky, C C 1897, I 141)

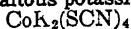
*See also* Chromisulphocyanhydric acid**Chromic sulphocyanide with  $\text{MSCN}$** *See* Chromisulphocyanide, M**Cobaltous sulphocyanide,  $\text{Co}(\text{SCN})_2 + \frac{1}{2}\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  and alcohol, also in ether Sol in liquid  $\text{SO}_2$  (Walden, B 1899, 32 2864)

Sol in acetone (Krug and M'Elroy)

Sol in methyl acetate (Naumann, B 1909, 42 3790)

 $+3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  and in alcohol (Rosenheim and Cohn, Z anorg 1901, 27 288)**Cobaltous mercuric sulphocyanide,  $\text{Co}(\text{SCN})_2$ ,  $\text{Hg}(\text{SCN})_2$** Very sl sol in  $\text{H}_2\text{O}$  and dil  $\text{HCl} + \text{Aq}$  Easily sol in  $\text{HNO}_3 + \text{Aq}$  (Cleve, J pr 91 227)



**Cobaltous potassium sulphocyanide,**Decomp by  $\text{H}_2\text{O}$  (Treadwell, Z anorg 1901, 26 109)+4 $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Sol in methyl, ethyl and amyl alcohol, in acetone and in ether+Aq Can be recryst from  $\text{H}_2\text{O}$  or alcohol without decomp (Rosenheim and Cohn, Z anorg 1901, 27 289)**Cobaltous silver sulphocyanide,  $\text{CoAg}(\text{SCN})_3$**   
+2 $\text{H}_2\text{O}$ Decomp by  $\text{H}_2\text{O}$  (Shinn and Wells, Am Ch J 1903, 29 476) $\text{Ag}_2\text{Co}(\text{SCN})_4$  Almost insol in  $\text{H}_2\text{O}$  and in alcohol (Rosenheim, Z anorg 1901, 27 291)**Cobaltous sodium sulphocyanide,**Sol in  $\text{H}_2\text{O}$  and in alcohol (Rosenheim)**Cobaltous sulphocyanide ammonia,  $\text{Co}(\text{SCN})_2$**   
2 $\text{NH}_3$  and  $\text{Co}(\text{SCN})_2 \cdot 6\text{NH}_3$ 

(Peters, B 1908, 41 3178)

 $\text{Co}(\text{SCN})_2 \cdot 4\text{NH}_3$  Sol in  $\text{H}_2\text{O}$  and alcohol (Sand, B 1903, 36 1439)**Cobaltous sulphocyanide mercuric chloride**  
2 $\text{Co}(\text{SCN})_2 \cdot 2\text{HgCl}_2$ 

(Hantzsch and Shibata, Z anorg 1912, 7 320)

2 $\text{Co}(\text{SCN})_2 \cdot 3\text{HgCl}_2$  Easily decomp (Hantzsch and Shibata)**Cuprous sulphocyanide,  $\text{CuSCN}$** 1 l  $\text{H}_2\text{O}$  at 18° dissolves 0.004 mg mol or 0.5 mg  $\text{CuSCN}$  (Kohlrausch and Ros, Z phys Ch 1893, 12 241)Insol in dil acids SI sol in cold, easl in warm conc  $\text{HCl}$ +Aq Decomp by con  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ +Aq Sol with combinatio in  $\text{NH}_4\text{OH}$ +Aq Insol in  $\text{KSCN}$ +AqLess sol in  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{SO}_4$ +Aq than 1  $\text{HNO}_3$  (Kuhn, Ch Z 1908, 32 1056)Sol in  $\text{Fe}_2(\text{SO}_4)_3$ +Aq (Johnson, J So Chem Ind 1889, 8 603) $\text{KSCN}$ +Aq (85-90 g in 50 g  $\text{H}_2\text{O}$ ) dissolves 18 g  $\text{CuSCN}$  (Thurnauer, B 1891, 23 770)

Sol in ether (Skey, C N 1867, 16 201)

**Cupric sulphocyanide,  $\text{Cu}(\text{SCN})_2$** Decomp by  $\text{H}_2\text{O}$  to cuprous salt Sol in warm  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3$ +Aq Sol in  $\text{MSCN}$ +Aq, but solutions decomp by dilution Sol in  $\text{NH}_4\text{OH}$ +AqSolubility in  $\text{NH}_4\text{OH}$ +Aq at 25° and at 40°

At 25°

Sp gr 20°/25	One gram of solution contains			1000 mols $\text{H}_2\text{O}$ dissolve		Composition of solid salt in contact with solution
	g $\text{NH}_3$	g $\text{Cu}(\text{SCN})_2$	g $\text{H}_2\text{O}$	Mols $\text{NH}_3$	Mols $\text{Cu}(\text{SCN})_2$	
0 99853	0 2147	0 1522	0 6331	358 04	24 09	} $\text{Cu}(\text{SCN})_2 \cdot 4\text{NH}_3$
0 99871	0 1655	0 1124	0 7221	242 02	15 60	
1 00703	0 0993	0 0798	0 8209	127 76	9 74	
1 01336	0 0639	0 0659	0 8702	77 51	7 59	
1 01506	0 0535	0 0622	0 8843	64 05	7 04	
1 01705	0 0426	0 0596	0 8978	50 21	6 65	} $\text{Cu}(\text{SCN})_2 \cdot 2\text{NH}_3$
1 02132	0 0250	0 0511	0 9239	28 55	5 55	
1 01661	0 0198	0 0408	0 9394	22 27	4 35	
1 00816	0 0079	0 0245	0 9676	18 61	2 54	

At 40°

	0 1802	0 1976	0 6222	306 28	31 83	} $\text{Cu}(\text{SCN})_2 \cdot 4\text{NH}_3$
	0 1398	0 1658	0 6944	213 10	23 93	
	0 0758	0 1299	0 7943	101 00	16 38	
	0 0550	0 1207	0 8243	70 59	14 67	
	0 0435	0 1178	0 8388	54 82	14 07	
	0 0352	0 0876	0 8772	42 53	10 00	} $\text{Cu}(\text{SCN})_2 \cdot 2\text{NH}_3$
	0 0257	0 0655	0 9088	30 00	7 22	
	0 0177	0 0418	0 9405	19 86	4 46	
	0 0094	0 0281	0 9625	10 31	2 93	

(Horn, Am Ch J 1907, 37 471)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

**Cuprocupric sulphocyanide,  $\text{Cu}(\text{SCN})_2$**   
 $\text{Cu}_2(\text{SCN})_2$ Not attacked by hot  $\text{HCl}$ +Aq Insol in  $\text{KSCN}$ +Aq

**Cupric mercuric sulphocyanide,  $\text{CuHg(SCN)}_4$** 

Almost insol in cold  $\text{H}_2\text{O}$  and in alcohol,  
sl sol in boiling  $\text{H}_2\text{O}$  (Rosenheim, Z anorg  
1901, 27 286)

**Cuprous potassium sulphocyanide,  $\text{CuSCN}$ ,  
 $6\text{KSCN}$** 

Deliquescent. Decomp by  $\text{H}_2\text{O}$  (Thurn-  
auer, B 1890, 23 770)

**Cuprous sulphocyanide ammonia,  $\text{Cu}_2(\text{SCN})_2$ ,  
 $2\text{NH}_3$** 

Decomp in the air (Richards, Z anorg  
1898, 17 247)

$\text{Cu}_2(\text{SCN})_2$ ,  $5\text{NH}_3$ . Very unstable in the  
air (Richards)

**Cupric sulphocyanide ammonia,  $\text{Cu(SCN)}_2$ ,  
 $2\text{NH}_3$** 

Sol in little  $\text{H}_2\text{O}$ , but decomp by dilution  
with pptn of basic salt. Sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
By long standing a small amount dissolves  
in  $\text{H}_2\text{O}$  with separation of  $\text{CuSCN}$  (Litter-  
scheid, Arch Pharm 1901, 239 337)

Insol in  $\text{H}_2\text{O}$ . Sol in  $\text{H}_2\text{O}$  containing  
a small amount of ammonia (Horn, Am  
Ch J 1907, 37 477)

$\text{Cu(SCN)}_2$ ,  $4\text{NH}_3$ . Very unstable in the  
air

Sol in  $\text{H}_2\text{O}$ , but decomp by much  $\text{H}_2\text{O}$   
with pptn of a basic salt (Horn)

100 pts  $\text{N}/10$   $\text{NH}_4\text{OH} + \text{Aq}$  dissolve 10.4  
pts anhydrous salt at  $25^\circ$  (Pudschies, Dis-  
sert)

Loses  $\text{NH}_3$  in the air

Sol in  $\text{H}_2\text{O}$  (Kohlschutter, B 1904, 37  
1156)

Decomp in the air and by  $\text{H}_2\text{O}$  and dil  
and conc acids, sol in cold conc  $\text{HNO}_3$  and  
 $\text{NH}_4\text{OH} + \text{Aq}$ . Sol in boiling conc  $\text{HCl}$   
(Richards, Z anorg 1898, 17 250)

**Didymium sulphocyanide,  $\text{D}_1(\text{SCN})_3 + 6\text{H}_2\text{O}$** 

Deliquescent, and sol in  $\text{H}_2\text{O}$

**Erbium sulphocyanide,  $\text{Er(SCN)}_3 + 6\text{H}_2\text{O}$** 

Deliquescent. Sol in  $\text{H}_2\text{O}$  (Hoglund)

**Glucinum sulphocyanide,  $\text{Gl(SCN)}_2$  (?)**

Sol in  $\text{H}_2\text{O}$  (Hermes, J pr 97 465)

**Gold (aurous) potassium sulphocyanide,  
 $\text{AuSCN}$ ,  $\text{KSCN}$** 

Easily sol in  $\text{H}_2\text{O}$ , less in absolute alcohol  
(Cleve, J pr 94 16)

**Gold (aurous) potassium sulphocyanide  
ammonia,  $\text{KAu(SCN)}_2$ ,  $5\text{NH}_3$** 

(Peters, B 1908, 41 3178)

**Gold (auric) potassium sulphocyanide am-  
monia,  $\text{KAu(SCN)}_4$ ,  $4\text{NH}_3$** 

(Peters)

**Gold (aurous) silver sulphocyanide,  $\text{AuSCN}$ ,  
 $\text{AgSCN}$** 

Insol in  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Gold (auric) potassium sulphocyanide**

Sol in  $\text{H}_2\text{O}$ , alcohol, and ether (Cleve)

**Gold (aurous) sulphocyanide ammonia,  
 $\text{AuSCN}$ ,  $\text{NH}_3$** 

Very sl sol in cold, decomp by hot  $\text{H}_2\text{O}$

**Iron (ferrous) sulphocyanide,  $\text{Fe(SCN)}_2 +$   
 $3\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$ , alcohol, or ether

Sol in acetone (Krug and M'Elroy)

**Iron (ferric) sulphocyanide,  $\text{Fe(SCN)}_3 + 3\text{H}_2\text{O}$** 

Deliquescent. Very sol in  $\text{H}_2\text{O}$ , alcohol,  
or ether. Ether extracts the salt from  
 $\text{Fe(SCN)}_3 + \text{Aq}$ . Decomp by much  $\text{H}_2\text{O}$   
if pure. Not decomp by monobasic acids,  
but conc  $\text{H}_2\text{SO}_4$  and  $\text{H}_3\text{PO}_4$ , also oxalic,  
tartaric, malic, etc., acids destroy the colour

**Iron (ferric) lithium sulphocyanide,  $\text{Fe(SCN)}_3$ ,  
 $9\text{LiSCN} + 4\text{H}_2\text{O}$** 

More deliquescent than the other ferric  
sulphocyanides (Kruss and Moraht)

**Iron (ferrous) mercuric sulphocyanide,  
 $\text{Fe(SCN)}_2$ ,  $\text{Hg(SCN)}_2 + 2\text{H}_2\text{O}$** 

Moderately sol in hot  $\text{H}_2\text{O}$  (Cleve, J  
pr 91 227)

**Iron (ferric) potassium sulphocyanide,  
 $\text{Fe(SCN)}_3$ ,  $3\text{KSCN} + x\text{H}_2\text{O}$** 

Extremely deliquescent, and sol in  $\text{H}_2\text{O}$   
(Kruss and Moraht)

$\text{Fe(SCN)}_3$ ,  $9\text{KSCN} + 4\text{H}_2\text{O}$ . Hygroscopic.  
Sol in  $\text{H}_2\text{O}$  without decomp. Insol in pure  
anhydrous ether, but decomp by ether con-  
taining traces of  $\text{H}_2\text{O}$  into  $\text{Fe(SCN)}_3$  and  
 $\text{KSCN}$  (Kruss and Moraht, A 260 204)

**Iron (ferrous) sodium sulphocyanide,  
 $\text{Na}_4\text{Fe(SCN)}_6 + 12\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  and alcohol (Rosenheim, Z  
anorg 1901, 27 299)

**Iron (ferric) sodium sulphocyanide,  $\text{Fe(SCN)}_3$ ,  
 $9\text{NaSCN} + 4\text{H}_2\text{O}$** 

Less deliquescent than the corresponding  
 $\text{NH}_4$  or  $\text{K}$  salt (Kruss and Moraht)

$\text{Na}_3\text{Fe(SCN)}_6 + 12\text{H}_2\text{O}$  (Rosenheim, Z  
anorg 1901, 27 297)

**Lanthanum sulphocyanide,  $\text{La(SCN)}_3 +$   
 $7\text{H}_2\text{O}$** 

Deliquescent, sol in  $\text{H}_2\text{O}$  (Cleve)

**Lead sulphocyanide, basic,  
 $6\text{PbO}$ ,  $\text{Pb(SCN)}_2 + 2\text{H}_2\text{O}$** 

Ppt  
 $\text{Pb(SCN)}_2$ ,  $\text{PbO} + \text{H}_2\text{O}$ . Insol in  $\text{H}_2\text{O}$   
(Stromholm, Z anorg 1904, 38 440)

**Lead sulphocyanide,  $\text{Pb}(\text{SCN})_2$** 

Nearly insol in cold, decomp by boiling  $\text{H}_2\text{O}$  (Liebig)  
 Sol in  $\text{H}_2\text{O}$   
 $4.5 \times 10^{-1}$  g are dissolved in 1 liter of sat solution at  $20^\circ$  (Böttger, Z phys Ch 1903, 46 603)

**Lead sulphocyanide bromide,  $\text{Pb}(\text{SCN})_2 \cdot 8\text{PbBr}_2$** 

(Grissom and Thorp, Am Ch J 10 219)

**Lead sulphocyanide chloride,  $\text{PbSCNCl}$** 

Sol in cold, easily sol in hot  $\text{H}_2\text{O}$  (Murtry, Chem Soc 55 50)  
 Sol in  $\text{H}_2\text{O}$  (Grissom and Thorp, Am Ch J 10 229)

**Lead sulphocyanide iodide,  $3\text{Pb}(\text{SCN})_2 \cdot \text{PbI}_2$** 

Sol in  $\text{H}_2\text{O}$  (Grissom and Thorp, Am Ch J 10 229)

**Lithium sulphocyanide,  $\text{LiSCN}$** 

Very deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol (Hermes, Z Ch 1866 417)  
 Sol in methyl acetate (Naumann, B 1909, 42 3789)

**Magnesium sulphocyanide,  $\text{Mg}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$** 

Deliquescent Easily sol in  $\text{H}_2\text{O}$  and alcohol

**Magnesium stannic sulphocyanide,  $\text{MgSn}(\text{SCN})_6 \cdot 6\text{H}_2\text{O}$** 

Hygroscopic Sol in  $\text{H}_2\text{O}$ , alcohol and acetone (Weinland and Barnes, Z anorg 1909, 62 258)

**Manganous sulphocyanide,  $\text{Mn}(\text{SCN})_2 \cdot 3\text{H}_2\text{O}$** 

Deliquescent Easily sol in  $\text{H}_2\text{O}$  and alcohol

**Mercurous sulphocyanide,  $\text{Hg}_2(\text{SCN})_2$** 

Insol in  $\text{H}_2\text{O}$  Sol in hot  $\text{HCl} + \text{Aq}$   
 Slowly decomp by hot aqua regia Sol in hot  $\text{KSCN} + \text{Aq}$

**Mercuric sulphocyanide, basic,  $\text{Hg}(\text{SCN})_2 \cdot 3\text{HgO}$** 

Insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HCl} + \text{Aq}$   
 Insol in  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$  (Fleischer)  
 $\text{Hg}(\text{SCN})_2 \cdot 2\text{HgO}$  Insol in  $\text{H}_2\text{O}$  Sol attacked by acids (Claus, J pr 15 401)

**Mercuric sulphocyanide,  $\text{Hg}(\text{SCN})_2$** 

Very sl sol in cold, much more easily in hot  $\text{H}_2\text{O}$  Easily sol in dil  $\text{HCl} + \text{Aq}$  (Crookes, Chem Soc 4 18)  
 Solubility in  $\text{H}_2\text{O} = 0.00218$  mol in 1 l (Grossmann, Z anorg 1904, 43 358)  
 More sol in  $\text{H}_2\text{O}$  than in alcohol (Peters, B 1908, 41 3180)

Very sl sol in  $\text{H}_2\text{O}$  at  $25^\circ$  Appreciat sol only in boiling  $\text{H}_2\text{O}$  (Jander, Disse 1902)

Sol in  $\text{Hg}(\text{NO}_3)_2$  or  $\text{KSCN} + \text{Aq}$ , also  $\text{NH}_4\text{Cl} + \text{Aq}$  Sol in many sulphocyanic + Aq

Easily sol in cold  $\text{HCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{KCl}$ ,  $\text{BaCl}_2 + \text{Aq}$  (Hermes, J pr 1866, (1) 477)

Very sol in liquid  $\text{NH}_3$  (Franklin, A Ch J 1898, 20 829)

Sol in benzonitrile (Naumann, 1914, 47 1369)

**Mercuric hydrogen sulphocyanide,  $\text{Hg}(\text{SCN})_2 \cdot 2\text{HSCN}$** 

Easily decomp (Hermes, Dissert 186

**Mercuric nickel sulphocyanide,  $\text{Hg}(\text{SCN})_2 \cdot \text{Ni}(\text{SCN})_2 \cdot 2\text{H}_2\text{O}$** 

Moderately sol in hot  $\text{H}_2\text{O}$  (Cleve, pr 91 227)

Very sol in  $\text{MSCN} + \text{Aq}$  (Orloff, C 1906, I 1411)

**Mercuric potassium sulphocyanide,  $\text{Hg}(\text{SCN})_2 \cdot \text{KSCN}$** 

Sol in cold, more easily in hot  $\text{H}_2\text{O}$  & in alcohol and ether Very sol in  $\text{NH}_4\text{Cl}$   $\text{KCl} + \text{Aq}$  (Claus)  
 $\text{K}_2\text{Hg}(\text{SCN})_4$  Very sol in  $\text{H}_2\text{O}$ , sol alcohol

Insol in anhydrous ether (Rosenhe Z anorg 1901, 27 285)

**Mercuric rubidium sulphocyanide,  $\text{Hg}(\text{SCN})_2 \cdot \text{RbSCN}$** 

Sol in alcohol without decomp Decon by  $\text{H}_2\text{O}$

$\text{Hg}(\text{SCN})_2 \cdot 2\text{RbSCN} + \frac{1}{2}\text{H}_2\text{O}$  Easily in  $\text{H}_2\text{O}$  without decomp (Grossmann, 1904, 37 1259)

**Mercuric sodium sulphocyanide,  $\text{Na}_2\text{Hg}(\text{SCN})_3$** 

Very hygroscopic (Rosenheim, Z anorg 1901, 27 286)

**Mercuric zinc sulphocyanide,  $\text{Hg}(\text{SCN})_2 \cdot \text{Zn}(\text{SCN})_2$** 

Scarcely sol in cold  $\text{H}_2\text{O}$  Easily sol  $\text{HCl} + \text{Aq}$  (Cleve)

**Mercuric sulphocyanide ammonia,  $2\text{Hg}(\text{SCN})_2 \cdot 3\text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  and alcohol  
 $\text{Hg}(\text{SCN})_2 \cdot 4\text{NH}_3$  (Peters, B 1908, 3178)

**Mercuric sulphocyanide ammonium bromide,  $\text{Hg}(\text{SCN})_2 \cdot \text{NH}_4\text{Br}$** 

Decomp by  $\text{H}_2\text{O}$  Sol in alcohol (Grossmann, Z anorg 1903, 37 418)

**Mercuric sulphocyanide ammonium chloride**,  $\text{Hg}(\text{SCN})_2, \text{NH}_4\text{Cl}$

Decomp by  $\text{H}_2\text{O}$  Sol in warm alcohol from which it can be cryst (Grossmann)

**Mercuric sulphocyanide bromide**,  $\text{HgSCNBr}$

Insol in cold  $\text{H}_2\text{O}$ , sol in hot  $\text{H}_2\text{O}$  and in alcohol (Rosenheim, Z anorg 1901, 27 282)

**Mercuric sulphocyanide chloride**,  $\text{HgSCNCl}$

Insol in cold  $\text{H}_2\text{O}$

Sol in hot  $\text{H}_2\text{O}$  and alcohol (Rosenheim)

**Mercuric sulphocyanide potassium bromide**,  $\text{Hg}(\text{SCN})_2, 2\text{KBr}$

Very sol in  $\text{H}_2\text{O}$  (Grossmann, Z anorg 1903, 37 418)

**Mercuric sulphocyanide potassium chloride**,  $\text{Hg}(\text{SCN})_2, \text{KCl}$

Decomp by  $\text{H}_2\text{O}$

Not decomp by recryst from warm alcohol (Grossmann)

**Molybdenum sulphocyanide**,  $\text{Mo}(\text{SCN})_3(?)$

Sol in  $\text{H}_2\text{O}$  and ether (Braun, Z anal 6 36)

**Molybdenum potassium sulphocyanide**,



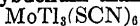
Cryst from boiling  $\text{H}_2\text{O}$  and alcohol Chilesotti, Gazz ch it 1904, 34 (2) 493)

**Molybdenum sodium sulphocyanide**,



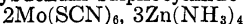
(Rosenheim, B 1909, 42 154)

**Molybdenum thallous sulphocyanide**,



(Rosenheim and Garfunkel, B 1908, 41 388)

**Molybdenum sulphocyanide zinc amine**,



(Rosenheim and Garfunkel, B 1908, 41 390)

$2\text{Mo}(\text{SCN})_6(\text{OH})$ ,  $\text{Zn}_3(\text{NH}_3)_{11}$  Can be ryst from boiling  $\text{NH}_4\text{OH} + \text{Aq}$  Air-dried alt probably has the composition  $\text{Mo}(\text{SCN})_6(\text{OH})$ ,  $3\text{Zn}(\text{NH}_3)_4 + 2\text{H}_2\text{O}$  (Maas and Sand, B 1908, 41 1510)

$2\text{Mo}(\text{SCN})_6(\text{OH})$ ,  $\text{Zn}_3(\text{NH}_3)_{13}$  (Maas and Sand)

**Nickel sulphocyanide**,  $\text{Ni}(\text{SCN})_2$

Sol in  $\text{H}_2\text{O}$  (Grossmann, B 1904, 37 65)

$+ \frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  and alcohol Insol in acetone (Krug and M'Elroy)

$+ \frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Rosenheim and Cohn, Z anorg 1901, 27 292)

**Nickel potassium sulphocyanide**,



Sol in  $\text{H}_2\text{O}$  with decomp

Sl sol in cold, easily sol in hot alcohol (Rosenheim, Z anorg 1901, 27 292)

**Nickel sodium sulphocyanide**,



Sol in  $\text{H}_2\text{O}$  with decomp

Sl sol cold, readily sol hot alcohol (Rosenheim, Z anorg 1901, 27 292)

**Nickel sulphocyanide ammonia**,  $\text{Ni}(\text{SCN})_2, 3\text{NH}_3$

(Peters, B 1908, 41 3178)

$\text{Ni}(\text{SCN})_2, 4\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$

**Platinous sulphocyanide**,  $\text{Pt}(\text{SCN})_2(?)$

Insol in  $\text{H}_2\text{O}$

See *Platinosulphocyanides, and Platinosulphocyanides*

**Potassium sulphocyanide**,  $\text{KSCN}$

Deliquescent Very sol in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  dissolve 177 2 pts at  $0^\circ$ , and 217 0 pts at  $20^\circ$

100 g sat,  $\text{KSCN} + \text{Aq}$  contain 70 5 g  $\text{KSCN}$  at  $25^\circ$  (Foote, Z phys Ch 1903, 46 81)

150 pts  $\text{KSCN} + 100$  pts  $\text{H}_2\text{O}$  at  $10.8^\circ$  lower the temp  $34.5^\circ$  (Rudorff, B 2 68)

Solubility of  $\text{KSCN} + \text{AgSCN}$  at  $25^\circ$

% KSCN	% AgSCN	Solid phase
70 53	0 00	KSCN
66 55	9 32	KSCN + 2KSCN, AgSCN
64 47	10 62	2KSCN, AgSCN
61 25	11 76	"
58 34	13 55	"
53 21	17 53	"
50 68	20 43	2KSCN, AgSCN + KSCN, AgSCN
49 43	20 32	KSCN, AgSCN
32 51	18 34	"
24 68	16 41	"
23 86	16 07	KSCN, AgSCN + AgSCN

(Foote, Z phys Ch 1903, 46 81)

See also  $\text{AgSCN}$

Sol in alcohol, especially easily if boiling

Sol in acetone (Krug and M'Elroy)

Sol in liquid  $\text{SO}_2$  (Walden, Z anorg 1902, 30 160)

100 g acetone dissolve 20 75 g KSCN at  $22^\circ$ , and 20 40 g at  $58^\circ$

100 g amyl alcohol dissolve 0 18 g KSCN at  $13^\circ$ , 1 34 g at  $65^\circ$ , 2 14 g at  $100^\circ$ , 3 15 g at  $133.5^\circ$

100 g ethyl acetate dissolve 0 44 g KSCN at  $0^\circ$ , 0 40 g at  $14^\circ$ , 0 20 g at  $79^\circ$

100 g pyridine dissolve 6 75 g KSCN at  $0^\circ$ , 6 15 g at  $20^\circ$ , 4 97 g at  $58^\circ$ , 3 88 g at

97°, 3.21 g at 115° (Laszcynski, B 1894, 27 2285)

100 g acetonitrile dissolve 11.31 g KSCN at 18° (Naumann and Schier, B 1914, 47 249)

Sl sol in benzonitrile (Naumann, B 1914, 47 1369)

Sol in methyl acetate (Naumann, B 1909, 42 3789)

**Potassium molybdenyl sulphocyanide**,  $3\text{KSCN} \cdot \text{Mo}(\text{OH})(\text{SCN})_3 + 4\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Sand and Maas, B 1908, 41 1506)

**Potassium silver sulphocyanide**,  $\text{KSCN} \cdot \text{AgSCN}$

Decomp by  $\text{H}_2\text{O}$

See Donk under KSCN

$2\text{KSCN} \cdot \text{AgSCN}$  Stable in the air (Wells, Am Ch J 1902, 28 265)

See Donk under KSCN

$3\text{KSCN} \cdot \text{AgSCN}$  (Wells)

**Potassium stannic sulphocyanide**,  $\text{K}_2\text{Sn}(\text{SCN})_6 + 4\text{H}_2\text{O}$

Verv sol in  $\text{H}_2\text{O}$

Sol in alcohol and acetone (Weinland and Bames, Z anorg 1909, 62 258)

**Potassium titanyl sulphocyanide**,  $2\text{KSCN} \cdot \text{TiO}(\text{SCN})_2 + \text{H}_2\text{O}$

Sol in cold  $\text{H}_2\text{O}$  without immediate decomp but slowly decomp (Rosenheim and Cohn, Z anorg 1901, 28 169)

**Potassium vanadium sulphocyanide**,  $3\text{KSCN} \cdot \text{V}(\text{SCN})_3 + 4\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Sol in alcohol with a green color Sl sol in ether (Ciocci, Z anorg 1898, 19 309)

Sol in  $\text{H}_2\text{O}$  with decomp, stable in aq solution in the presence of an excess of KSCN, sol in alcohol (Locke, Am Ch J 1898, 20 604)

**Potassium vanadyl sulphocyanide**,  $\text{KVO}(\text{SCN})_4 + 5\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , alcohol, ether, amyl alcohol and ethyl acetate (Koppel, Z anorg 1903, 36 292)

**Potassium zinc sulphocyanide**,  $2\text{KSCN} \cdot \text{Zn}(\text{SCN})_2 + 3\text{H}_2\text{O}$

Easily sol in alcohol (Walden, Z anorg 1900, 23 374)

**Potassium sulphocyanide mercuric bromide**,  $\text{KSCN} \cdot \text{HgBr}$

Very sol in  $\text{H}_2\text{O}$

Sol in alcohol (Grossmann, B 1902, 35 2945)

$2\text{KSCN} \cdot \text{HgBr}$  Very sol in  $\text{H}_2\text{O}$  Sol in alcohol (Grossman)

**Potassium sulphocyanide mercuric iodide**,  $2\text{KSCN} \cdot \text{HgI}_2$

Undecomp by solution in conc alc coh or in KSCN + Aq (Grossmann, Z anorg 1903, 37 421)

$+2\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Philp Pogg, 1867, 131 94)

**Silicon sulphocyanide**,  $\text{Si}(\text{SCN})_4$

Decomp by  $\text{H}_2\text{O}$  and alcohol Sol in  $\text{CS}_2$ ,  $\text{CHCl}_3$  and ligrom, (Reynold Proc Chem Soc 1906, 22 17)

**Silver sulphocyanide**,  $\text{AgSCN}$

1 l  $\text{H}_2\text{O}$  dissolves  $1.08 \times 10^{-6}$  g mol  $\text{AgSCN}$  at 25° (Kuster and Thiel, Z anorg 1902, 33 139)

1 l  $\text{H}_2\text{O}$  dissolves  $1.25 \times 10^{-6}$  gram-atom of silver at 25° (Abegg and Cox, Z phys Ch 1903, 46 11)

Sl sol in  $\text{H}_2\text{O}$  1 liter of sat solution 19.96° contains  $1.37 \times 10^{-4}$  g (Böttge Z phys Ch 1903, 46 603)

6.4 milligrams are dissolved in 1 liter sat solution at 100° (Böttger, Z phys C 1906, 56 93)

Solubility product of  $\text{AgSCN}$  is 0.49 at  $1.16 \times 10^{-12}$  mols per l at 18° and 25° respectively (Kirschner, Z phys Ch 191 79 245)

Solubility in  $\text{H}_2\text{O} = 1.2 \times 10^{-6}$  g mol p liter at 25° (A E Hill, J Am Chem Soc 1908, 30 74)

1 l  $\text{H}_2\text{O}$  dissolves 0.00025 g  $\text{AgSCN}$  21° (Whitby, Z anorg 1910, 67 108)

Insol in acids, excepting conc  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$  Insol in dl, sol in conc  $\text{NH}_4\text{OH}$  Aq Sol in KSCN + Aq Insol in  $\text{AgNO}_3$  or  $\text{NH}_4\text{SCN}$  + Aq Sol in  $\text{Hg}_2(\text{NO}_3)_2$  Aq

Solubility in KSCN at 25°

Mol KSCN in 1 litre	g $\text{AgSCN}$ in 1 litre
1.25	22.34
1.20	19.93
1.12	16.18
1.066	14.10
0.626	2.80
0.573	2.06

(Hellwig, Z anorg 1900, 25 184)

Solubility in N/10 KSCN + Aq at 18° =  $4 \times 10^{-4}$  (Kirschner, Z phys Ch 1912, 247)

See also KSCN

1 l of a 3-N solution of  $\text{AgNO}_3$  dissolve 0.432 g  $\text{AgSCN}$  at 25° Nearly insol in dl solution (Hellwig, Z anorg 1900, 2 179)

Insol in methyl acetate (Naumann, 1909, 42 3790)

Insol in ethyl acetate (Hamers, Disse 1906, Naumann, B 1910, 43 314)

**Silver strontium sulphocyanide**,  $2\text{AgSCN}$ ,  $\text{Sr}(\text{SCN})_2 + 2\text{H}_2\text{O}$

Stable in the air (Wells, Am Ch J 1902, 28 270)

**Silver zinc sulphocyanide**,  $2\text{AgSCN}$ ,  $\text{Zn}(\text{SCN})_2$

Decomp by hot  $\text{H}_2\text{O}$  (Wells)

**Silver sulphocyanide ammonia**,  $\text{AgSCN}$ ,  $2\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$

**Samarium sulphocyanide**,  $\text{Sm}(\text{SCN})_3 + 6\text{H}_2\text{O}$   
Very deliquescent (Cleve)

**Sodium sulphocyanide**,  $\text{NaSCN}$

Very deliquescent Very sol in  $\text{H}_2\text{O}$  and alcohol

Sol in benzonitrile (Naumann, B 1914, 47 1369)

Sol in methyl acetate (Naumann, B 1909, 42 3789)

**Sodium stannic sulphocyanide**,  $\text{Na}_2\text{Sn}(\text{SCN})_6 + 6\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  Sol in alcohol and acetone (Weinland and Barnes, Z anorg 1909, 62 257)

**Sodium vanadium sulphocyanide**,  $3\text{NaSCN}$ ,  $\text{V}(\text{SCN})_3 + 12\text{H}_2\text{O}$

Very hygroscopic Sol in  $\text{H}_2\text{O}$  and alcohol (Ciocci, Z anorg 1898, 19 313)

**Strontium sulphocyanide**,  $\text{Sr}(\text{SCN})_2 + 3\text{H}_2\text{O}$

Very deliquescent, and sol in  $\text{H}_2\text{O}$  and alcohol

**Strontium stannic sulphocyanide**,  $\text{SrSn}(\text{SCN})_6 + 12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , alcohol and acetone (Weinland and Barnes, Z anorg 1909, 62 259)

**Thallium sulphocyanide**,  $11\text{SCN}$

Sl sol in  $\text{H}_2\text{O}$  3.15 g are contained in 1 liter of sat solution at  $20^\circ$ , 3.905 g at  $25^\circ$ , 7.269 g at  $39.75^\circ$  Insol in alcohol (Bottger, Z phys Ch 1903, 46 603)

**Titanyl sulphocyanide**,  $11\text{O}(\text{SCN})_2 + 2\text{H}_2\text{O}$

Sol in cold  $\text{H}_2\text{O}$

**Tin (stannous) sulphocyanide**,  $\text{Sn}(\text{SCN})_2$

Sol in  $\text{H}_2\text{O}$  and alcohol (Classen, J pr 96 349)

Sol in cold  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1901, 28 168)

**Yttrium sulphocyanide**,  $\text{Y}(\text{SCN})_3 + 6\text{H}_2\text{O}$

Not deliquescent Very sol in  $\text{H}_2\text{O}$ , alcohol, or ether

**Zinc sulphocyanide**,  $\text{Zn}(\text{SCN})_2$

Less sol in  $\text{H}_2\text{O}$  and alcohol than most other cyanides

**Zinc sulphocyanide ammonia**,  $\text{Zn}(\text{SCN})_2$ ,  $12\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Sulphocyanoplatinic acid**

See Platinosulphocyanhydric acid

**Sulphocyanoplatinous acid**

See Platinosulphocyanhydric acid

**Sulphohypophosphoric acid**

**Aluminum sulphohypophosphate**,  $\text{Al}_2(\text{PS}_3)_3$

Unstable in the air Sol in  $\text{H}_2\text{O}$  with decomp (Friedel, C R 1894, 119 262)

**Cadmium —**,  $\text{Cd}_2\text{P}_2\text{S}_6$

Partially decomp in moist air Decomp by  $\text{H}_2\text{O}$ , cold  $\text{HNO}_3$  or alkalis + Aq (Ferriand, A ch 1899, (7) 17 423, Bull Soc 1895, (3) 13 116)

**Chromium —**,  $\text{Cr}_2\text{P}_2\text{S}_6$

Insol in  $\text{HNO}_3$  Very sl attacked by aqua regia (Ferriand)

**Cupric —**,  $\text{Cu P S}_6$

Ppt (Friedel, C R 1894, 119 262)

**Iron (ferrous) —**,  $\text{Fe P S}_6$

Sol in  $\text{HNO}_3$  and in a mixture of  $\text{HNO}_3$  with  $\text{KClO}_3$  (Friedel)

**Lead —**,  $\text{Pb P S}_6$

Not decomp by boiling  $\text{H}_2\text{O}$  (Friedel)

**Mercuric —**,  $\text{Hg P S}_6$

Slowly decomp by boiling  $\text{H}_2\text{O}$ , more rapidly by  $\text{KOH} + \text{Aq}$  (Friedel)

**Nickel —**,  $\text{Ni P S}_6$

Not attacked by boiling  $\text{H}_2\text{O}$  or hot or cold acids Sl attacked by aqua regia (Ferriand, A ch 1899, (7) 17 416)

**Silver —**,  $\text{Ag}_4\text{P}_2\text{S}_6$

Ppt (Friedel, C R 1894, 119 263)

**Tin (stannous) hypophosphate —**,  $\text{SnPS}_3$

Decomp by boiling  $\text{H}_2\text{O}$  Sol in dil  $\text{KOH} + \text{Aq}$  (Friedel, C R 1894, 119 264)

**Tin (stannic) —**,  $\text{SnP}_2\text{S}_6$

Easily decomp by boiling  $\text{H}_2\text{O}$  Sol in dil  $\text{KOH} + \text{Aq}$  (Friedel)

**Zinc sulphohypophosphate,  $Zn_2P_2S_6$** 

Decomp in moist air Insol in  $H_2O$  Partially decomp by boiling  $H_2O$  Violently attacked by  $HNO_3$  Sol in aqua regia Not attacked by  $HCl$  (Ferrand, A ch 1899, (7) 17 421)

**Zinc —,  $Zn_2P_2S_6$** 

Insol in  $H_2O$  Partly decomp by boiling  $H_2O$  Not decomp by  $HCl$  or  $HNO_3$  but by aqua regia (Ferrand, Bull Soc 1895, (3) 13 115)

**Sulphomolybdic acid****Ammonium sulphomolybdate,  $(NH_4)_2MoS_4$** 

Easily sol in  $H_2O$ , very sl sol in alcohol (Berzelius, Pogg 83 261)

**Ammonium cupric sulphomolybdate**

Sl sol in  $H_2O$  (Debray, C R 96 1616)

**Barium sulphomolybdate,  $BaMoS_4$** 

More sol in  $H_2O$  than  $BaMoS_{10}$  Known only in solution (Berzelius)

$BaS, 3MoS_2 = BaMoS_{10}$  Sl sol in cold, easily sol in hot  $H_2O$  Not decomp by conc cold  $HNO_3 + Aq$ , but more easily by dil  $HNO_3 + Aq$  (Berzelius)

**Cadmium sulphomolybdate**

Insol in  $H_2O$  (Berzelius)

**Cæsium sulphomolybdate,  $Cs_2S, 3MoS_4 + 7H_2O$** 

As Rb comp (Herschfinkel, Dissert 1907)  $3Cs_2S, 5MoS_4$  (Herschfinkel)

**Calcium sulphomolybdate,  $CaS, 3MoS_2$** 

Sol in  $H_2O$  (Berzelius)

$CaMoS_4$  More sol in  $H_2O$  than  $CaS, 3MoS_2$  Known only in solution (Berzelius)

**Cerium sulphomolybdate**

Precipitate (Berzelius)

**Cobalt sulphomolybdate,  $CoMoS_4$** 

Sol in  $K_2MoS_4 + Aq$  (Berzelius)

**Cupric sulphomolybdate**

(Debray, C R 96 1616)

**Ferrous sulphomolybdate,  $FeMoS_4$** 

Sol in  $H_2O$  (Berzelius)

**Ferric sulphomolybdate,  $Fe(MoS_4)_3$** 

Sol in  $K_2MoS_4 + Aq$

**Lead sulphomolybdate**

Ppt (Berzelius)

**Lithium sulphomolybdate**

Not deliquescent, but very easily sol in  $H_2O$  (Berzelius)

**Magnesium sulphomolybdate,  $MgMoS_4$** 

Sol in  $K_2MoS_4 + Aq$  (Berzelius)

**Manganous sulphomolybdate,  $MnMoS_4$** 

Sol in  $H_2O$  (Berzelius)

**Mercurous sulphomolybdate,  $Hg_2MoS_4$  (?)**

Ppt

**Mercuric sulphomolybdate,  $HgMoS_4$** 

Insol in  $K_2MoS_4 + Aq$

**Nickel sulphomolybdate,  $NiMoS_4$** 

Sol in  $K_2MoO_4 + Aq$  (Berzelius)

**Potassium sulphomolybdate, basic,  $K_6Mo$** 

Easily sol in  $H_2O$  Insol in alcohol ether (Kruss, B 16 2050)

**Potassium sulphomolybdate,  $K_2MoS_4$** 

Sol in  $H_2O$ , from which it is precipitated by alcohol (Berzelius)

**Rubidium sulphomolybdate,  $3Rb_2S, 8MoS_4 + 30H_2O$** 

Very sl sol in  $H_2O$  Sol by addition  $NH_3$  (Herschfinkel, Dissert 1907)  $5Rb_2S, 6MoS_2$  (Herschfinkel)

**Silver sulphomolybdate,  $Ag_2MoS_4$** 

Ppt

**Sodium sulphomolybdate,  $Na_2MoS_4$** 

Sol in  $H_2O$ , and not precipitated by alcohol from aqueous solution (Berzelius)

**Strontium sulphomolybdates**

Exactly analogous to the Ba salts, wh see (Berzelius)

**Zinc sulphomolybdate**

Ppt Insol in  $H_2O$  (Berzelius)

**Monosulphomolybdic acid,****Sodium monosulphomolybdate,  $Na_2MoO_3S$** 

Rather hygroscopic Sol in  $H_2O$ , for deep blue solution with  $H_2SO_4$  Sol  $HC_2H_3O_2 + Aq$  (Kruss, A 225 I)

***D*-sulphomolybdic acid****Ammonium *d*-sulphomolybdate,**

$(NH_4)_2MoO_3S_2$

Sl sol in cold, easily in hot  $H_2O$  Insol in sat  $NH_4Cl + Aq$  and absolute alcohol

Aqueous solution is decomp by boil (Bodenstab, J pr 78 186)

**Potassium disulphomolybdate**,  $K_2MoO_2S_2$

Very sol in  $H_2O$  and alcohol Sol in  $HC_2H_3O_2 + Aq$  (Kruss, B 16 2046)

**Trisulphomolybdic acid**

**Ammonium hydrogen trisulphopyromolybdate**,  $NH_4HMo_2O_4S_3$

Precipitate Insol in alcohol or  $CS_2$  (Kruss, B 16 2047)

**Potassium hydrogen trisulphopyromolybdate**,  $KHMo_2O_4S_3$

Very easily sol in  $H_2O$  (Kruss, B 16 2048)

**Sodium hydrogen trisulphopyromolybdate**,  $NaHMo_2O_4S_3$

Precipitate Much more sol in  $H_2O$  than the  $NH_4$  compound (Kruss, B 16 2047)

**Potassium sulphomolybdate**,  $K_2Mo_4S_9O_7$

Sol in  $H_2O$ ,  $HC_2H_3O_2$ , and  $H_2SO_4$  (Kruss, B 17 1771)

**Pentasilphomolybdic acid**

**Potassium pentasilphomolybdate**,  $KMoS_5$

Sol in warm  $H_2O$  (Hofmann, Z anorg 1896, 12 62)

**Persulphomolybdic acid**,  $H_2MoS_5$

Precipitate Insol in  $H_2O$ , alcohol, ether,  $CS_2$ , and acetic acid

Decomp slowly by hot  $H_2SO_4$  Sol in warm  $KOH + Aq$ , and cold  $K_2S + Aq$  Not attacked by cold  $KSH + Aq$ , but dissolves on warming (Kruss, B 17 1773)

**Ammonium persulphomolybdate**,  $(NH_4)_2MoS_5$

Very sl sol in cold, more easily in hot  $H_2O$  Insol in  $NH_4OH + Aq$  (Berzelius)

**Barium** —,  $BaMoS_5$

Insol in boiling  $H_2O$  or dil  $HCl + Aq$  (Berzelius)

**Calcium** —

Difficultly sol in  $H_2O$  (Berzelius)

**Cerium** —

Precipitate (Berzelius)

**Ferrous** —

Insol in Fe salts +  $Aq$ , but sol in  $K_2MoS_5 + Aq$  (Berzelius)

**Ferric** —

Ppt

**Lithium persulphomolybdate**

Sl sol in cold, easily sol in hot  $H_2O$  (Berzelius)

**Magnesium** —

Insol precipitate (Berzelius)

**Nickel** —

Ppt Sol in  $K_2MoS_5 + Aq$ , from which it separates in 24 hours (Berzelius)

**Potassium** —,  $K_2MoS_5$

Almost insol in cold, more sol in hot  $H_2O$  Insol in cold  $KOH + Aq$  (Berzelius)

**Potassium hydrogen** —,  $KHMoS_5$

Sol in  $H_2O$  (Kruss)

**Sodium** —,  $Na_2MoS_5$

Sl sol in cold, easily in hot  $H_2O$  (Berzelius)

**Sodium hydrogen** —,  $NaHMoS_5$

(Kruss)

**Persulphomolybdic acid**,  $HMoS_5$

Sol in  $H_2O$  (Hofmann, Z anorg 1896, 12 59)

**Ammonium** —,  $NH_4MoS_5 + H_2O$

Sl sol in  $H_2O$  and in alcohol with decomp (Hofmann)

**Cæsium** —,  $CsMoS_5$

Almost insol in  $H_2O$  (Hofmann)

**Potassium** —,  $KMoS_5$

Sol in  $H_2O$  (Hofmann,)

**Thallium** —,  $TlMoS_5$

Insol in  $H_2O$  (Hofmann)

**Sulphonosmic acid**

**Potassium sulphonosmate**,

$7K_2O, 4OsO_3, 10SO_2$

Sol in  $H_2O$  (Rosenheim, Z anorg 1899, 21 127)

+  $3H_2O$  Sol in  $H_2O$  (Rosenheim)

+  $7H_2O$  Easily sol in  $H_2O$ , decomp in aq solution at  $70^\circ$  (Rosenheim)

$11K_2O, 4OsO_3, 14SO_2 + 7H_2O$  Sol in  $H_2O$  (Rosenheim)

**Sodium sulphonosmate**,

$3Na_2O, OsO_3, 4SO_2 + 5H_2O$

Easily sol in  $H_2O$ , decomp in aq solution (Rosenheim)



**Sulphopalladic acid**

**Potassium palladious sulphopalladate**,  $K_2S, Pd_2S, PdS_2 = K_2Pd_2S_4$

Insol in  $H_2O$  Moderately conc  $HCl + Aq$  dissolves out K without evolution of  $H_2S$  (Schneider, Pogg 141 526)

**Silver sulphopalladate**,  $Ag_2PdS_3$   
(Schneider)

**Silver palladious sulphopalladate**,  $Ag_2S, Pd_2S, PdS_2 = Ag_2Pd_2S_4$   
Extraordinarily stable (Schneider)

**Sodium sulphopalladate**,  $Na_2PdS_3$   
Slowly sol in  $H_2O$  Insol in alcohol  
(Schneider, Pogg 141 520)

**Sulphophosphide of M**  
See M phosphosulphide

**Sulphophosphamic acid**,  $PS(OH)_2(?)$   
See Thiophosphamic acid

**Sulphophosphodiamic acid**,  $PS(OH)(NH_2)_2(?)$   
See Thiophosphodiamic acid

**Sulphophosphotriamide**,  $PS(NH_2)_3$   
See Thiophosphoryl triamide

**Sulphophosphoric acid**,  $H_3PSO_3$   
See Thiophosphoric acid  
 $H_3PS_4$  Known only in its salts

**Ammonium sulphophosphate**,  $(NH_4)_3PS_4$   
Stable in the air (Ephraim, B 1911, 44 3408)

**Antimony sulphophosphate**,  $SbPS_4$   
Insol in  $H_2O$ , alcohol, ether,  $CS_2$ ,  $HCl + Aq$ , dil  $H_2SO_4 + Aq$ ,  $C_2H_5$ , or  $HC_2H_3O_2$  Decomp by boiling with conc  $HNO_3 + Aq$ ,  $H_2SO_4$ , aqua regia,  $KOH$ ,  $NaOH$  or  $NH_4OH + Aq$  (Glatzel, B 24 3886)

**Arsenic sulphophosphate**,  $AsPS_4$   
Insol in  $H_2O$ , alcohol,  $HCl + Aq$ , etc Decomp by warm  $HNO_3$ , aqua regia, dil  $H_2SO_4$ , also sol in  $KOH$  or  $NH_4OH + Aq$  (Glatzel, Z anorg 4 186)

**Barium sulphophosphate**,  $Ba_3(PS_4)_2 + xH_2O$   
(Ephraim, B 1911, 44 3409)

**Bismuth sulphophosphate**,  $BiPS_4$   
Insol in  $H_2O$ , alcohol, ether,  $CS_2$ , benzene,  $HC_2H_3O_2$ , or dil  $H_2SO_4 + Aq$  Decomp by boiling  $HCl + Aq$ , conc  $H_2SO_4$ ,  $HNO_3$ , or aqua regia, also by  $NaOH$ ,  $KOH$ , or  $NH_4OH + Aq$  (Glatzel, Z anorg 4 186)

**Cadmium sulphophosphate**,  $Cd_3(PS_4)_2$

Insol in  $H_2O$ , alcohol, ether, benzene,  $CS_2$ , and  $HC_2H_3O_2$  Decomp by hot  $HCl + Aq$  Very sl attacked by dil  $H_2SO_4 + Aq$  Slowly sol in hot  $HNO_3$ , rapidly in aqua regia or hot conc  $H_2SO_4$  (Glatzel, Z anorg 186)

**Cuprous sulphophosphate**,  $Cu_3PS_4$

Insol in  $H_2O$ , alcohol, etc, also in  $HCl$  dil  $H_2SO_4 + Aq$  Decomp by  $HNO_3$ , aqua regia, etc, not by  $KOH$  or  $NaOH + Aq$  (Glatzel)

**Ferrous sulphophosphate**,  $Fe_3(PS_4)_2$

Insol in  $H_2O$ , alcohol, ether, etc, insol in  $HCl$  or hot dil  $H_2SO_4 + Aq$  Decomp by  $HNO_3$ , aqua regia, or conc  $H_2SO_4$ , attacked by  $KOH$  or  $NH_4OH + Aq$  (Glatzel)

**Lead sulphophosphate**,  $Pb_3(PS_4)_2$

Insol in  $H_2O$ , alcohol, etc Decomp by warm  $HCl + Aq$ , conc  $HNO_3 + Aq$ , not attacked by  $NH_4OH + Aq$ , sl decomp by  $K + Aq$  (Glatzel)

**Manganous sulphophosphate**,  $Mn_3(PS_4)_2$

Insol in  $H_2O$ , alcohol, ether, benzene,  $C_2H_5$ , or  $HC_2H_3O_2$  Not attacked by  $HCl + Aq$  Sol in  $HNO_3$ , or aqua regia, with separation of S Not attacked by dil  $H_2SO_4 + Aq$  (Glatzel, Z anorg 4 186)

**Mercuric sulphophosphate**,  $Hg_3(PS_4)_2$

Insol in  $H_2O$ , alcohol, etc, also in  $HCl$  dil  $HNO_3$ , or  $H_2SO_4 + Aq$  Not attacked by conc  $HNO_3$ , or aqua regia, easily sol in  $HNO_3 + Br_2 + Aq$  (Glatzel)

**Nickel sulphophosphate**,  $Ni_3(PS_4)_2$

As the ferrous salt (Glatzel)

**Potassium sulphophosphate**,  $K_3PS_4 + H_2O$   
Easily sol in  $H_2O$  (Ephraim, B 1911, 44 3407)

**Silver sulphophosphate**,  $Ag_3PS_4$

Insol in  $H_2O$ , alcohol, etc, also in  $HCl$  dil  $HNO_3$ , or dil  $H_2SO_4 + Aq$  Decomp by conc  $H_2SO_4$ , and aqua regia (Glatzel)

**Sodium sulphophosphate**,  $Na_3PS_4 + 8H_2O$

Decomp by  $H_2O$   
Sol in  $Na_2S + Aq$  (Glatzel, Z anorg 1905, 44 65)

**Thallous sulphophosphate**,  $Tl_3PS_4$

Insol in  $H_2O$ , alcohol, etc Sol in  $HCl$  dil  $H_2SO_4 + Aq$ , etc Not attacked by  $NH_4OH + Aq$ , sl decomp by conc  $KOH + Aq$  (Glatzel)

**Tin (stannous) sulphophosphate,  $\text{Sn}_3(\text{PS}_4)_2$**   
 Insol in  $\text{H}_2\text{O}$ , alcohol, etc Insol in dil  
 $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$  Decomp by  $\text{HNO}_3 +$   
 $\text{Aq}$ , aqua regia,  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$   
 (Glatzel)

**Zinc sulphophosphate,  $\text{Zn}_3(\text{PS}_4)_2$**

Insol in  $\text{H}_2\text{O}$ , alcohol, ether, etc Sol in  
 $\text{HCl} + \text{Aq}$  or dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Easily at-  
 tacked by  $\text{KOH} + \text{Aq}$ , sl decomp by  $\text{NH}_4\text{OH}$   
 $+ \text{Aq}$  (Glatzel)

**Sulphopyrophosphoric acid**

**Aluminum sulphopyrophosphate,  $\text{Al}_2\text{P}_2\text{S}_7$**

Decomp in moist air  
 Violently decomp by  $\text{H}_2\text{O}$  or acids (Fer-  
 rand, A ch 1899, (7) 429)

**Cadmium —,  $\text{Cd}_2\text{P}_2\text{S}_7$**

Decomp in moist air  
 Not attacked by cold acids (Ferrand)

**Chromium —,  $\text{Cr}_2\text{P}_2\text{S}_7$**

Decomp in moist air  
 Not readily attacked by acids (Ferrand)

**Cuprous —,  $\text{Cu}_4\text{P}_2\text{S}_7$**

Not attacked by cold  $\text{H}_2\text{SO}_4$  or boiling  
 $\text{HCl}$  (Ferrand)  
 Sol in hot conc  $\text{HNO}_3$  (Ferrand)  
 Sol in alkalis, and in all acids except  $\text{HCl}$   
 (Ferrand, C R 1896, 122 886)

**Ferrous —,  $\text{Fe}_2\text{P}_2\text{S}_7$**

Insol in cold acids  
 Sl attacked by boiling  $\text{HCl}$  or hot  $\text{KOH} +$   
 $\text{Aq}$   
 Decomp by fused  $\text{KOH}$  (Ferrand, A  
 ch 1899, (7) 17 410)

**Lead —,  $\text{Pb}_2\text{P}_2\text{S}_7$**

Not attacked by cold  $\text{HNO}_3$  (Ferrand,)

**Mercurous —,  $\text{Hg}_4\text{P}_2\text{S}_7$**

Decomp by moist air or hot  $\text{HNO}_3$  (Fer-  
 rand)  
 Almost insol in acids, decomp by  $\text{H}_2\text{O}$   
 and moist air (Ferrand, C R 1896, 122  
 888)

**Nickel —,  $\text{Ni}_2\text{P}_2\text{S}_7$**

Decomp by  $\text{H}_2\text{O}$  and by conc  $\text{HNO}_3$  at  
 $150^\circ$  in a sealed tube (Ferrand, A ch  
 1899, (7) 17 418)

**Silver —,  $\text{Ag}_4\text{P}_2\text{S}_7$**

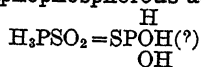
Not decomp by  $\text{H}_2\text{O}$   
 Decomp by aqua regia  
 Not attacked by  $\text{HNO}_3$  (Ferrand)

**Zinc —,  $\text{Zn}_2\text{P}_2\text{S}_7$**

Decomp in moist air  
 Decomp by  $\text{H}_2\text{O}$

Violently attacked by cold  $\text{HNO}_3$  (Fer-  
 rand)

**Sulphophosphorous acid,**



See Thiophosphorous acid

$\text{H}_3\text{PS}_3$  Known only in its salts

**Aluminum sulphophosphite,  $\text{Al}_3(\text{PS}_3)_2$**

Very unstable  
 Decomp in the air (Ferrand, C R 1896,  
 122 622)

**Barium sulphophosphite,  $\text{Ba}_3(\text{PS}_3)_2 + x\text{H}_2\text{O}$**

Sol in dil acids  
 Insol in alcohol (Ephram, B 1911, 44  
 3412)

**Chromous sulphophosphite,  $\text{Cr}_3(\text{PS}_3)_2$**

Easily attacked by hot conc  $\text{HNO}_3$  or  
 aqua regia  
 Decomp by boiling  $\text{NaOH} + \text{Aq}$  (Fer-  
 rand, A ch 1899, (7) 17 419)

Quite stable in moist air, very slowly at-  
 tacked by acids (Ferrand, C R 1896, 122  
 622)

**Cuprous sulphophosphite,  $\text{Cu}_3\text{PS}_3$**

Not attacked by  $\text{H}_2\text{O}$  or hot conc  $\text{HCl}$   
 Sl attacked by cold fuming  $\text{HNO}_3$   
 Violently attacked by  $\text{HNO}_3$ , aqua regia  
 and boiling conc  $\text{H}_2\text{SO}_4$   
 Not attacked by boiling  $\text{NaOH} + \text{Aq}$   
 (Ferrand, A ch 1899, (7) 17 398)  
 Fairly stable decomp by damp air (Fer-  
 rand, C R 1896, 122 621)

**Iron (ferrous) sulphophosphite,  $\text{Fe}_3(\text{PS}_3)_2$**

Very stable and resists the action of alkalis  
 and acids (Ferrand, C R 1896, 122 622)  
 Insol in cold acids or hot  $\text{NCl}$   
 Sol in hot fuming  $\text{HNO}_3$   
 Insol in hot  $40^\circ\text{C}$   $\text{KOH} + \text{Aq}$  (Ferrand,  
 A ch 1899, (7) 17 412)

**Mercuric sulphophosphite,  $\text{Hg}_3(\text{PS}_3)$**

Decomp in moist air  
 Not attacked by cold  $\text{HNO}_3$  Decomp  
 by hot  $\text{HNO}_3$  (Ferrand)  
 Unstable in the air  
 Very slowly attacked by acids (Ferrand,  
 C R 1896, 122 622)

**Nickel sulphophosphite,  $\text{Ni}_3(\text{PS}_3)_2$**

Unstable in the air  
 Attacked slowly by  $\text{HNO}_3$  (Ferrand)

**Silver sulphophosphite,  $\text{Ag}_3\text{PS}_3$**

Insol in most reagents (Ferrand C R  
 1896, 122 622)  
 Not decomp by  $\text{H}_2\text{O}$   
 Not easily attacked by acids (Ferrand,  
 A ch 1899, (7) 17 414)

**Sodium sulphophosphite,  $\text{Na}_2\text{PS}_2 + x\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$ , probably with decomp (Ephram, B 1911, 44 3410)

**Zinc sulphophosphite,  $\text{Zn}_2(\text{PS}_2)_2$** 

Decomp in moist air  
Sl attacked by  $\text{H}_2\text{O}$   
Decomp by  $\text{HNO}_3$  (Ferrand, A ch 1899, (7) 17 422)  
Very unstable in the air, and attacked violently by acids (Ferrand, C R 1896, 122 622)

**Sulphoplatinic acid,  $\text{H}_2\text{Pt}_4\text{S}_6$** 

Insol in  $\text{H}_2\text{O}$ , but decomp on air (Schneider, Pogg 138 604)  
 $\text{H}_4\text{Pt}_3\text{S}_6$  Insol in  $\text{H}_2\text{O}$ , but decomp very rapidly on air (Schneider)

**Copper sulphoplatinate,  $2\text{CuS}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$** 

Insol in  $\text{H}_2\text{O}$   $\text{HCl}$ ,  $\text{HNO}_3$ , or aqua regia dissolve out part of the Cu (Schneider, Pogg 139 661)

**Lead sulphoplatinate,  $2\text{PbS}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$** 

Insol in hot or cold  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$   
 $\text{HNO}_3 + \text{Aq}$  dissolves out Pb partly, aqua regia dissolves completely with difficulty (Schneider, Pogg 139 662)

**Mercuric sulphoplatinate chloride,  $2\text{HgS}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$ ,  $2\text{HgCl}_2$** 

Insol in  $\text{H}_2\text{O}$ , not attacked by  $\text{HCl} + \text{Aq}$ , and only partially sol in boiling aqua regia (Schneider)

**Potassium sulphoplatinate,  $\text{K Pt}_4\text{S}_6$** 

Insol in  $\text{H}_2\text{O}$   $\text{HCl} + \text{Aq}$  dissolves out K without evolution of  $\text{H}_2\text{S}$   
Composition its potassium platinum sulphoplatinate,  $\text{K}_2\text{S}$ ,  $3\text{PtS}$ ,  $\text{PtS}_2$  (Schneider, Pogg 138 604)  
 $\text{K PtS}$

**Silver sulphoplatinate,  $2\text{Ag}_2\text{S}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$** 

Insol in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$   $\text{HNO}_3 + \text{Aq}$  dissolves out Ag on warming Aqua regia decomp with formation of  $\text{AgCl}$  (Schneider, Pogg 138 664)

**Sodium sulphoplatinate,  $\text{Na}_4\text{Pt}_3\text{S}_6 = 2\text{Na}_2\text{S}$ ,  $2\text{PtS}$ ,  $\text{PtS}$** 

Decomp by hot  $\text{H}_2\text{O}$ , with residue of  $\text{PtS}$  (Schneider)  
 $\text{Na}_2\text{Pt}_2\text{S}_3 = \text{Na}_2\text{S}$ ,  $\text{PtS}$ ,  $2\text{PtS}_2$  Insol in  $\text{H}_2\text{O}$  (Schneider, J pr (2) 48 418)

**Thallium sulphoplatinate,  $2\text{Tl}_2\text{S}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$** 

Insol in cold  $\text{H}_2\text{O}$  Dil acids dissolve out all the thallium (Schneider, Pogg 138 626)

**Sulphoplatinous acid,  $\text{H}_2\text{PtS}_2$** 

Known only in solution in  $\text{H}_2\text{O}$ , which soon decomposes (Schneider, J pr (2) 48 424)

**Sodium sulphoplatinite,  $\text{Na}_2\text{PtS}_2$** 

Sol in  $\text{H}_2\text{O}$  with decomp (Schneider, pr (2) 48 420)  
 $\text{H}_4\text{Na}_2(\text{PtS}_2)_2$  Sol in  $\text{H}_2\text{O}$ , from which is pptd by alcohol (Schneider)

**Sulphoselenantimonous acid**

See Selenosulphantimonous acid

**Sulphoselenarsenic acid**

See Selenosulpharsenic acid

**Sulphoselenostannic acid**

See Selenosulphostannic acid

**Sulphoselenoxyarsenic acid**

See Selenosulphoxyarsenic acid

**Sulphoselenyl chloride,  $\text{SSeO}_3\text{Cl}$** 

Deliquescent, decomposed by  $\text{H}_2\text{O}$  (Clau nitzer, B 11 2007)

**Metasulphosilicic acid****Sodium metasulphosilicate,  $\text{Na}_2\text{SiS}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Hempel, Z anorg 1900, 23 41)

**Sulphostannic acid,  $\text{H}_2\text{SnS}_3$** 

Ppt (Kuhn, A 84 110)  
Does not exist (Storch, W A B 9 2b 236)

**Ammonium sulphostannate,  $(\text{NH}_4)_2\text{S}$ ,  $3\text{SnS}_2 + 6\text{H}_2\text{O}$** 

Easily sol in  $\text{H}_2\text{O}$ , and easily decomp (Ditte, C R 95 641)  
 $(\text{NH}_4)_2\text{SnS}_3 + 3\text{H}_2\text{O}$ , and  $+ 7\text{H}_2\text{O}$  Decomp by acid (Stanek, Z anorg 1898, 1 124)

**Barium sulphostannate,  $\text{BaSnS}_3 + 8\text{H}_2\text{O}$** 

Sol in cold  $\text{H}_2\text{O}$  (Ditte, C R 95 641)

**Calcium sulphostannate,  $2\text{CaS}$ ,  $\text{SnS}_2 + 14\text{H}_2\text{C}$** 

Sol in  $\text{H}_2\text{O}$  (Ditte, C R 95 641)

**Tetraplatinous sulphostannate,  $4\text{PtS}$ ,  $\text{SnS}_2$** 

Not decomp by acids (Schneider, J pr (2) 7 214)

**Platinum potassium sulphostannate,  $3\text{PtS}$ ,  $\text{K}_2\text{S}$ ,  $\text{SnS}_2$** 

Insol in cold  $\text{H}_2\text{O}$  Dil  $\text{HCl}$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  dissolves out all the potassium (Schneider, Pogg 136 109)

**Platinum sodium sulphostannate**,  $3\text{PtS}$ ,  $\text{Na}_2\text{S}$ ,  $\text{SnS}_2$   
 Insol in cold  $\text{H}_2\text{O}$  (Schneider, Pogg 136 109)

**Potassium sulphostannate**,  $\text{K}_2\text{SnS}_3$   
 Sol in  $\text{H}_2\text{O}$  (Kuhn, A 84 110)  
 $+3\text{H}_2\text{O}$  (Ditte, C R 95 641)  
 $\text{K}_4\text{SnS}_4 + 4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  pptd by alcohol (Weinland, Z anorg 1898, 17 419)

**Sodium sulphostannate**,  $\text{Na}_2\text{SnS}_3 + 2\text{H}_2\text{O}$   
 Sl sol in  $\text{H}_2\text{O}$  (Kuhn, A 84 110)  
 $+3\text{H}_2\text{O}$  (Ditte, C R 95 641)  
 $+7\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Horing, Zeitsch Pharm 1851 120)  
 $\text{Na}_4\text{SnS}_4 + 12\text{H}_2\text{O}$  Melts in crystal  $\text{H}_2\text{O}$  on heating Very sol in  $\text{H}_2\text{O}$  (Kuhn)

**Strontium sulphostannate**,  $\text{SrSnS}_3 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Ditte, C R 95 641)

**Thallium sulphostannate**,  $\text{Tl}_4\text{SnS}_4$   
 Ppt Practically insol in  $\text{H}_2\text{O}$  (Hawley, J Am Chem Soc 1907, 29 1011)

### ***D*<sub>2</sub> sulphopersulphuric acid**

**Sodium *d*<sub>2</sub> sulphopersulphate**,  $\text{Na}_2\text{S}_4\text{O}_8$   
 Sol in  $\text{H}_2\text{O}$  Cryst in cold with  $2\text{H}_2\text{O}$  (Villiers, C R 106 851, 1354)  
 Contains 4H more and is sodium tetrathionate,  $\text{Na}_4\text{S}_4\text{O}_6$ ,  $2\text{H}_2\text{O}$  (Villiers, C R 108 402)

### **Sulphotelluric acid**

**Mercurous sulphotellurate**,  $3\text{Hg}_2\text{S}$ ,  $\text{TeS}_2$   
 Ppt

**Mercuric** —,  $3\text{HgS}$ ,  $\text{TeS}_2$   
 Ppt (Berzelius)

**Potassium** —,  $\text{K}_2\text{TeS}_4$   
 Sol in  $\text{H}_2\text{O}$  (Oppenheim, J pr 71 279)

**Sodium** —  
 Sol in  $\text{H}_2\text{O}$  (Oppenheim)

### **Sulphotellurous acid**

**Ammonium sulphotellurite**,  $3(\text{NH}_4)_2\text{S}$ ,  $\text{TeS}_2$   
 Decomp on air Sol in  $\text{H}_2\text{O}$

**Barium** —  
 Very slowly sol in  $\text{H}_2\text{O}$

**Calcium** —  
 Somewhat sol in  $\text{H}_2\text{O}$

**Cerium** —  
 Insol ppt

**Cobalt sulphotellurite**,  $\text{Co}_3\text{TeS}_6$   
 Ppt

**Copper** —,  $\text{Cu}_3\text{TeS}_6$   
 Ppt

**Ferrous** —  
 Ppt

**Ferric** —  
 Ppt

**Lead** —  
 Ppt

**Lithium** —  
 Sol in  $\text{H}_2\text{O}$

**Magnesium** —  
 Sol in  $\text{H}_2\text{O}$  and alcohol

**Manganous** —  
 Ppt

**Potassium** —,  $3\text{K S}$ ,  $\text{TeS}_2$   
 Sol in  $\text{H}_2\text{O}$

**Silver** —,  $3\text{Ag S}$ ,  $\text{TeS}_2$   
 (Berzelius)

**Sodium** —  
 Sol in  $\text{H}_2\text{O}$

**Strontium** —  
 Sol in  $\text{H}_2\text{O}$

**Zinc** —,  $3\text{ZnS}$ ,  $\text{TeS}$   
 Ppt (Berzelius)

### **Sulphotungstic acid**

**Ammonium sulphotungstate**,  $(\text{NH}_4)_2\text{WS}_4$   
 Very deliquescent Easily sol in  $\text{H}_2\text{O}$ , and still more easily in  $\text{NH}_4\text{OH} + \text{Aq}$  (Corleis, A 232 244)  
 More sol in pure  $\text{H}_2\text{O}$  than in  $\text{H}_2\text{O}$  acidified with  $\text{HCl}$  Decomp slowly on air (Berzelius)

**Barium** —  
 Sol in  $\text{BaS} + \text{Aq}$

**Cadmium** —,  $\text{CdWS}_4$   
 Ppt (Berzelius)

**Calcium** —  
 Sol in  $\text{H}_2\text{O}$  and alcohol (Berzelius)

**Cobalt** —,  $\text{CoWS}_4$   
 Sl sol in  $\text{H}_2\text{O}$

**Copper sulphotungstate,  $\text{CuWS}_4$** 

Ppt

**Glucinum —,  $\text{GlWS}_4$** Sol in  $\text{H}_2\text{O}$  (?)**Ferrous —,  $\text{FeWS}_4$** Sol in  $\text{H}_2\text{O}$ **Ferric —**

Ppt

**Lead —,  $\text{PbWS}_4$** 

Ppt (Berzelus)

**Magnesium —,  $\text{MgWS}_4$** Easily sol in  $\text{H}_2\text{O}$  or alcohol**Manganous —,  $\text{MnWS}_4$** Sol in  $\text{H}_2\text{O}$  (Berzelus)**Mercurous —**

Ppt (Berzelus)

**Mercuric —,  $\text{HgWS}_4$** 

Ppt (Berzelus)

**Nickel —,  $\text{NiWS}_4$** 

Ppt (Berzelus)

**Potassium —,  $\text{K}_2\text{WS}_4$** Sol in  $\text{H}_2\text{O}$  Alcohol precipitates from aqueous solutions, but is not entirely insol in alcohol (Berzelus)Very sol in  $\text{H}_2\text{O}$  (Corleis, A 232 264)**Potassium — nitrate,  $\text{K}_2\text{WS}_4, \text{KNO}_3$** Very sol in cold or hot  $\text{H}_2\text{O}$ , from which it is precipitated by alcohol (Berzelus)**Potassium — tungstate,  $\text{K}_2\text{WO}_2\text{S}_2 = \text{K}_2\text{WS}_4, \text{K}_2\text{WO}_4$** Easily sol in  $\text{H}_2\text{O}$  Not precipitated by alcohol (Berzelus)Is potassium trisulphotungstate,  $\text{K}_2\text{WOS}_3$ , which see (Corleis, A 232 244)**Silver —,  $\text{AgWS}_4$** 

Ppt (Berzelus)

**Sodium —,  $\text{Na}_2\text{WS}_4$** Very sol in  $\text{H}_2\text{O}$ , less sol in alcohol (Berzelus)

Very deliquescent (Corleis, A 232 264)

**Strontium —**Sol in  $\text{H}_2\text{O}$ , and in  $\text{SrO} + \text{Aq}$ **Stannous —,  $\text{SnWS}_4$** 

Ppt (Berzelus)

**Stannic —,  $\text{SnWS}_4$** 

Ppt (Berzelus)

**Zinc sulphotungstate,  $\text{ZnWS}_4$** Sol in  $\text{H}_2\text{O}$  with subsequent pptn (Berzelus)**Monosulphotungstic acid****Potassium monosulphotungstate,  $\text{K}_2\text{WOS} + \text{H}_2\text{O}$** Deliquescent in moist air Very sol in  $\text{H}_2\text{O}$  (Corleis, A 232 244)**Disulphotungstic acid****Ammonium disulphotungstate,  $(\text{NH}_4)_2\text{WO}_5$** Sol in  $\text{H}_2\text{O}$  and alcohol (Berzelus)  
Decomp easily when moist (Corleis A 232 264)**Trisulphotungstic acid****Potassium trisulphotungstate,  $\text{K}_2\text{WOS} + \text{H}_2\text{O}$** Hygroscopic Effloresces on dry air d easily decomposed Easily sol in  $\text{H}_2\text{O}$  (Corleis, A 232 244)**Sulphovanadic acid,  $\text{V}_2\text{O}_5, 3\text{SO}_3 + 3\text{H}_2\text{C}$** 

See Vanadiousulphuric acid, and Sulph vanadium

**Sulphovanadates**Alkali sulphovanadates are sol in  $\text{H}_2\text{O}$  Ca, Sr, and Ba sulphovanadates are sl sol in  $\text{H}_2\text{O}$ , and all other sulphovanadates are in l in  $\text{H}_2\text{O}$  (Berzelus)**Ammonium sulphovanadate,  $(\text{NH}_4)_3\text{VS}_4$** Easily sol in  $\text{H}_2\text{O}$  Very sl sol in cc  $\text{NH}_4\text{SH} + \text{Aq}$  Insol in ether,  $\text{CS}_2$ , or  $\text{CH}_2\text{Cl}_2$  (Kruss and Ohnmaier, A 263 46)

See also Sulphoxyvanadic acid

**Sodium pentasulphoxyvanadate,  $\text{Na}_4\text{V}_2\text{O}_{11}$** Hydroscopic, sol in  $\text{H}_2\text{O}$  with rapid comp (Locke, Am Ch J 1898, 20 375)**Sulphoxyantimonic acid****Potassium sulphonyantimonate,  $\text{K}_2\text{HSbO}_5 + 2\text{H}_2\text{O}$** Sol in hot, less sol in cold  $\text{H}_2\text{O}$  Decomposed by cold  $\text{H}_2\text{O}$  (Weinland and Gutmann, J anorg 1898, 17 414)**Sulphoxyarsenic acid,  $\text{H}_4\text{AsO}_5\text{S}$** 

Known only in aqueous solution (McCarty, Am Ch J 10 459)

**Ammonium monosulphoxyarsenate,  $(\text{NH}_4)_2\text{AsSO}_5 + 3\text{H}_2\text{O}$** Decomp in the air, sol in  $\text{H}_2\text{O}$ , decomp on boiling (Weinland, B 1896, 29 1009)

Very sol in  $H_2O$ , insol in alcohol, decomp in aq solution and also in the air (Weinland, Z anorg 1897, 14 53)

Decomp in the air (McLaughlan, B 1901, 34 2166)

**Ammonium hydrogen monosulphoxyarsenate,**  $(NH_4)_2HAsSO_3$

Ppt (McLaughlan, B 1901, 34 2168)

**Barium monosulphoxyarsenate,**  $BaHAsO_3 + 10H_2O$

(Preis, A 257 184)

$Ba_3(AsSO_3)_2 + 6H_2O$  Ppt (Weinland, Z anorg 1897, 14 54)

**Barium disulphoxyarsenate,**  $Ba_3(AsS_2O_2)_2 + 4H_2O$

Ppt (Preis, A 257 185)

$+6H_2O$  (Weinland and Rumpf, Z anorg 1897, 14 64)

**Barium potassium trisulphoxyarsenate,**  $KBaAsS_3O + 7H_2O$

Ppt (McCay, Z anorg 1904, 41 469)

**Barium sodium monosulphoxyarsenate,**  $BaNaAsSO_3 + 9H_2O$

Ppt (Weinland, Z anorg 1897, 14 55)

**Barium sodium sulphoxyarsenate,**  $Ba_7Na_2As_5O_7S_{14} + 12H_2O$

(McCay and Foster, Z anorg 1904, 41 467)

**Calcium trisulphoxyarsenate,**  $Ca_3(AsS_3O)_2 + 20H_2O$

Ppt (McCay and Foster, Z anorg 1904, 41 463)

**Potassium monosulphoxyarsenate,**  $K_3AsSO_3$   
Hydroscopic (Weinland, B 1896, 29 109)

Sol in conc KOH + Aq, free from carbonate, very hydroscopic (Weinland, Z anorg 1897, 14 51)

**Potassium hydrogen monosulphoxyarsenate,**  $K_2HAsSO_3 + 2\frac{1}{2}H_2O$

Very hygroscopic (Weinland and Rumpf, Z anorg 1897, 14 59)

$KH_2AsSO_3$  Sol in  $H_2O$ , solution slowly decomp on standing (McCay, Am Ch J 10 459)

Formula given by Bouquet and Cloez (A ch (3) 13 44) is  $K_2H_4As_2S_3O_5$

**Potassium disulphoxyarsenate,**  $K_3AsS_2O_2 + 10H_2O$

Very hygroscopic, decomp by  $H_2O$  (Weinland, Z anorg 1897, 14 63)

**Potassium trisulphoxyarsenate,**  $K_3AsS_3O + 7H_2O$

Yellow oil which cryst at  $-20^\circ$  (McCay and Foster, Z anorg 1904, 41 468)

**Sodium monosulphoxyarsenate,**  $Na_3AsSO_3 + 12H_2O$

Easily sol in  $H_2O$  (Preis, A 257 180) (McLaughlan, B 1901, 34 2170)

Sol in  $H_2O$  (Weinland, B 1896, 29 1009)

Sl efflorescent Insol in alcohol (McCay, Z anorg 1902, 29 42)

Sol in NaOH + Aq, decomp by boiling with conc NaOH (Weinland, Z anorg 1897, 14 49)

**Sodium hydrogen monosulphoxyarsenate,**  $NaH_2AsSO_3$

Decomp by  $H_2O$ , insol in alcohol (Weinland, Z anorg 1897, 14 58)

$Na_2HAsSO_3 + 8H_2O$  Easily sol in  $H_2O$  (Preis)

**Sodium disulphoxyarsenate,**  $Na_3AsS_2O_2 + 10H_2O$

Easily sol in  $H_2O$  (Preis)

Sol in  $H_2O$ , pptd by alcohol (McCay, B 1899, 32 2472)

Not decomp by boiling NaOH + Aq (Weinland, Z anorg 1897, 14 62)

Insol in alcohol (McCay, Z anorg 1900, 25 461)

$+11H_2O$  (McLaughlan, B 1901, 34 2170)

Insol in alcohol (McCay, Z anorg 1902, 29 46)

**Sodium trisulphoxyarsenate,**  $Na_3AsS_3O + 11H_2O$

Decomp by  $H_2O$  (McCay and Foster, Z anorg 1904, 41 454)

**Sodium trisulphoxydiarsenate,**  $As_2O_2S_3, 3NaO + 24H_2O$

Easily sol in  $H_2O$  (Geuther, A 240 208)

$2As_2O_2S_3, NaO + 7H_2O$  Sol in  $H_2O$

(Nilson, J pt (2) 14 14)

Correct composition is  $Na_8As_{18}S_4O_7 + 30H_2O$  (Preis)

**Sodium sulphoxyarsenate,**  $Na_3As_{18}S_4O_7 + 30H_2O = 4NaO, 6AsS, 3AsS_2O + 30H_2O$

Decomp by  $H_2O$  Sol in  $NH_4OH$  or KOH + Aq (Preis, A 257 187)

= Sodium oxytrisulpharsenate of Nilson

**Sodium pentasulphoxytetraarsenate,**  $Na_{12}As_4S_{11}O_{11} + 48H_2O$

Less sol in  $H_2O$  than other sulphoxyarsenates (Preis)

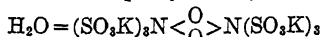
**Sodium strontium trisulphoxyarsenate,**  $NaSrAsS_3O + 10H_2O$

Unstable (McCay and Foster, Z anorg 1904, 41 462)

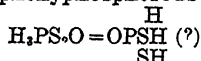
**Trisulphoxyazotic acid**,  $\text{ON}(\text{SO}_3\text{H})_3$ 

Known only in its salts (Claus, A, 158 52 and 194)

Has the formula  $(\text{SO}_3\text{H})_3\text{N} < \underset{\text{O}}{\text{O}} > \backslash (\text{SO}_3\text{H})_3$   
(Raschig, A 241 161)

**Potassium trisulphoxyazotate**,  $\text{ON}(\text{SO}_3\text{K})_3 +$ 

Easily sol in  $\text{H}_2\text{O}$  without decomp, even on boiling (Claus, A 157 210)

**Sulphoxyphosphorous acid**,

See Thiophosphorous acid

**Sulphoxyvanadic acid****Ammonium pyrohexasulphoxyvanadate**,  
 $(\text{NH}_4)_4\text{V}_2\text{S}_6\text{O}$ 

Sol in  $\text{H}_2\text{O}$  (Kruss and Ohnmaiss, A 263 53)

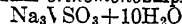
**Potassium pyrohexasulphoxyvanadate**,  
 $\text{K}_4\text{V}_2\text{S}_6\text{O} + 3\text{H}_2\text{O}$ 

Melts in crystal  $\text{H}_2\text{O}$  (Kruss and Ohnmaiss)

$\text{K}_3\text{V}_2\text{S}_6\text{O}_2 + 3\text{H}_2\text{O}$  More sol in  $\text{H}_2\text{O}$  than preceding comp (K and O)

**Sodium orthotrisulphoxyvanadate**,  $\text{Na}_3\text{VS}_3\text{O} + 5\text{H}_2\text{O}$ 

Very deliquescent, and easily sol in  $\text{H}_2\text{O}$   
Somewhat sol in alcohol (Kruss and Ohnmaiss)

**Sodium orthomonosulphoxyvanadate**,

Less sol in  $\text{H}_2\text{O}$  than other sulphoxyvanadates (K and O)

**Sulphur, S**

The various modifications of sulphur have been classified in many different ways, and there is a difference of opinion as to whether certain forms are true allotropic modifications or not

The data, as far as concerns the solubility, may be arranged as follows —

A Sol in  $\text{CS}_2$  1 Rhombic, octahedral, or alpha sulphur, ordinary sulphur Easily sol in  $\text{CS}_2$ , etc See below for solubility in various solvents

2 Prismatic, monoclinic, or beta sulphur Sol in  $\text{CS}_2$ , but is converted into A, 1 Prismatic sulphur obtained by melting brimstone is not wholly sol in  $\text{CS}_2$  on account of admixture of gamma sulphur

Monoclinic modification is more sol than rhombic in  $\text{CHCl}_3$ , ether and benzene (Meyer C C 1903, II 481)

3 Soft sulphur, milk of sulphur

4 Amorphous sol sulphur is also a rate modification, according to Berth

B Soft sulphur, obtained by str heating and quickly cooling, is sol in but becomes insol therein by repeatedly solving and evaporating More easily in  $\text{CS}_2$  than A, 1

C Insol in  $\text{CS}_2$  1 By action of st light on S in  $\text{CS}_2$

2 By heating to b-pt, cooling sudd and allowing to stand until hard Has called gamma sulphur, but is a mixtur  $\frac{2}{3}$  A, 4 and  $\frac{1}{3}$  insol S

3 Insol S in flowers of sulphur verted into A 1 by standing 3 days alcohol

According to Berthelot (A ch (3) 49 there are only two varieties of S I "C hedral" II "Amorphous"

I Octahedral Sol in  $\text{CS}_2$  Scarcely a upon by  $\text{KHSO}_3 + \text{Aq}$  Converted by ox ing agents into II

II Amorphous Insol in neutral solve viz  $\text{H}_2\text{O}$ , alcohol, ether,  $\text{CS}_2$ , etc

Sol with tolerable rapidity in  $\text{KHSO}_3 +$  By long action of  $\text{Na}_2\text{S} + \text{Aq}$ , a portio dissolved, and the remainder converted

I Less easily oxidised by  $\text{HNO}_3 + \text{Aq}$  t

I Some varieties of this modification sol to a certain extent in alcohol and et and by boiling the rest of the sulphur is verted into I, also by long-continued t act with cold alcohol Berthelot holds t the modification is changed before dissolv Solutions of the alkalis, alkali salts, alkali sulphides change insol into sol sulph (Berthelot)

Elastic sulphur obtained by pouring r ten sulphur at a temp of over  $260^\circ$  into l contains 35% or more of a modification (S which is insol in  $\text{CS}_2$ , hot or cold, but in absolute alcohol, this modification be converted back into ord sulphur by h ing to  $100^\circ$  (Pelouze and Fremy) (C 2)

This modification can be obtained by action of  $\text{HCl}$  on thiosulphates (For and Gélis)

The soft pasty sulphur obtained by dec position of  $\text{H}_2\text{S}$  by  $\text{SO}_2$  forms an alm clear emulsion (pseudo solution) with  $\text{H}_2\text{O}$  from which it is pptd by various salts substances which have no chemical affin for it 23 pts S combine in this way w 100 pts  $\text{H}_2\text{O}$  When pptd by saline sc tions, some of the S remains in soluti When solution is exposed to the light, gradually separates out, also on boiling same takes place The above pseudo-so tion is pptd by mineral acids, and the pp S may still be dissolved in fresh water, if left in contact for some time with the ac Also pptd by K salts, with loss of pov of forming pseudo-solutions Pptd by N and Na salts without losing that pow

Alkal hydrates, carbonates, or sulphides convert it into insol S

The solution may be mixed with alcohol without change. Decomposed by long shaking with naphtha or oil of turpentine. The pseudo-solution combines with  $\text{CS}_2$ , forming an emulsion which subsequently decomposes. The S itself is only partially sol in  $\text{CS}_2$  (Selmi, J pr 57 49)

By treatment of amorphous "insoluble" S with  $\text{CS}_2$  or  $\text{CCl}_4$ , a small part goes into solution, the amount being dependent on the time of contact with the temp, and nature of the solvent, but independent of the amount of the solvent. It is assumed that this is due to a partial change of the "insoluble" into soluble S (Wigand, Z phys Ch 1910, 75 235)

*"Delta" sulphur* Partly sol in  $\text{H}_2\text{O}$  (Debus, Chem Soc 53 18)

A colloidal form wholly sol in  $\text{H}_2\text{O}$  exists, which, however, decomposes very easily (Engel, C R 112 866)

*Black sulphur* Insol in alcohol, ether,  $\text{CS}_2$ , fatty oils even at  $200^\circ$ , cold alkali hydroxides + Aq,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or aqua regia (Knapp, J pr (2) 43 305)

*Green modification* Five times more sol than ordinary sublimed sulphur in a mixture of salicylaldehyde and benzene (Orloff, C C 1902, I 1264)

The following data relate to octahedral or ordinary sulphur (A 1) —

Sol in warm liquid  $\text{H}_2\text{S}$  (Niemann), warm  $\text{P}_2\text{S}_5$ ,  $\text{SBr}_2$ ,  $\text{SCl}_2$ , Br,  $\text{NCl}_3$ ,  $\text{BaS}$  + Aq (Dumas), in alcoholic solution of  $\text{K}_2\text{S}_5$ , but is reprecipitated by addition of  $\text{H}_2\text{O}$  to saturation

Sol in liquid  $\text{SO}_2$

Sol in aqueous solution of alkali sulphates, especially when hot. Sol in boiling conc  $\text{HSCN}$  + Aq, from which it mostly separates on cooling

$\text{Na}_2\text{CO}_3$  + Aq (5.6%  $\text{Na}_2\text{CO}_3$ ) dissolves no S at  $20^\circ$  0.06775% at  $100^\circ$  (Pohl, Dingl 197 508)

The solubility of S in  $\text{Na}_2\text{S}$  + Aq between  $0^\circ$  and  $50^\circ$  diminishes slightly with increase in temp, but increases with dilution of the solution, having its largest value in a N/16 solution of  $\text{Na}_2\text{S}$  + Aq when the relation of  $\text{Na}_2\text{S}$  to dissolved S equals about 1.4 (Kuster, Z anorg 1905, 43 56)

Sol in  $\text{AlBr}_3$  (Isbekow, Z anorg 1913, 84 27)

Insol in liquid  $\text{CO}_2$  (Buchner, Z phys Ch 1906, 54 674)

Sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 822)

Sol in liquid  $\text{NH}_3$  1 gr S is sol in 3-4 cc liquid  $\text{NH}_3$  (Hugot, A ch 1900, (7) 21 32)

The solubility of S in liquid  $\text{NH}_3$  is constant from  $-23^\circ$  to  $-84^\circ$  and equals 39% (Ruff, Z anorg Ch 1910, 23 1830)

Solubility in liquid  $\text{NH}_3$   
(g S in 100 g solution)

t°	S	t°	S
-78	38 6	16 4	25 65
-20 5	38 1	30	21 0
0	32 34	40	18 5

(Ruff and Hecht, Z anorg 1911, 70 62)

Sol in liquid  $\text{NO}$ . (Frankland, Chem Soc 1901, 79 1361)

$\text{S}_2\text{Cl}_2$  dissolves 66.74% S at ord temp to form a liquid of 1.7 sp gr (Rose)

Solubility of S in  $\text{S}_2\text{Cl}_2$  varies according to the variety of sulphur used. Aten has published an extended investigation on the subject, which see for details (Z phys Ch 1905-14, 54 86, 124, 81 268, 83 443, 86 1, 88 321)

Solubility in  $\text{SnCl}_4$

100 g  $\text{SnCl}_4$  dissolve at

99°	101°	110°	110°
5 8	6 2	8 7	9 1 pts solid S,

112°	112°	121°
9 4	9 9	17 0 pts liquid S

(Gerardin)

Sol in alkalis + Aq with decomp

Sol in 1926.7 pts absolute alcohol at  $15^\circ$  (Pohl, W A B 6 600)

Sol in 20 pts hot nearly absolute alcohol less sol in weaker alcohol (Laurogais)

Sol in 600 pts boiling alcohol of  $40^\circ$  B (Chevallier J ch med 2 387) in 500 pts alcohol (Meissner) 200 pts alcohol (Pelouze and Fremy)

100 pts absolute alcohol dissolve 0.42 pt at b-pt, and 0.12 pt S at  $16^\circ$ , 100 pts ether dissolve 0.54 pt at b-pt, and 0.19 pt S at  $16^\circ$ , 100 pts benzene dissolve 17.04 pts at b-pt, and 1.79 pts S at  $16^\circ$ , 100 pts oil of turpentine dissolve 16.16 pts at b-pt, and 1.35 pts S at  $16^\circ$ , 100 pts  $\text{CS}_2$  dissolve 73.46 pts at b-pt, and 38.70 pts S at  $16^\circ$ , 100 pts naphtha dissolve 10.56 pts at b-pt, and 2.77 pts S at  $16^\circ$ , 100 pts tar-oil dissolve 26.98 pts at b-pt, and 1.51 pts S at  $16^\circ$  (Payen, C R 34 456)

100 pts absolute methyl alcohol dissolve 0.028 pt at  $18.5^\circ$ , 100 pts absolute ethyl alcohol dissolve 0.053 pt at  $18.5^\circ$  (de Bruyn, Z phys Ch 10 781)

Solubility in amyl alcohol

95°	110°	110°
1 5	2 1	2 2 pts solid S,

112°	112°	120°	131°
2 6	2 7	3 0	5 3 pts liquid S

(Gerardin, A ch (4) 5 134)

Quickly sol in 12.5 pts ether (Favre)

100 pts benzene dissolve 0.965 pt S at  $26^\circ$ , 100 pts benzene dissolve 4.377 pts S at  $71^\circ$ , 100 pts toluene dissolve 1.479 pts S at  $23^\circ$ , 100 pts ethyl ether dissolve 0.972 pt S at



23 5°, 100 pts chloroform dissolve 1 205 pts S at 22°, 100 pts phenol dissolve 16 35 pts S at 174°, 100 pts aniline dissolve 85 27 pts S at 130° (Cossa, B 1 139)

## Solubility in benzene at t°

t°	pts S in 10 g of solution
15 17	0 1480
19 29	0 1692

(Bronsted, Z phys Ch 1906, 55 377)

A mixture of S and toluene separates into two layers, containing 33 and 92 5% S respectively (Haywood, J phys Ch 1897, 1 232)

CS<sub>2</sub> dissolves 0 35 pt ordinary sulphur, some varieties of S, however, are not entirely sol in CS<sub>2</sub>, thus—

Variety of Sulphur	Pts sol in 1 pt CS <sub>2</sub>	Fraction of original wt insol in CS <sub>2</sub>
Octahedral, from Sicily	0 335	0 000
Crystallised in dry wav, recently prepared	0 415	0 029
Do, prepared 8 years	0 33	0 004
Do, prepared 9 years		0 020
Do, prepared 15 years		0 051
Red needles, recently prepared	0 382	0 023
Soft yellow, do		0 353
Do, prepared 2 years	0 316	0 157
Soft red, recently prepared	0 374	0 157
Do, prepared 5 years		0 181
Flowers of sulphur	0 351	0 113
Do, another sample		0 234
Roll brimstone, outside		0 029
Do inside		0 073

(Deville, A ch (3) 47 99)

The pt insol in CS<sub>2</sub> is sol in hot absolute alcohol crystallising on cooling, less sol in chloroform or ether (Deville)

100 pts pure CS<sub>2</sub> dissolve pts S at t°

t	pts S	t°	Pts S
-11	16 54	22	46 05
- 6	15 75	38	94 57
0	23 99	48 5	146 21
+15	37 15	55	181 34
18 5	41 65		

(Cossa, B 1 138)

Neither ordinary stick S nor flowers of S is completely sol in CS<sub>2</sub>. Pptd S is completely sol in 5 pts CS<sub>2</sub> (Tittenger, C C 1894, II 267)

2 99 g S are sol in 100 grams CS<sub>2</sub> at — (Arctowski, C R 1895, 121 124)

Solubility in CS<sub>2</sub>

100 g of the sat solution contain at

—77° —84 5° —89° —116°  
4 84 4 46 4 29 2 99 g S

(Arctowski, Z anorg 1896, 11 274)

When 20 pts S dissolve in 50 pts CS<sub>2</sub> at 22° the temp is lowered 5° (Cossa)

Sat solution of S in CS<sub>2</sub> boils at 5° (Cossa)

Sp gr of S dissolved in CS<sub>2</sub> at 15°

(Pts S per 100 pts CS<sub>2</sub>)

Sp gr	Pts S	Sp gr	Pts S	Sp gr	P	S
1 271	0 0	1 312	9 9	1 352	1	6
1 272	0 2	1 313	10 2	1 353	1	9
1 273	0 4	1 314	10 4	1 354	2	1
1 274	0 6	1 315	10 6	1 355	2	4
1 275	0 9	1 316	10 9	1 356	2	6
1 276	1 2	1 317	11 1	1 357	2	0
1 277	1 4	1 318	11 3	1 358	2	2
1 278	1 6	1 319	11 6	1 359	2	5
1 279	1 9	1 320	11 8	1 360	2	8
1 280	2 1	1 321	12 1	1 361	2	1
1 281	2 4	1 322	12 3	1 362	2	3
1 282	2 6	1 323	12 6	1 363	2	7
1 283	2 9	1 324	12 8	1 364	2	0
1 284	3 1	1 325	13 1	1 365	2	2
1 285	3 4	1 326	13 3	1 366	2	6
1 286	3 6	1 327	13 5	1 367	2	0
1 287	3 9	1 328	13 8	1 368	2	3
1 288	4 1	1 329	14 0	1 369	2	8
1 289	4 4	1 330	14 2	1 370	2	1
1 290	4 6	1 331	14 5	1 371	2	6
1 291	4 8	1 332	14 7	1 372	2	0
1 292	5 1	1 333	15 0	1 373	2	5
1 293	5 3	1 334	15 2	1 374	2	9
1 294	5 6	1 335	15 4	1 375	2	4
1 295	5 8	1 336	15 6	1 376	2	1
1 296	6 0	1 337	15 9	1 377	2	5
1 297	6 3	1 338	16 1	1 378	2	0
1 298	6 5	1 339	16 4	1 379	2	7
1 299	6 7	1 340	16 6	1 380	3	2
1 300	7 0	1 341	16 9	1 381	3	5
1 301	7 2	1 342	17 1	1 382	3	4
1 302	7 5	1 343	17 4	1 383	3	9
1 303	7 8	1 344	17 6	1 384	3	8
1 304	8 0	1 345	17 9	1 385	3	2
1 305	8 2	1 346	18 1	1 386	3	3
1 306	8 5	1 347	18 4	1 387	3	5
1 307	8 7	1 348	18 6	1 388	3	2
1 308	8 9	1 349	18 9	1 389	3	1
1 309	9 2	1 350	19 0	1 390	3	7
1 310	9 4	1 351	19 3	1 391	3	2
1 311	9 7					

(Mascagno, C N 43 192)

p gr of S dissolved in CS<sub>2</sub> at 15° Water at  
4°=1

p gr	% S	Sp gr	% S	Sp gr	% S
2708	0 0	1 2736	0 6	1 2764	1 2
2717	0 2	1 2745	0 8	1 2774	1 4
2727	0 4	1 2755	1 0	1 2783	1 6
2792	1 8	1 3096	8 0	1 3409	14 2
2802	2 0	1 3105	8 2	1 3419	14 4
2812	2 2	1 3115	8 4	1 3430	14 6
2822	2 4	1 3125	8 6	1 3440	14 8
2832	2 6	1 3135	8 8	1 3450	15 0
2842	2 8	1 3145	9 0	1 3460	15 2
2852	3 0	1 3155	9 2	1 3471	15 4
2862	3 2	1 3165	9 4	1 3481	15 6
2872	3 4	1 3175	9 6	1 3491	15 8
2882	3 6	1 3185	9 8	1 3502	16 0
2892	3 8	1 3195	10 0	1 3512	16 2
2901	4 0	1 3205	10 2	1 3522	16 4
2911	4 2	1 3215	10 4	1 3532	16 6
2921	4 4	1 3226	10 6	1 3543	16 8
2930	4 6	1 3236	10 8	1 3553	17 0
2940	4 8	1 3246	11 0	1 3563	17 2
2949	5 0	1 3256	11 2	1 3573	17 4
2959	5 2	1 3266	11 4	1 3584	17 6
2969	5 4	1 3277	11 6	1 3594	17 8
2978	5 6	1 3287	11 8	1 3604	18 0
2988	5 8	1 3297	12 0	1 3615	18 2
2998	6 0	1 3307	12 2	1 3625	18 4
3008	6 2	1 3317	12 4	1 3635	18 6
3017	6 4	1 3328	12 6	1 3646	18 8
3027	6 6	1 3338	12 8	1 3656	19 0
3037	6 8	1 3348	13 0	1 3667	19 2
3047	7 0	1 3358	13 2	1 3677	19 4
3056	7 2	1 3368	13 4	1 3688	19 6
3066	7 4	1 3379	13 6	1 3698	19 8
3076	7 6	1 3389	13 8	1 3709	20 0
3086	7 8	1 3399	14 0		

(Pfeiffer, Z anorg 1897, 15 200)

Sol in acetone (Eidmann, C C 1899, II 14)

Solubility of S in acetone + Aq at 25°

S = millimols g S in 100 cc of the solution  
A = g acetone in 100 g acetone + Aq

A	S	p gr
100	65 0	0 78540
95 36	45 0	0 79114
90 62	33 0	0 81654
85 38	25 3	0 82958

Herz and Knoch, Z anorg 1905, 45 263)

### Solubility in organic solvents

Solvent	t°	Sat solution contains % S
CS <sub>2</sub>	—61	3 6
	—55	4 4
	—19	10 6
	—18	10 8
	—17	11 5
	—13	12 4
	—11	13 3
	—11	13 5
	— 2	17 2
	+ 3	19 5
	9	23 1
	11	23 7
	14	25 9
	17	27 2
	19	28 9
	20	28 5
	21	29 7
	26	33 4
	27	34 6
	29	37 8
	30 5	39 7
Ethylene dibromide	33	42 2
	40	48 7
	44	53 2
	46	56 2
	48	57 5
	53	60 0
	54	60 6
	65	67 9
	77 5	76 4
	81 0	79 4
	92 0	87 8
	98 0	90 1
	9	1 7
Benzene	22	2 4
	40	4 4
	50	6 4
	72	12 4
	95	30 2
	105	60 0
	8	1 2
	10	1 3
	21	1 8
	30	2 6
Hexane	39	3 3
	47	4 0
	54	4 9
	65	6 8
	72	8 6
	100	17 5
	123	31 9
	127	34 0
	150	36 8
	—20	0 07
	0	0 16
	+26	0 41
	+68	1 2
	+130	5 2
	+142	6 2
	+184	8 3

(Etard, A ch 1894, (7) 2 571)

Solubility in $\text{CHCl}_3$ at $t^\circ$	
$t^\circ$	g S in 10 g of solution
12 25	0 0744
19 29	0 0918

(Bronsted, Z phys Ch 1906, 55 377)

Solubility of octahedral and prismatic S in organic solvents at  $t^\circ$ 

Solvent	$t^\circ$	% prismatic S	% octahedral S
Benzene	18 6	2 004	1 512
	25 3	2 335	1 835
Chloroform	0	1 101	0 788
	15 5	1 658	1 253
	40	2 9	2 4
Ethyl ether	0	0 113	0 080
	25 3	0 253	0 200
Ethyl bromide	0	0 852	0 611
	25 3	1 676	1 307
Ethyl formate	0	0 028	0 019
Ethyl alcohol	25 3	0 066	0 052

(Bronsted, Z phys Ch 1906, 55 377)

Solubility in organic solvents at  $25^\circ$  (G S dissolved in 1 g mol of solvent)

Solvent	g S
Ethylene chloride	0 831
Tetrachlorethane	2 063
Dichlorethylene	1 237
Pentachlorethane	2 421
Trichlorethylene	2 43
Perchlorethylene	2 537
Carbon tetrachloride	1 354

(Hoffmann et al 1910, B 43 188)

100 g trichlorethylene dissolve 1 19 g S at  $15^\circ$  (Wester and Bruuns, Pharm Weekbl 1943, 51 1443)Solubility in benzyl chloride at  $t^\circ$ 

$t^\circ$	g S per 100 g of solution	
	in upper layer	in lower layer
0	0 99	
17	1 78	
35	2 57	
46 1	3 64	
63 3	6 15	
78 0	9 88	
99 1	19 89	
109 6		90 62
114 6		87 99
118 8	37 29	
121 4	40 04	85 02
130 0	49 71	80 07
134 2	56 20	72 23

Above  $134.2^\circ$  sulphur is miscible with

benzyl chloride in all proportions, below temp two layers are formed (Bogusky, J Russ Phys Chem Soc 37 92-99, C C 1905, I 1207)

Easily sol in boiling acetic anhydride (Rosenfeld, B 13 1475)

Sol in considerable amount in warm  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , but very sl sol if dil (Bermann, B 10 866)

Sol in stearic acid + Aq (Vulpinus, Pharm (3) 13 38)

Acetic ether dissolves 6% S (Favre, Difficultly sol in methyl acetate (Naumann, B 1909, 42 3790)

Sol in ethyl acetate (Naumann, B 37 3601)

Sl sol in benzonitrile at ord temp more sol at higher temp (Naumann, 1914, 47 1369)

Sol in 12 pts hot petroleum from A but nearly insol in cold (de Saussure, 100 pts nicotine at  $100^\circ$  dissolve 10 S, but this separates out as the solution (Klever, C C 1872 434)

Sol in warm aniline (Barral, A 20 352)

Easily sol in hot, less sol in cold (Fritzsche)

Very sol in aniline and quinoline, esp when warm (Hofmann)

Sol in quinoline but reacts with the with evolution of H (Beckmann and Z anorg 1906, 51 236)

 $\frac{1}{2}$  ccm oleic acid dissolves 0 0335 6 days (Gates, J phys Chem 19 143)

Sol in 26 pts of boiling, sl sol creosote

Sol by digestion in 2 pts oil of turp Sol in hot oil of copaiba, crystall cooling

Sol in hot oil of mandarin, crystall on cooling

Sol in hot oil of caraway, crystall cooling

Somewhat sol in hot, less in cold spirit

Sl sol in lignone, bromoform, col zene, but easily in hot benzene (Mann, Chem Soc 1 262)

Sol in ethyl sulphide, and carbonyl chloride (Rathke, A 152 187)

Sol in mercuric methyl

Sol in 20 pts ethyl nitrate, from which is not pptd by  $\text{H}_2\text{O}$ 

Sol in naphtha, aldehyde, iodol, chloroform, warm chloral, sinkalr ethyl chloride, warm benzoyl chloride

100 pts methylene iodide dissolve S at  $10^\circ$  Melted sulphur is miscible with hot methylene iodide (Retgers, Z 3 343)

S dissolves in 2000 pts glycerine (and Garot, J Pharm (3) 26 81)

Glycerine dissolves 0 10% S (Klever, 1872 434)

100 g glycerine dissolve 0.14 g at 15.5°  
(Ossendowski, Pharm J 1907, 79 575)

Sol in butyl sulphhydrate, and warm retinole

Sol in ethyl sulphhydrate

Very sol in conine, hexyl alcohol, warm allyl sulphocyanide, cacodyl oxide. Somewhat sol in hot styrene, separating out on cooling

Readily sol in warm, less readily in cold toluene or resin-oil

Sol in olive oil at 115°, from which it mostly separates on cooling

Sol in hot oil of amber, crystallising upon cooling. Sol in 2 pts hot, sl sol in cold caoutchou

Insol in valerianic acid, amyl valerate, valeryl hydride

Linseed oil dissolves % S at t°

t°	% S	t	% S	t°	% S
25	0.630	95	2.587	160	9.129
60	1.852	130	4.935		

(Pohl)

Solubility in olive oil (sp gr = 0.885)

100 pts dissolve pts S at t°

t	Pts S	t	Pts S	t	Pts S
15	2.3	65	20.6	110	30.3
40	5.6	100	25.0	130	43.2

(Pelouze C R 68 1179)

Solubility in 100 pts coal-tar oil at t°

t	Pts S in		
	Oil of 0.870	Oil of 0.880	Oil of 0.852
	sp gr B pt 1.00 100	sp gr B pt 1.00 120	sp gr B pt 1.00 200
15	2.1	2.3	2.5
30	3.0	4.0	5.3
50	5.2	6.1	8.3
80	11.8	13.7	15.2
100	15.2	18.7	23.0
110		23.0	26.2
120		27.0	32.0
130			38.7

t	Pts S in		
	Oil of 0.885	Oil of 1.010	Oil of 1.020
	sp gr B pt 1.00 200	sp gr B pt 2.10 310	sp gr B pt 2.20 300
15	2.6	6.0	7.0
30	5.8	8.5	8.5
50	8.7	10.0	12.0
80	21.0	37.0	41.0
100	26.4	52.5	54.0
110	31.0	105.0	115.0
120	38.0	∞	∞
130	43.8	∞	∞

(Pelouze, C R 69 56)

Sulphur bromide, S<sub>2</sub>Br<sub>2</sub>

Decomp gradually with H<sub>2</sub>O. Dissolves S on warming, which crystallises out on cooling. Sol in CS<sub>2</sub>

Decomp by current of dry air into S and Br (Hannay, Chem Soc 35 16)

Decomp slowly by cold H<sub>2</sub>O, rapidly by hot H<sub>2</sub>O. Decomp by dil KOH + Aq or NaHCO<sub>3</sub> + Aq (Korndorfer, Arch Pharm 1904, 242 156)

A study of the mpt curve of a series of mixtures of sulphur and bromine gave no evidence for the existence of the compounds SBr<sub>2</sub> and SBr<sub>4</sub> (Ruff, B 1903, 36 2446)

Sulphur monochloride, S<sub>2</sub>Cl<sub>2</sub>

Slowly decomp by H<sub>2</sub>O. Miscible with CS<sub>2</sub> and C<sub>6</sub>H<sub>6</sub>. Sol in alcohol and ether with subsequent decomposition. Sol in oil of turpentine

Moderately sol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 830)

Sol in CCl<sub>4</sub> and C<sub>6</sub>H<sub>6</sub> (Oddo, Gazz ch it 1899, 29 (2) 318)

Sulphur dichloride, SCl<sub>2</sub>

Decomp slowly with H<sub>2</sub>O, immediately by alcohol or ether

Sulphur tetrachloride, SCl<sub>4</sub>

Violently decomp by H<sub>2</sub>O. Decomp at temperatures above -22° (Michaelis, A 170 1)

Sulphur stannic chloride, 2SnCl<sub>4</sub>, SnCl<sub>4</sub>

Decomp by H<sub>2</sub>O. Sol in dil HNO<sub>3</sub> + Aq. Forms a mass with fuming HNO<sub>3</sub> which is sol in HNO<sub>3</sub> + Aq. Sol in POCl<sub>3</sub> (Casselmann)

Very hygroscopic. Fumes in moist air. Very easily sol in dry abs ether and in benzene. Sol in CHCl<sub>3</sub>, SOCl<sub>2</sub>, CS<sub>2</sub>, POCl<sub>3</sub>, ligroin and petroleum ether (Ruff, B 1904, 37 4517)

Sulphur titanium chloride, SCl<sub>4</sub>, 2TiCl<sub>4</sub>

Very deliquescent. Easily sol in dil HNO<sub>3</sub> + Aq (Weber, Pogg 132 454)

SCl<sub>4</sub>, TiCl<sub>4</sub>. Sol in SOCl<sub>2</sub>, CHCl<sub>3</sub>, CS<sub>2</sub> and petroleum ether (Ruff, B 1904, 37 4516)

Sulphur chloride ammonia, SCl<sub>2</sub>, 4NH<sub>3</sub>

Insol in H<sub>2</sub>O, but gradually decomp thereby, sol without decomp in absolute alcohol, from which it is pptd by H<sub>2</sub>O (Mertens)

Does not exist (Fordos and Gélis, C R 31 702)

SCl<sub>2</sub>, 2NH<sub>3</sub>. Decomp by H<sub>2</sub>O. Sol in alcohol or ether (Soubeiran, A ch 67 71). Not a true chemical compound, but a mixture (Fordos and Gélis, C R 31 702)

$\text{SCl}_2, 4\text{NH}_3$  Decomp by  $\text{H}_2\text{O}$  Sl sol in absolute alcohol and ether (Soubeiran, A ch 67 71), mixture (Fordos and Gélis)

**Sulphur chloride nitrogen sulphide**  
See Nitrogen sulphochloride

**Sulphur perfluoride,  $\text{SF}_6$**

Very sl sol in  $\text{H}_2\text{O}$ , sl sol in alcohol (Moissan, C R 1900, 130 868)

**Sulphur monoxide,  $\text{S}_2\text{I}_2$**

Insol in  $\text{H}_2\text{O}$  Decomp by alcohol, which dissolves out  $\text{I}_2$  Sl sol in cold caoutchou, the solution decomposing when boiled Freely sol in glycerine Sol in 60 pts glycerine, and 82 pts olive oil (Cap and Garot, J Pharm (3) 26 81)

Very sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 830)

Sol in  $\text{CS}_2$  (Linebarger, Am Ch J 1895, 17 58)

**Sulphur hexoxide,  $\text{SI}_6$**

Decomp on air Alcohol or alkalis dissolve out iodine (vom Rath, Pogg 110 116)

Does not exist (M'Leod, Rep Brit Assn Advn Sci 1892 690)

**Sulphur stannic iodide**

See Tin sulphur iodide

**Sulphur sesquioxide,  $\text{S}_2\text{O}_3$**

Deliquescent Violently decomp by  $\text{H}_2\text{O}$  at ordinary temp Sol in fuming  $\text{H}_2\text{SO}_4$  Insol in  $\text{SO}_2$  Decomp by alcohol or other (Weber, Pogg 156 531)

**Sulphur dioxide,  $\text{SO}_2$**

Liquid Insol in  $\text{H}_2\text{O}$  if brought in contact therewith below the b-pt of  $\text{SO}_2$

Sol in 3 vols  $\text{CS}_2$  on warming, separating out on cooling Dissolves some P, little S, and no sulphuric or phosphoric acids

Dissolves ether, chloroform, P, Br, S, I, CS, colophonum, and other gums, also benzene when warmed (Sestini, Bull Soc (2) 10 226)

Miscible with liquid  $\text{SO}_3$ , but not with  $\text{H}_2\text{SO}_4$

**Gas**

1 vol H O absorbs 50 vols  $\text{SO}_2$  at 18 (Davy) 20 vols at ord temp (Dalton) 43 78 vols at ord temp (de Saussure) 50 vols at 20 and 760 mm (Pelouze and Fremy) 33 vol at ord temp (Thomson)

1 pt  $\text{SO}_2$  by weight is sol in 0 1429 pt H O at 5 and the solution has 1 020 sp gr

1 pt  $\text{SO}_2$  is sol in 0 0400 pt H O at ord temp (Priestley) in 0 0909 pt H O at 10 and sp gr of the solution is 1 0513 (Thomson)

Sol in 2 pts H O at 10 (Pierre A ch (3) 23 421)  
100 vol H O at 15 and 760 mm absorb 4378 vols  $\text{SO}_2$  gas 100 vols alcohol of 0 84 sp gr at 760 mm ab orb 11 5 vols (de Saussure 1814)

Solubility of  $\text{SO}_2$  gas in  $\text{H}_2\text{O}$   $t^\circ = \text{temp}$  vols  $\text{SO}_2$  reduced to  $0^\circ$  and 760 mm tained in 1 vol sat  $\text{SO}_2 + \text{Aq}$ ,  $V_1 = \text{SO}_2$  gas reduced to  $0^\circ$  and 760 mm solved by 1 vol  $\text{H}_2\text{O}$  under 760 mm sure

$t^\circ$	V	$V_1$	$t^\circ$	V	
0	68 861	79 789	21	34 986	37 70
1	67 003	77 210	22	33 910	36 17
2	65 169	74 691	23	32 847	35 02
3	63 360	72 230	24	31 800	34 26
4	61 576	69 828	25	30 766	32 86
5	59 816	67 485	26	29 748	31 84
6	58 080	65 200	27	28 744	30 22
7	56 369	62 973	28	27 754	29 14
8	54 683	60 805	29	26 788	28 10
9	53 021	58 697	30	25 819	27 61
10	51 383	56 647	31	24 873	26 51
11	49 770	54 655	32	23 942	25 78
12	48 182	52 723	33	23 025	24 44
13	46 618	50 849	34	22 122	23 47
14	45 079	49 033	35	21 234	22 80
15	43 564	47 276	36	20 361	21 68
16	42 073	45 578	37	19 502	20 86
17	40 608	43 939	38	18 658	20 41
18	39 165	42 360	39	17 827	19 37
19	37 749	40 838	40	17 013	18 66
20	36 206	39 374			

(Schonfeld, A 95 5)

This table may be formulated as follo  
1 vol  $\text{H}_2\text{O}$  absorbs 79 789—260 t  
0 029349 $t^2$  vols  $\text{SO}_2$  at temp between 0 an  
20°, or 1 vol sat solution contains 68 1-  
1 87025 $t + 0 01225t^2$  vols  $\text{SO}_2$  Coeffici t  
absorption between 21° and 40°=75 2  
2 1716 $t + 0 01903t^2$  vols  $\text{SO}_2$  or 1 vol sa  
solution between 21° and 40° contains 6 95  
—1 38898 $t + 0 00726t^2$  vols  $\text{SO}_2$

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{O}$  at various temp an  
760 mm  $t^\circ = \text{temp}$ , G = grunme SC  
dissolved in 1 g  $\text{H}_2\text{O}$ , V = vols SC di  
solved in 1 g H O

t	G	V	t	G	
8	0 168	58 7	30	0 078	2 3
10	0 154	53 9	32	0 073	2 7
12	0 142	49 6	34	0 069	2 3
14	0 130	45 6	36	0 065	2 8
16	0 121	42 2	38	0 062	2 6
18	0 112	39 3	40	0 058	2 4
20	0 104	36 4	42	0 055	1 3
22	0 098	34 2	44	0 053	1 4
24	0 092	32 3	46	0 050	1 4
26	0 087	30 5	48	0 047	1 4
28	0 083	28 9	50	0 045	1 6

(Sims, A 118 340)

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{O}$  at various pressures  
 $P$  = "partial pressure," i.e. the total pressure minus the tension of aqueous vapour at given temp,  $G$  at  $P$  = weight  $\text{SO}_2$  in grammes, which is dissolved in 1 g  $\text{H}_2\text{O}$  at pressure  $P$ ,  $G$  at 760 = calculated weight  $\text{SO}_2$  that would be contained in 1 g  $\text{H}_2\text{O}$  at 760 mm if the absorption were proportional to the pressure,  $V$  = the volume of  $G$  grammes of  $\text{SO}_2$  at  $0^\circ$  and 760 mm

P	7°			
	G at P	G at 760	V at P	V at 760
30	0 010	0 263	3 634	92 06
40	0 013	0 242	4 451	84 55
50	0 015	0 223	5 129	77 95
60	0 017	0 218	6 024	76 28
70	0 020	0 213	6 868	74 55
80	0 022	0 210	7 743	73 55
90	0 025	0 208	8 598	72 62
100	0 027	0 205	9 421	71 60
120	0 032	0 201	11 09	70 20
140	0 036	0 197	12 71	69 00
160	0 041	0 195	14 34	68 15
180	0 046	0 193	15 97	67 40
200	0 050	0 191	17 59	66 83
220	0 055	0 190	19 19	66 30
240	0 059	0 188	20 79	65 84
260	0 064	0 187	22 40	65 44
280	0 069	0 186	23 99	65 10
300	0 073	0 185	25 59	64 81
350	0 085	0 184	29 55	64 16
400	0 096	0 182	33 51	63 65
450	0 107	0 181	37 44	63 25
500	0 118	0 180	41 42	62 94
550	0 130	0 179	45 31	62 60
600	0 141	0 178	49 20	62 32
650	0 152	0 178	53 10	62 09
700	0 163	0 177	56 98	61 86
750	0 174	0 176	60 88	61 69
760	0 176	0 176	61 65	61 65
800	0 185	0 176	64 74	61 50
850	0 196	0 175	68 57	61 30
900	0 207	0 175	72 41	61 15
950	0 218	0 175	76 25	61 00
1000	0 229	0 174	80 01	60 88
1050	0 240	0 174	83 97	60 77
1100	0 251	0 174	87 80	60 65
1200	0 273	0 173	95 45	60 45
1300	0 295	0 172	103 00	60 25

P	20°			
	G at P	G at 760	V at P	V at 760
40	0 007	0 143	2 637	50 09
50	0 009	0 138	3 171	48 20
60	0 011	0 135	3 718	47 10
70	0 012	0 131	4 205	45 64
80	0 013	0 127	4 663	44 30
90	0 015	0 125	5 169	43 65
100	0 016	0 124	5 692	43 25
120	0 019	0 121	6 683	42 33
140	0 022	0 119	7 690	41 75
160	0 025	0 118	8 666	41 17
180	0 028	0 117	9 652	40 75
200	0 030	0 116	10 62	40 35
220	0 033	0 115	11 59	40 03
240	0 036	0 114	12 54	39 70
260	0 038	0 112	13 45	39 30
280	0 041	0 112	14 41	39 10
300	0 044	0 111	15 34	38 87
350	0 050	0 110	17 66	38 35
400	0 059	0 109	20 56	38 10
450	0 064	0 108	22 37	37 77
500	0 071	0 107	24 67	37 50
550	0 077	0 106	26 93	37 20
600	0 083	0 105	29 14	36 90
650	0 090	0 105	31 39	36 70
700	0 096	0 105	33 62	36 50
750	0 103	0 104	35 94	36 43
760	0 104	0 104	36 43	36 43
800	0 110	0 104	38 32	36 40
1000	0 137	0 104	47 85	36 37
1300	0 178	0 104	62 10	36 31
1600	0 218	0 104	76 35	36 27
1900	0 259	0 104	90 53	36 21

P	39.8			
	G at P	G at 760	V at P	V at 760
200	0 016	0 062	5 675	21 57
300	0 024	0 061	8 368	21 20
400	0 031	0 060	11 03	20 95
500	0 039	0 059	13 67	20 77
600	0 047	0 059	16 29	20 64
760	0 059	0 059	20 50	20 50
800	0 062	0 059	21 58	20 50
1000	0 077	0 059	26 84	20 40
1500	0 113	0 057	39 65	20 09
2000	0 149	0 057	52 11	19 80

P	50			
	G at P	G at 760	V at P	V at 760
200	0 012	0 045	4 156	15 97
400	0 024	0 015	8 275	15 72
600	0 035	0 045	12 36	15 65
760	0 045	0 045	15 62	15 62
800	0 047	0 045	16 43	15 60
1000	0 059	0 045	20 51	15 59
1500	0 088	0 044	30 73	15 57
2000	0 012	0 044	39 07	15 55

1 g H<sub>2</sub>O dissolves 0.0909 g SO<sub>2</sub> = 34.73 cc (at 25°) at 25° and 748 mm pressure (Walden and Centnerszwer, Z phys Ch 1901, 42 462)

Solubility of SO<sub>2</sub> in H<sub>2</sub>O at t° and 760 mm pressure

t°	G SO per 1 g H <sub>2</sub> O	t°	G SO <sub>2</sub> per 1 g H <sub>2</sub> O
0	0.236	7	0.176
2	0.218	8	0.168
4	0.201	10	0.154
6	0.184	12	0.142

(Roozeboom, R t c 1884, 3 29)

From a gas containing 10% by vol of SO<sub>2</sub> at 10°, 1.63% by wt is dissolved by 1 litre of H<sub>2</sub>O, if the pressure is increased to 5 atmospheres, 8.14% by wt is dissolved (Harpf, Chem Zeitschr, 1905, 4 136)

Solubility of SO<sub>2</sub> in H<sub>2</sub>O at t°

C = g SO<sub>2</sub> in 1 cc of the solution

P = Pressure in mm of Hg

t°	C	P	$\frac{C}{P} \times 10^4$
0	0.000537	0.4	13.4
	0.00237	3.5	6.78
	0.01227	29.4	4.17
	0.03894	109.4	3.48
25	0.000534	1.4	3.81
	0.00234	11.75	2.00
	0.01212	87.9	1.379
	0.03750	313.0	1.198
50	0.000525	4.9	1.07
	0.002276	30.5	0.746
	0.01181	204.5	0.577
	0.03628	696.0	0.521

(Lindner, M 1912, 33 645)

Sp gr of sat solution at—

0° 10° 20° 40°

1.06091 1.05472 1.02386 0.95548

(Bunsen and Schonfeld A 95 2)

Sat SO<sub>2</sub>+Aq has sp gr = 1.0040 (Berthollet)

Sp gr of sat SO<sub>2</sub>+Aq at t°

t°	Sp gr	t	Sp gr	t	Sp gr
0	1.0609	9	1.0548	17	1.0358
1	1.0596	10	1.0547	18	1.0321
2	1.0585	11	1.0528	19	1.0281
3	1.0576	12	1.0505	20	1.0239
4	1.0569	13	1.0481	21	1.0195
5	1.0562	14	1.0454	22	1.0147
6	1.0557	15	1.0424	23	1.0099
7	1.0552	16	1.0392	24	0.9991
8	1.0549				

(Scheff, A 107 312)

Sp gr of SO<sub>2</sub>+Aq at 4°

% SO <sub>2</sub>	Sp gr	% SO <sub>2</sub>	Sp gr	% SO <sub>2</sub>	Sp
1	1.0024	8	1.0217	15	1.0
2	1.0049	9	1.0247	16	1.0
3	1.0075	10	1.0278	17	1.0
4	1.0102	11	1.0311	18	1.0
5	1.0130	12	1.0343	19	1.0
6	1.0158	13	1.0376	20	1.0
7	1.0187	14	1.0410	21	1.0

(Scheff, calculated by Gerlach, Z anal 8)

Sp gr of SO<sub>2</sub>+Aq

% SO <sub>2</sub>	Temp	Sp gr
0.99	15.5°	1.0051
2.05	"	1.0102
2.87	"	1.0148
4.04	"	1.0204
4.99	"	1.0252
5.89	"	1.0297
7.01	"	1.0353
8.08	"	1.0399
8.68	"	1.0438
9.80	"	1.0492
10.75	"	1.0541
11.65	12.5°	1.0597
13.09	11.0°	1.0668

(Giles and Scheerer, Jour Soc Ch Inc 4 303)

Sp gr of SO<sub>2</sub>+Aq

% SO	Sp gr	% SO <sub>2</sub>	Sp gr	% SO <sub>2</sub>	Sp
1	1.0052	4	1.0167	7	1.0
2	1.0094	5	1.0208	8	1.0
3	1.0134	6	1.0242	9	1.0

(Anthon)

Sp gr of SO<sub>2</sub>+Aq

% SO	Sp gr	% SO <sub>2</sub>	Sp gr	% SO <sub>2</sub>	Sp
1	1.0042	5	1.0210	8	1.0
2	1.0083	6	1.0252	9	1.0
3	1.0125	7	1.0295	10	1.0
4	1.0167				

(Hager, Adjumenta varia, Leipzig, 1 6 146)

Sp gr of  $\text{SO}_2 + \text{Aq}$  at  $15^\circ$ 

$\frac{\%}{\text{SO}}$	Sp gr	$\frac{\%}{\text{SO}}$	Sp gr	$\frac{\%}{\text{SO}_2}$	Sp gr
0.5	1.0028	4.0	1.0221	7.5	1.0401
1.0	1.0056	4.5	1.0248	8.0	1.0426
1.5	1.0085	5.0	1.0275	8.5	1.0450
2.0	1.0113	5.5	1.0302	9.0	1.0474
2.5	1.0141	6.0	1.0328	9.5	1.0497
3.0	1.0168	6.5	1.0353	10.0	1.0520
3.5	1.0194	7.0	1.0377		

(Scott, Polyt Centralbl **1873** 826)

Conc  $\text{H}_2\text{SO}_4$  absorbs 0.009 pt by weight (58 vols), and  $\text{SO}_2$  is more soluble in dilute  $\text{H}_2\text{SO}_4 + \text{Aq}$ , the more  $\text{H}_2\text{O}$  there is present (Kolb, Dingl **209** 270)

Solubility in  $\text{H}_2\text{SO}_4$ 

Sp gr of $\text{H}_2\text{SO}_4$	Absorbs $\text{SO}$ per kg	Absorbs $\text{SO}_2$ per litre
1.841	0.009	5.8
1.839	0.014	8.9
1.540	0.021	11.2
1.407	0.032	15.9
1.227	0.068	29.7
1.020	0.135	49.0

(Kolb, Bull Soc Ind Mullhouse, **1872** 224)

Coefficient of absorption for  $\text{H}_2\text{SO}_4$  (1.841 sp gr at  $15^\circ$  and 760 mm) is 28.14 at  $17^\circ$ , and 28.86 at  $16^\circ$  (Dunn, C N **43** 121)

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{SO}_4$  of 1.84 sp gr

t	Sp gr of sat solution	Coeff of absorption (760 mm)	t°	Sp gr of sat solution	Coeff of absorption (760 mm)
0		53	50	1.8186	9.5
10	1.8232	35.0	60	1.8165	7.0
20	1.8225	25.0	70	1.8140	5.5
25	1.8221	21.0	80	1.8112	4.5
30	1.8216	18.0	90	1.8080	4.0
40	1.8205	13.0			

(Dunn, C N 1882, **45** 272, Calc by Seidell, Solubilities, 1st Ed)Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$ 

t°	Sp gr of $\text{H}_2\text{SO}_4$ solution	Approx % $\text{H}_2\text{SO}_4$	Coeff of absorption	t°	Sp gr of $\text{H}_2\text{SO}_4$ solution	Approx % $\text{H}_2\text{SO}_4$	Coeff of absorption
6.9	1.139	20	48.67	15.2	1.173	25	31.82
6.9	1.300	40	45.38	16.8	1.151	21	31.56
8.6	1.482	58	39.91	14.8	1.277	36	30.41
9.8	1.703	78	29.03	15.1	1.458	56	29.87
5.5	0.67	10	36.78	15.6	1.609	70	25.17
6.6	1.102	15	34.08	15.0	1.739	81	20.83

(Dunn, C N 1882, **45** 272, Seidell, Solubilities, 1st Ed)

Coefficient of absorption in  $\text{H}_2\text{SO}_4$  (sp gr = 1.841) = 5.8, (sp gr = 1.839) = 8.9 (Lunge)

Solubility in salts + Aq at  $35^\circ$ l = coefficient of absorption of  $\text{SO}_2$  in the given salt solution at  $35^\circ$ lo = coefficient of absorption of  $\text{SO}_2$  in water at  $35^\circ = 22.43$ 

Salt		3 normal	2 o normal	2 normal	1 o normal	1 normal	0 o normal
KI	1	45.43	41.87	38.04	34.64	30.25	26.30
	l-lo	23.00	19.44	15.61	12.21	7.82	3.87
KBr	1	36.14	34.12	31.93	29.64	27.49	24.83
	l-lo	13.71	11.69	9.50	7.21	5.01	2.40
KCl	1	30.02	28.93	27.94	26.54	25.15	23.74
	l-lo	7.59	6.50	5.31	4.11	2.72	1.31
KCNS	1	42.94	38.13	35.05	32.03	28.79	25.63
	l-lo	18.51	15.70	12.62	9.60	6.36	3.20
$\text{NH}_4\text{NO}_3$	1	27.43	26.66	25.57	24.78	24.23	23.35
	l-lo	5.00	4.23	3.14	2.35	1.80	0.92
$\text{KNO}_3$	1	27.33	26.54	25.72	24.79	24.03	23.27
	l-lo	4.90	4.11	3.29	2.36	1.60	0.84



Solubility in salts + Aq at 35° — *Continued*l = coefficient of absorption of SO<sub>2</sub> in the given salt solution at 35°l<sub>0</sub> = coefficient of absorption of SO<sub>2</sub> in water at 35° = 22.43

Salt		3 normal	2.5 normal	2 normal	1.5 normal	1 normal	0	norm
$\frac{1}{2}(\text{NH}_4)_2\text{SO}_4$	1	24.60	24.23	23.93	23.49	23.14		2.91
	l-l <sub>0</sub>	2.17	1.80	1.50	1.06	0.71		0.48
$\frac{1}{2}\text{CdI}_2$	1	24.30	23.99	23.71	23.38	23.06		2.75
	l-l <sub>0</sub>	1.87	1.56	1.28	0.95	0.63		0.32
$\frac{1}{2}\text{Na}_2\text{SO}_4$	1	19.27	19.79	20.20	20.81	21.35		1.88
	l-l <sub>0</sub>	-3.16	-2.64	-2.23	-1.62	-1.08		0.55
$\frac{1}{2}\text{CdBr}_2$	1	19.17	19.70	20.60	20.81	21.46		1.88
	l-l <sub>0</sub>	-3.26	-2.73	-1.83	-1.62	-0.97		0.55
$\frac{1}{2}\text{CdCl}_2$	1	18.68	19.23	20.02	20.55	21.23		1.73
	l-l <sub>0</sub>	-3.75	-3.20	-2.41	-1.88	-1.20		0.70
$\frac{1}{2}\text{CdSO}_4$	1	16.25	17.41	18.31	19.42	20.43		1.45
	l-l <sub>0</sub>	-6.81	-5.02	-4.12	-3.01	-2.00		0.98

## Solubility in salts + Aq at 25°

l = coefficient of absorption of SO<sub>2</sub> in the given solution at 25°l<sub>0</sub> = coefficient of absorption of SO<sub>2</sub> in water at 25° = 32.76

Salt		3 normal	2.5 normal	2 normal	1.5 normal	1 normal	0	norm
KI	1	68.36	62.63	56.75	50.58	44.76		3.66
	l-l <sub>0</sub>	35.60	29.87	23.99	17.82	12.00		5.90
$\frac{1}{2}\text{CdI}_2$	1	35.77	34.98	34.74	34.16	33.76		3.27
	l-l <sub>0</sub>	3.01	2.22	1.98	1.40	1.00		0.51
NH <sub>4</sub> Br	1	52.25	49.17	46.06	42.78	39.46		3.28
	l-l <sub>0</sub>	19.49	16.41	13.30	10.02	6.70		3.52
KBr	1	52.26	48.87	44.96	42.41	39.11		3.94
	l-l <sub>0</sub>	19.00	15.71	12.70	9.15	6.35		3.18
NaBr	1	37.74	36.84	36.26	35.27	34.54		3.76
	l-l <sub>0</sub>	4.98	4.08	3.50	2.51	1.78		1.00
$\frac{1}{2}\text{CdBr}_2$	1	27.46	28.15	29.27	30.17	31.01		1.91
	l-l <sub>0</sub>	-5.30	-4.61	-3.49	-2.59	-1.75		0.85
NH <sub>4</sub> Cl	1	42.78	41.37	39.76	38.06	36.37		4.58
	l-l <sub>0</sub>	10.02	8.61	7.00	5.30	3.61		1.80
KCl	1	42.27	40.96	39.32	37.76	36.05		4.42
	l-l <sub>0</sub>	9.51	8.20	6.56	5.00	3.29		1.66

## Solubility in salts + Aq at 25°—Continued

l = coefficient of absorption of SO<sub>2</sub> in the given solution at 25°l<sub>0</sub> = coefficient of absorption of SO<sub>2</sub> in water at 25° = 32.76

Salt		3 normal	2.5-normal	2 normal	1.5-normal	1 normal	0.5 normal
NaCl	l	31.36	31.51	31.76	31.96	32.25	32.46
	l-l <sub>0</sub>	-1.40	-1.25	-1.00	-0.80	-0.51	-0.30
$\frac{1}{2}$ CdCl <sub>2</sub>	l	26.06	27.09	28.16	29.46	30.55	31.66
	l-l <sub>0</sub>	-6.70	-5.67	-4.60	-3.30	-2.21	-1.10
NH <sub>4</sub> CNS	l	61.46	57.01	52.26	47.26	42.74	37.78
	l-l <sub>0</sub>	28.70	24.25	19.50	14.50	9.98	5.02
KCNS	l	61.26	55.87	51.86	47.02	42.38	37.57
	l-l <sub>0</sub>	28.50	23.11	19.10	14.26	9.62	4.81
NaCNS	l	48.34	45.86	43.37	40.78	38.24	35.44
	l-l <sub>0</sub>	15.58	13.10	10.61	8.02	5.48	2.68
NH <sub>4</sub> NO <sub>3</sub>	l	39.14	38.01	37.27	36.28	35.07	33.96
	l-l <sub>0</sub>	6.38	5.25	4.51	3.52	2.31	1.20
KNO <sub>3</sub>	l	38.52	37.57	36.66	35.77	34.79	33.80
	l-l <sub>0</sub>	5.76	4.81	3.90	3.01	2.03	1.04
$\frac{1}{2}$ (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	l	35.96	35.47	34.95	34.34	33.82	33.35
	l-l <sub>0</sub>	3.20	2.71	2.19	1.58	1.06	0.59
$\frac{1}{2}$ K <sub>2</sub> SO <sub>4</sub>	l					33.61	33.20
	l-l <sub>0</sub>					0.85	0.48
$\frac{1}{2}$ Na <sub>2</sub> SO <sub>4</sub>	l	28.44	28.66	29.51	30.45	31.14	31.96
	l-l <sub>0</sub>	-4.32	-4.10	-3.25	-2.31	-1.62	-0.80
$\frac{1}{2}$ CdSO <sub>4</sub>	l	23.76	25.14	26.58	28.24	29.71	31.11
	l-l <sub>0</sub>	-9.00	-7.62	-6.18	-4.52	-3.05	-1.85

(Fox, Z. phys. Ch. 1902, 41, 462)

Sol. in Cl<sub>2</sub> + Aq. Sol. in Br. Solidification curves determined (Van der Goot, Z. phys. Ch. 1913, 84, 419)

Solubility of SO in alcohol 1 vol alcohol at  
t° and 760 mm dissolves V vols SO<sub>2</sub> gas  
at 0° and 760 mm

t°	V	t°	V	t°	V
0	328 62	9	201 33	17	130 61
1	311 98	10	190 31	18	124 58
2	295 97	11	179 91	19	119 17
3	280 58	12	170 13	20	114 48
4	265 81	13	160 98	21	110 22
5	251 67	14	152 45	22	106 68
6	238 16	15	144 55	23	103 77
7	225 26	16	137 27	24	101 47
8	212 98				

(Bunsen's Gasometry)

100 pts absolute methyl alcohol dissolve  
247 pts SO<sub>2</sub> at 0° and 760 mm, 47 pts at 26°  
and 760 mm, 100 pts absolute ethyl alcohol  
dissolve 115 pts SO<sub>2</sub> at 0° and 760 mm, 32 3  
pts at 26° and 760 mm (de Bruyn, Z phys  
Ch 10 783)

Sol in ether

Absorbed by oil of turpentine

Rapidly absorbed by anhydrous aldehyde in  
the cold, 11 pts aldehyde absorbing 19 pts  
SO<sub>2</sub>

Absorption coefficient of aldehyde for SO<sub>2</sub>  
is 1 4 times greater than that of alcohol, and  
7 times greater than that of H<sub>2</sub>O (Geuther  
and Cartmell, Proc Roy Soc 10 111)

1 pt camphor dissolves 0 880 pt by weight  
(=308 vols) SO<sub>2</sub> at 0° and 725 mm, 1 pt  
glacial HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> dissolves 0 961 pt by weight  
(=318 vols) SO at 0° and 725 mm, 1 pt  
formic acid dissolves 0 821 pt by weight  
(=351 vols) SO<sub>2</sub> at 0° and 725 mm, 1 pt  
acetone dissolves 2 07 pts by weight (=589  
vols) SO at 0° and 725 mm, 1 pt sulphuryl  
chloride dissolves 0 323 pt by weight (=187  
vols) SO<sub>2</sub> at 0° and 725 mm (Schulze,  
J pr (2) 24 168)

Solubility of SO<sub>2</sub> in CHCl<sub>3</sub>

C = g SO in 1 cc of the solution

P = Pressure in mm Hg

t	C	P	$\frac{C}{P} \times 10^4$
0	0 000701	2 7	2 6
	0 001790	5 6	3 14
	0 006982	22 0	3 17
	0 03097	90 2	3 43
	0 08217	219 6	3 74
20	0 000669	5 7	1 17
	0 001712	12 9	1 37
	0 006723	48 0	1 40
	0 02904	208 2	1 47
	0 07839	488 8	1 60

(Lindner, M 1912, 33 645)

Distribution of SO<sub>2</sub> between H<sub>2</sub>O and C Cl<sub>4</sub>  
at 20°

c<sub>1</sub> = g SO<sub>2</sub> per l of H<sub>2</sub>O solution  
c<sub>2</sub> = g SO<sub>2</sub> per l of CHCl<sub>3</sub> solution

C <sub>1</sub>	C <sub>2</sub>	C <sub>1</sub> /C <sub>2</sub>
1 738	1 123	1 55
1 753	1 122	1 56
2 326	1 704	1 37
2 346	1 703	1 38
2 628	1 897	1 38
3 039	2 395	1 27
3 058	2 385	1 28
3 686	3 063	1 20
3 735	3 062	1 22
4 226	3 626	1 17
5 269	4 798	1 10
5 372	4 813	1 12
6 588	6 183	1 07
31 92	33 84	0 94
33 26	37 25	0 89

(McCrae, Z anorg 1903, 35 12)

Distribution of SO<sub>2</sub> between HCl+Ac and  
CHCl<sub>3</sub> at 20°

c<sub>1</sub> = g SO<sub>2</sub> per l of HCl+Aq solution

c<sub>2</sub> = g SO<sub>2</sub> per l of CHCl<sub>3</sub> solution

HCl = normality of HCl+Aq used

HCl	C <sub>1</sub>	C	C <sub>1</sub> 2
0 05-N	1 86	1 46	1 8
	3 076	2 830	1 8
	4 277	4 07	1 4
	5 340	5 42	0 6
0 1 -N	1 25	1 41	0 8
	1 324	1 416	0 3
	2 78	3 08	0 0
	3 86	4 08	0 4
0 2 -N	5 161	5 715	0 0
	1 268	1 509	0 4
	1 914	2 274	0 4
	2 464	3 040	0 1
0 4 -N	3 967	4 898	0 1
	1 202	1 614	0 9
	1 894	2 263	0 3

(McCrae, Z anorg 1903, 35 14)

Sulphur dioxide ammonia, SO<sub>2</sub>, NH<sub>3</sub>

Very hygroscopic Easily sol in H<sub>2</sub>C with  
decomp (Schumann, Z anorg 1900 23  
49)

SO<sub>2</sub>, 2NH<sub>3</sub> Somewhat hygroscopic

Sol in H<sub>2</sub>O with evolution of NH<sub>3</sub> (hu  
mann, Z anorg 1900, 23 50)

5SO<sub>2</sub>, 4NH<sub>3</sub> Very deliquescent

Very sol in H<sub>2</sub>O (Divers and O wa,  
Chem Soc 1901, 79 1103)

Sulphur trioxide, SO<sub>3</sub>

Fumes on air Miscible with H<sub>2</sub>O, with  
evolution of much heat Sol in H<sub>2</sub>SO<sub>4</sub> De-  
comp by alcohol and ether

Exists in two modifications, one of which is liquid and miscible with  $H_2SO_4$ , while the solid form is only slowly sol therein

Miscible with  $CS_2$  at  $30^\circ$ , but at  $15^\circ$   $CS_2$  dissolves only  $1\frac{1}{8}$  pt  $SO_3$ , and  $SO_3$ ,  $1\frac{1}{8}$  pt  $CS_2$  (Schultz-Sellack, Pogg 139 480)

There is only one modification, the liquid, which absorbs  $H_2O$  and becomes solid (Rebs, A 246 356)

Miscible with liquid  $SO_2$  (Schultz-Sellack)

See also Sulphuric acid

### Sulphur heptoxide, $S_2O_7$

Fumes on air Slowly decomp at  $0^\circ$ , instantaneously on warming Sol in conc  $H_2SO_4$  (Berthelot, J pr (2) 17 48)

Forms compound  $S_2O_7 \cdot 2H_2O$

Formula is  $SO_4$ , according to Traube (B 24. 1764), and  $S_2O_7$  is  $SO_3 + SO_4$

See also Marshall (Chem Soc 59 771)

Traube (B 26 148) denies the existence of  $SO_4$

### Sulphur oxybromide, $SOBr_2$

See Thionyl bromide

### Sulphur oxychloride, $SOCl_2$

See Thionyl chloride

$SOCl_2$  See Sulphuryl chloride

$SO_2Cl_2$  See Pyrosulphuryl chloride

$HSO_2Cl$  See Sulphuryl hydroxyl chloride

$S_2OCl_4$  Decomp by  $H_2O$  and alcohol (Ogier, C R 94 446)

Mixture of about  $17SOCl_2 + 2SOCl$  and  $5SO_2Cl_2$  (Knoll, B 1898, 31 2183)

### Sulphur oxytetrachloride, $S_2O_3Cl_4$

Violently decomp by  $H_2O$ , dil acids, or alcohol (Millon, A ch (3) 29 327)

Sol in warm  $S_2Cl_2$  (Carius, A 106 295)

Decomp violently with  $CS_2$

### Sulphur oxyfluoride, $SO_2F_2$

See Sulphuryl fluoride

$SOF_2$  See Thionyl fluoride

### Sulphur diphosphide, $P_2S$

See Phosphorus monosulphide

### Sulphur tetrachloride, $P_4S$

See Phosphorus semisulphide

### Sulphuretted hydrogen, $H_2S$

See Hydrogen sulphide

### Sulphuric acid, $H_2SO_4$

Miscible with  $H_2O$  in all proportions

Sp gr of  $H_2SO_4 + Aq$ 

Baume degrees	Sp gr	% $H_2SO_4$	Baume degrees	Sp gr	% $H_2SO_4$
66	1.842	100	66	1.844	100
60	1.720	84.22	60	1.717	82.34
50	1.618	74.32	50	1.618	74.32
40	1.524	66.40	40	1.603	72.70
30	1.466	58.02	30	1.586	71.17
20	1.370	50.41	20	1.566	69.80
10	1.310	43.21	10	1.550	68.03
5	1.260	38.02	5	1.532	66.45
	1.210	30.12		1.515	64.37
	1.162	24.01		1.500	62.80
	1.114	17.39		1.482	61.32
	1.076	11.73		1.466	59.80
	1.023	6.60		1.454	58.02

(Vauquelin A ch

76 260)

(Darcet A ch

(2) 1 198)

Sp gr of  $H_2SO_4 + Aq$ 

% $H_2SO_4$	Sp gr at $15^\circ$	Sp gr at $20^\circ$	% $H_2SO_4$	Sp gr at $15^\circ$	Sp gr at $25^\circ$
0	0.9986	0.9950	50	1.3806	1.3780
2	1.0110	1.0110	50	1.4347	
5	1.0284	1.0272	60	1.4860	1.4767
10	1.0609	1.0604	60	1.5402	
15	1.0998		70	1.5946	1.5863
20	1.1378	1.1311	70	1.6534	
25	1.1767		80	1.7092	1.6996
30	1.2154	1.2078	80	1.7602	
30	1.2582		90	1.8050	1.7940
40	1.2976	1.2888	90	1.8318	
45	1.3409		100	1.8406	1.8286

(Dele enne 1823)

Sp gr at  $15^\circ$  and b pt of  $H_2SO_4 + Aq$ 

Sp gr	% $SO_3$	B pt	Sp gr	% $SO_3$	B pt
1.860	81	326	1.769	67	217°
1.849	80	318	1.757	66	210
1.848	79	310	1.744	65	205
1.847	78	301	1.730	64	200
1.840	77	293	1.715	63	195
1.842	76	285	1.699	62	190
1.838	75	277	1.684	61	186
1.833	74	268	1.670	60	182
1.827	73	260	1.660	58.6	177
1.819	72	253	1.650	50	143
1.810	71	245	1.608	40	127
1.801	70	238	1.300	30	115
1.791	69	230	1.200	20	107
1.780	68	224	1.100	10	103

(Dalt n \ Syst 2 210)

Sp gr of  $H_2SO_4 + Aq$  at  $15^\circ$ 

Sp gr	% $SO_3$	% $H_2SO_4$	Sp gr	% $SO_3$	% $H_2SO_4$
1.8480	81.04	100	1.5970	57.08	70
1.8460	79.90	98	1.5760	55.40	68
1.8410	78.28	96	1.5503	53.82	66
1.8360	76.60	94	1.5250	52.18	64
1.8233	75.02	92	1.5006	50.50	62
1.8110	73.39	90	1.4860	48.92	60
1.7962	71.75	88	1.4660	47.29	58
1.7774	70.12	86	1.4460	45.66	56
1.7570	68.49	84	1.4260	44.03	54
1.7360	66.86	82	1.4073	42.40	52
1.7120	65.23	80	1.3884	40.77	50
1.6870	63.60	78	1.3697	39.14	48
1.6630	61.97	76	1.3530	37.51	46
1.6415	60.34	74	1.3340	35.88	44
1.6204	58.71	72	1.3165	34.25	42

Sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ —Continued

Sp gr	% $\text{SO}_3$	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{SO}_3$	% $\text{H}_2\text{SO}_4$
1 2999	32 61	40	1 1410	16 31	20
1 2323	30 98	38	1 1246	14 68	18
1 2004	29 35	36	1 1080	13 05	16
1 2199	27 72	34	1 0933	11 41	14
1 2334	26 09	32	1 0839	9 78	12
1 2181	24 46	30	1 0822	8 15	10
1 2032	22 83	28	1 0644	6 52	8
1 1876	21 20	26	1 0405	4 89	6
1 1706	19 57	24	1 0238	3 25	4
1 1449	17 94	22	1 0140	1 63	2

(Ure Schw J 35 444)

Sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$ 

Degrees Baume	Sp gr	At $0^\circ$		At $15^\circ$	
		% $\text{SO}_3$	% $\text{H}_2\text{SO}_4$	% $\text{SO}_3$	% $\text{H}_2\text{SO}_4$
5	1 036	5 1	4 2	5 4	4 5
10	1 075	10 3	8 4	10 9	8 9
15	1 116	15 5	12 7	16 3	13 3
20	1 161	21 2	17 3	22 4	18 3
25	1 209	27 2	22 2	28 3	23 1
30	1 252	33 6	27 4	34 8	28 4
33	1 296	37 6	30 7	38 9	31 8
35	1 320	40 4	33 0	41 6	34 0
37	1 332	41 7	34 1	43 0	35 1
38	1 345	43 1	35 2	44 3	36 2
39	1 357	44 5	36 3	45 5	37 2
40	1 370	45 9	37 4	46 9	38 3
41	1 383	47 3	38 6	48 4	39 5
42	1 397	48 7	39 7	49 9	40 7
43	1 410	50 0	40 8	51 2	41 8
44	1 424	51 4	41 9	52 7	42 9
45	1 438	52 8	43 1	54 0	44 1
46	1 453	54 3	44 3	55 4	45 2
47	1 468	55 7	45 5	56 9	46 4
48	1 483	57 1	46 8	58 2	47 5
49	1 498	58 5	47 8	59 6	48 7
50	1 514	60 0	49 0	61 1	50 0
51	1 530	61 4	50 1	62 6	51 1
52	1 546	62 9	51 3	63 9	52 2
53	1 563	64 4	52 6	65 4	53 4
54	1 580	65 9	53 8	66 9	54 6
55	1 597	67 4	55 0	68 4	55 8
56	1 615	68 9	56 2	70 0	57 1
57	1 634	70 5	57 5	71 6	58 4
58	1 652	72 1	58 8	73 2	59 7
59	1 671	73 6	60 1	74 7	61 0
60	1 691	75 2	61 4	76 3	62 3
61	1 711	76 9	62 8	78 0	63 6
62	1 732	78 4	64 2	79 8	65 1
63	1 754	80 0	65 7	81 7	66 7
64	1 776	81 6	67 2	83 9	68 5
65	1 799	83 2	68 7	86 0	70 4
66	1 819	84 8	70 3	88 5	73 0
67	1 840	86 4	72 2	91 8	74 9
68	1 862	88 0	74 3	94 5	77 7
69	1 882	89 6	76 5	97 5	81 6
70	1 900	91 2	78 8	100 0	

(Bineau A ch (3) 26 121)

The sp gr found at t can be reduced to sp gr at  
0 by multiplying by  $\frac{144.38}{144.38 + t}$  or by using the follow-  
ing table (Bineau)

Correction of sp gr for temperature to be added or subtracted  
lowering of the temp of 10 or corresponding increase

Sp gr of acid at 0	Corr	Sp gr of acid at $0^\circ$	Corr	Sp gr of acid at 0	Corr
1 04	0 002	1 15	0 005	1 45	0 38
1 07	0 003	1 20	0 006	1 70	0 39
1 10	0 004	1 30	0 007	1 85	0 396

(Bineau)

Sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$  a = %, b = %, c = sp gr if % is  $\text{SO}_3$ , d = sp gr if % is  $\text{H}_2\text{SO}_4$ 

a	b	c	a	b	c
1	1 009	1 0064	51	1 530	1 08
2	1 017	1 013	52	1 545	1 18
3	1 025	1 019	53	1 556	1 28
4	1 034	1 0256	54	1 573	1 38
5	1 041	1 032	55	1 585	1 48
6	1 049	1 039	56	1 600	1 586
7	1 058	1 0464	57	1 615	1 69
8	1 067	1 0536	58	1 627	1 80
9	1 076	1 061	59	1 642	1 90
10	1 085	1 068	60	1 656	1 10
11	1 095	1 0756	61	1 675	1 12
12	1 104	1 083	62	1 689	1 23
13	1 114	1 091	63	1 701	1 34
14	1 123	1 098	64	1 716	1 45
15	1 133	1 106	65	1 730	1 57
16	1 142	1 1136	66	1 742	1 68
17	1 150	1 121	67	1 755	1 80
18	1 160	1 129	68	1 770	1 92
19	1 170	1 136	69	1 781	1 104
20	1 180	1 144	70	1 792	1 115
21	1 190	1 1516	71	1 802	1 127
22	1 200	1 159	72	1 810	1 139
23	1 210	1 167	73	1 819	1 151
24	1 220	1 174	74	1 825	1 163
25	1 229	1 182	75	1 830	1 175
26	1 239	1 190	76	1 834	1 186
27	1 248	1 198	77	1 837	1 198
28	1 258	1 2066	78	1 839	1 210
29	1 268	1 215	79	1 841	1 222
30	1 278	1 223	80	1 842	1 234
31	1 288	1 231	81		1 245
32	1 300	1 239	82		1 256
33	1 310	1 2476	83		1 267
34	1 320	1 256	84		1 277
35	1 332	1 264	85		1 286
36	1 344	1 272	86		1 294
37	1 354	1 281	87		1 302
38	1 367	1 289	88		1 309
39	1 378	1 2976	89		1 316
40	1 390	1 306	90		1 322
41	1 401	1 315	91		1 327
42	1 415	1 324	92		1 331
43	1 427	1 333	93		1 334
44	1 440	1 342	94		1 336
45	1 451	1 351	95		1 337
46	1 465	1 361	96		1 338
47	1 478	1 370	97		1 339
48	1 490	1 379	98		1 340
49	1 501	1 3886	99		1 341
50	1 517	1 398	100		1 342

(Bineau, calculated by Gerlach, Z anal 292)

Sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ ,  $\text{H}_2\text{O}$  at  $0^\circ = 1$ 

% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr
1	1 006	35	1 264	68	1 592
2	1 012	36	1 272	69	1 604
3	1 018	37	1 281	70	1 615
4	1 025	38	1 290	71	1 626
5	1 032	39	1 298	72	1 638
6	1 039	40	1 307	73	1 650
7	1 046	41	1 316	74	1 662
8	1 053	42	1 324	75	1 674
9	1 061	43	1 333	76	1 684
10	1 069	44	1 342	77	1 697
11	1 076	45	1 352	78	1 710
12	1 084	46	1 361	79	1 721
13	1 091	47	1 370	80	1 732
14	1 099	48	1 379	81	1 743
15	1 106	49	1 389	82	1 753
16	1 114	50	1 399	83	1 763
17	1 122	51	1 409	84	1 773
18	1 129	52	1 418	85	1 783
19	1 137	53	1 428	86	1 792
20	1 145	54	1 438	87	1 800
21	1 153	55	1 448	88	1 807
22	1 161	56	1 459	89	1 814
23	1 168	57	1 469	90	1 820
24	1 176	58	1 480	91	1 825
25	1 184	59	1 491	92	1 8294
26	1 191	60	1 501	93	1 8339
27	1 199	61	1 512	94	1 8372
28	1 207	62	1 523	95	1 8390
29	1 215	63	1 535	96	1 8406
30	1 223	64	1 546	97	1 8410
31	1 231	65	1 558	98	1 8412
32	1 239	66	1 569	99	1 8403
33	1 247	67	1 580	100	1 8384
34	1 256				

(From 1-91 % according to Kolb, calculated by Gerlach, from 92-100% according to Lunge and Naef, calculated by Gerlach, Z anal 27 316)

Sp gr of  $\text{H}_2\text{SO}_4$  at  $15^\circ$  compared with  $\text{H}_2\text{O}$  at  $4^\circ$  and 0 mm pressure

Sp gr	% $\text{SO}_3$	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{SO}_3$	% $\text{H}_2\text{SO}_4$
1 000	0 07	0 09	1 075	8 90	10 90
1 005	0 08	0 10	1 080	9 47	11 60
1 010	1 28	1 57	1 085	10 04	12 30
1 015	1 88	2 30	1 090	10 60	12 99
1 020	2 47	3 03	1 095	11 16	13 67
1 025	3 07	3 76	1 100	11 71	14 35
1 030	3 67	4 49	1 105	12 27	15 07
1 035	4 27	5 23	1 110	12 82	15 71
1 040	4 87	5 96	1 115	13 36	16 36
1 045	5 45	6 67	1 120	13 89	17 01
1 050	6 02	7 37	1 125	14 42	17 66
1 055	6 59	8 07	1 130	14 95	18 31
1 060	7 16	8 77	1 135	15 48	18 96
1 065	7 73	9 47	1 140	16 01	19 61
1 070	8 32	10 19	1 145	16 54	20 26

Sp gr of  $\text{H}_2\text{SO}_4$  etc—Continued

Sp gr	% SO <sub>3</sub>	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% SO <sub>3</sub>	% H <sub>2</sub> SO <sub>4</sub>
1 150	17 07	20 91	1 455	45 31	55 50
1 155	17 59	21 55	1 460	45 69	55 97
1 160	18 11	22 19	1 465	46 07	56 43
1 165	18 64	22 83	1 470	46 45	56 90
1 170	19 06	23 47	1 475	46 83	57 37
1 175	19 69	24 12	1 480	47 21	57 83
1 180	20 21	24 76	1 485	47 57	58 28
1 185	20 73	25 40	1 490	47 95	58 74
1 190	21 26	26 04	1 495	48 34	59 22
1 195	21 78	26 68	1 500	48 73	59 70
1 200	22 30	27 32	1 505	49 12	60 18
1 205	22 82	27 95	1 510	49 51	60 65
1 210	23 33	28 58	1 515	49 89	61 12
1 215	23 84	29 21	1 520	50 28	61 59
1 220	24 36	29 84	1 525	50 66	62 06
1 225	24 88	30 48	1 530	51 04	62 53
1 230	25 39	31 11	1 535	51 43	63 00
1 235	25 88	31 70	1 540	51 78	63 43
1 240	26 35	32 28	1 545	52 12	63 85
1 245	26 83	32 86	1 550	52 46	64 26
1 250	27 29	33 40	1 555	52 79	64 67
1 255	27 76	34 00	1 560	53 12	65 08
1 260	28 22	34 57	1 565	53 46	65 49
1 265	28 69	35 14	1 570	53 80	65 90
1 270	29 15	35 71	1 575	54 13	66 30
1 275	29 62	36 29	1 580	54 46	66 71
1 280	30 10	36 87	1 585	54 80	67 13
1 285	30 57	31 45	1 590	55 18	67 59
1 290	31 04	38 03	1 595	55 55	68 05
1 295	31 52	38 61	1 600	55 93	68 51
1 300	31 99	39 19	1 605	56 30	68 97
1 305	32 46	39 77	1 610	56 68	69 43
1 310	32 94	40 35	1 615	57 05	69 89
1 315	33 41	40 93	1 620	57 40	70 32
1 320	33 88	41 50	1 625	57 75	70 74
1 325	34 35	42 08	1 630	58 09	71 16
1 330	34 80	42 66	1 635	58 43	71 57
1 335	35 27	43 20	1 640	58 74	71 99
1 340	35 71	43 74	1 645	59 10	72 40
1 345	36 14	44 28	1 650	59 45	72 88
1 350	36 58	44 82	1 655	59 78	73 23
1 355	37 02	45 35	1 660	60 11	73 64
1 360	37 45	45 88	1 665	60 46	74 07
1 365	37 89	46 41	1 670	60 82	74 51
1 370	38 32	46 94	1 675	61 20	74 97
1 375	38 75	47 47	1 680	61 57	75 42
1 380	39 18	48 00	1 685	61 93	75 86
1 385	39 62	48 53	1 690	62 29	76 30
1 390	40 05	49 06	1 695	62 64	76 73
1 395	40 48	49 59	1 700	63 00	77 17
1 400	40 91	50 11	1 705	63 35	77 60
1 405	41 33	50 63	1 710	63 70	78 04
1 410	41 76	51 15	1 715	64 07	78 48
1 415	42 17	51 66	1 720	64 43	78 92
1 420	42 57	52 15	1 725	64 78	79 36
1 425	42 96	52 63	1 730	65 14	79 80
1 430	43 36	53 11	1 735	65 50	80 24
1 435	43 75	53 59	1 740	65 86	80 68
1 440	44 14	54 07	1 745	66 22	81 12
1 445	44 53	54 55	1 750	66 58	81 56
1 450	44 92	55 03	1 755	66 94	82 00

Sp gr of H<sub>2</sub>SO<sub>4</sub>+Aq at 15°—Continued

Sp gr	% SO <sub>4</sub>	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% SO <sub>4</sub>	% H <sub>2</sub> SO <sub>4</sub>
1 2999	32 61	40	1 1410	16 31	20
1 2922	30 98	38	1 1246	14 68	18
1 2854	29 35	36	1 1080	13 05	16
1 2491	27 72	34	1 0933	11 41	14
1 2334	23 09	32	1 0839	9 78	12
1 2181	24 46	30	1 0822	8 15	10
1 2032	22 83	28	1 0544	6 52	8
1 1876	21 20	26	1 0405	4 89	6
1 1706	19 57	24	1 0298	3 25	4
1 1549	17 94	22	1 0140	1 63	2

(Ure Schw J 35 444)

Sp gr of H<sub>2</sub>SO<sub>4</sub>+Aq

Degrees Baumé	Sp gr	At 0°		At 15°	
		% SO <sub>4</sub>	% H <sub>2</sub> SO <sub>4</sub>	% SO <sub>4</sub>	% H <sub>2</sub> SO <sub>4</sub>
5	1 036	5 1	4 2	5 4	4 5
10	1 070	10 3	8 4	10 9	8 9
15	1 116	15 5	12 7	16 3	13 3
20	1 161	21 2	17 3	22 4	18 3
25	1 209	27 2	22 2	28 3	23 1
30	1 252	33 6	27 4	34 8	28 4
33	1 296	37 6	30 7	38 9	31 8
35	1 320	41 4	33 0	41 6	34 0
35	1 332	41 7	34 1	43 0	35 1
37	1 345	45 1	35 2	44 3	36 2
38	1 357	44 5	35 3	45 5	37 2
39	1 370	45 9	37 5	46 9	38 3
40	1 383	47 3	38 6	48 4	39 5
41	1 397	48 7	39 7	49 9	40 7
42	1 410	50 0	40 8	51 2	41 8
43	1 424	51 4	41 9	52 5	42 9
44	1 438	52 8	43 1	54 0	44 1
45	1 453	54 3	44 3	55 4	45 2
46	1 468	55 7	45 5	56 9	46 4
47	1 483	57 1	46 6	58 2	47 5
48	1 498	58 5	47 8	59 6	48 7
49	1 514	60 0	49 0	61 1	50 0
50	1 530	61 4	50 1	62 6	51 1
51	1 545	62 9	51 3	63 9	52 2
52	1 563	64 4	52 6	65 4	53 4
53	1 581	65 9	53 8	66 9	54 6
54	1 597	67 4	55 0	68 4	55 8
55	1 615	68 9	56 2	70 0	57 1
56	1 634	70 5	57 5	71 6	58 4
57	1 652	72 1	58 8	73 2	59 7
58	1 671	73 6	60 1	74 7	61 0
59	1 691	75 2	61 4	76 3	62 3
60	1 711	76 7	62 8	77 9	63 6
61	1 732	78 3	64 2	79 5	65 1
62	1 753	80 4	65 7	81 7	66 7
63	1 774	82 4	67 2	83 9	68 5
64	1 796	84 6	69 0	85 3	70 4
65	1 817	86 4	71 3	87 5	73 0
66	1 830	88 1	72 2	91 8	74 9
67	1 847	90 4	73 8	94 5	77 7
68	1 866	92 5	75 5	100 0	81 6
69	1 887	95 0	77 5		
70	1 907	100 0	81 6		

(Bin au A ch (3) 26 121)

The p gr found at t° can be reduced to sp gr at 0 by multiplying by  $\frac{144.38}{144.38 + t}$  or by using the following table (Bineau)

Correction of sp gr for temperature to be added lowering of the temp of 10° or subtracted corresponding increase

Sp gr of acid at 0°	Corr	Sp gr of acid at 0°	Corr	Sp gr of acid at 0°	Corr
1 04	0 002	1 15	0 005	1 40	0 005
1 07	0 003	1 20	0 006	1 70	0 005
1 10	0 004	1 30	0 007	1 85	0 005

(Bineau)

Sp gr of H<sub>2</sub>SO<sub>4</sub>+Aq at 15° a=%, b gr if % is SO<sub>4</sub>, c=sp gr if % is H<sub>2</sub>

a	b	c	a	b	c
1	1 009	1 0064	51	1 530	1 4 3
2	1 017	1 013	52	1 545	1 4 3
3	1 025	1 019	53	1 556	1 4 3
4	1 034	1 0256	54	1 573	1 4 3
5	1 041	1 032	55	1 585	1 4 3
6	1 049	1 039	56	1 600	1 4 36
7	1 058	1 0464	57	1 615	1 4 9
8	1 067	1 0536	58	1 627	1 4 0
9	1 076	1 061	59	1 642	1 4 0
10	1 085	1 068	60	1 656	1 4 0
11	1 095	1 0756	61	1 675	1 4 2
12	1 104	1 083	62	1 689	1 4 3
13	1 114	1 091	63	1 701	1 4 4
14	1 123	1 098	64	1 716	1 4 5
15	1 133	1 106	65	1 730	1 4 7
16	1 142	1 1136	66	1 742	1 4 8
17	1 150	1 121	67	1 755	1 4 0
18	1 160	1 129	68	1 770	1 4 2
19	1 170	1 136	69	1 781	1 4 4
20	1 180	1 144	70	1 792	1 4 5
21	1 190	1 1516	71	1 802	1 4 7
22	1 200	1 159	72	1 810	1 4 9
23	1 210	1 167	73	1 819	1 4 1
24	1 220	1 174	74	1 825	1 4 3
25	1 229	1 182	75	1 830	1 4 5
26	1 239	1 190	76	1 834	1 4 6
27	1 248	1 198	77	1 837	1 4 8
28	1 258	1 2066	78	1 839	1 4 0
29	1 268	1 215	79	1 841	1 4 2
30	1 278	1 223	80	1 842	1 4 4
31	1 288	1 231	81		1 4 5
32	1 300	1 239	82		1 4 6
33	1 310	1 2476	83		1 4 7
34	1 320	1 256	84		1 4 7
35	1 332	1 264	85		1 4 8
36	1 344	1 272	86		1 4 8
37	1 354	1 281	87		1 4 9
38	1 367	1 289	88		1 4 9
39	1 378	1 2976	89		1 4 9
40	1 390	1 306	90		1 4 9
41	1 401	1 315	91		1 4 9
42	1 415	1 324	92		1 4 9
43	1 427	1 333	93		1 4 9
44	1 440	1 342	94		1 4 9
45	1 451	1 351	95		1 4 9
46	1 465	1 361	96		1 4 9
47	1 478	1 370	97		1 4 9
48	1 490	1 379	98		1 4 9
49	1 501	1 3886	99		1 4 9
50	1 517	1 398	100		1 4 9

(Bineau, calculated by Gerlach, Z anal 8 12)

Sp gr of H<sub>2</sub>SO<sub>4</sub>+Aq at 15°, H<sub>2</sub>O at 0°=1

H <sub>2</sub> SO <sub>4</sub>	Sp gr	H <sub>2</sub> SO <sub>4</sub>	Sp gr	H <sub>2</sub> SO <sub>4</sub>	Sp gr
1	1 006	35	1 264	68	1 592
2	1 012	36	1 272	69	1 604
3	1 018	37	1 281	70	1 615
4	1 025	38	1 290	71	1 626
5	1 032	39	1 298	72	1 638
6	1 039	40	1 307	73	1 650
7	1 046	41	1 316	74	1 662
8	1 053	42	1 324	75	1 674
9	1 061	43	1 333	76	1 684
10	1 069	44	1 342	77	1 697
11	1 076	45	1 352	78	1 710
12	1 084	46	1 361	79	1 721
13	1 091	47	1 370	80	1 732
14	1 099	48	1 379	81	1 743
15	1 106	49	1 389	82	1 753
16	1 114	50	1 399	83	1 763
17	1 122	51	1 409	84	1 773
18	1 129	52	1 418	85	1 783
19	1 137	53	1 428	86	1 792
20	1 145	54	1 438	87	1 800
21	1 153	55	1 448	88	1 807
22	1 161	56	1 459	89	1 814
23	1 168	57	1 469	90	1 820
24	1 176	58	1 480	91	1 825
25	1 184	59	1 491	92	1 8294
26	1 191	60	1 501	93	1 8339
27	1 199	61	1 512	94	1 8372
28	1 207	62	1 523	95	1 8390
29	1 215	63	1 535	96	1 8406
30	1 223	64	1 546	97	1 8410
31	1 231	65	1 558	98	1 8412
32	1 239	66	1 569	99	1 8403
33	1 247	67	1 580	100	1 8384
34	1 256				

(From 1-91 % according to Kolb, calculated by Gerlach, from 92-100% according to Lunge and Naef, calculated by Gerlach, Z anal 27 316)

Sp gr of H<sub>2</sub>SO<sub>4</sub> at 15° compared with H<sub>2</sub>O at 4° and 0 mm pressure

Sp gr	SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>	Sp gr	SO <sub>4</sub>	H <sub>2</sub> SO <sub>4</sub>
1 000	0 07	0 09	1 075	8 90	10 90
1 005	0 68	0 83	1 080	9 47	11 60
1 010	1 28	1 57	1 085	10 04	12 30
1 015	1 88	2 30	1 090	10 60	12 99
1 020	2 47	3 03	1 095	11 16	13 67
1 025	3 07	3 76	1 100	11 71	14 35
1 030	3 67	4 49	1 105	12 27	15 07
1 035	4 27	5 23	1 110	12 82	15 71
1 040	4 87	5 96	1 115	13 36	16 36
1 045	5 45	6 67	1 120	13 89	17 01
1 050	6 02	7 37	1 125	14 42	17 66
1 055	6 59	8 07	1 130	14 95	18 31
1 060	7 16	8 77	1 135	15 48	18 96
1 065	7 73	9 47	1 140	16 01	19 61
1 070	8 32	10 19	1 145	16 54	20 26

Sp gr of H<sub>2</sub>SO<sub>4</sub>, etc—Continued

Sp gr	% SO <sub>3</sub>	% H SO <sub>4</sub>	Sp gr	% SO <sub>3</sub>	% H SO <sub>4</sub>
1 150	17 07	20 91	1 455	45 31	55 50
1 155	17 59	21 55	1 460	45 69	55 97
1 160	18 11	22 19	1 465	46 07	56 43
1 165	18 64	22 83	1 470	46 45	56 90
1 170	19 06	23 47	1 475	46 83	57 37
1 175	19 69	24 12	1 480	47 21	57 83
1 180	20 21	24 76	1 485	47 57	58 28
1 185	20 73	25 40	1 490	47 95	58 74
1 190	21 26	26 04	1 495	48 34	59 22
1 195	21 78	26 68	1 500	48 73	59 70
1 200	22 30	27 32	1 505	49 12	60 18
1 205	22 82	27 95	1 510	49 51	60 65
1 210	23 33	28 58	1 515	49 89	61 12
1 215	23 84	29 21	1 520	50 28	61 59
1 220	24 36	29 84	1 525	50 66	62 06
1 225	24 88	30 48	1 530	51 04	62 53
1 230	25 39	31 11	1 535	51 43	63 00
1 235	25 88	31 70	1 540	51 78	63 43
1 240	26 35	32 28	1 545	52 12	63 85
1 245	26 83	32 86	1 550	52 46	64 26
1 250	27 29	33 40	1 555	52 79	64 67
1 255	27 76	34 00	1 560	53 12	65 08
1 260	28 22	34 57	1 565	53 46	65 49
1 265	28 69	35 14	1 570	53 80	65 90
1 270	29 15	35 71	1 575	54 13	66 30
1 275	29 62	36 29	1 580	54 46	66 71
1 280	30 10	36 87	1 585	54 80	67 13
1 285	30 57	31 45	1 590	55 18	67 59
1 290	31 04	38 03	1 595	55 55	68 05
1 295	31 52	38 61	1 600	55 93	68 51
1 300	31 99	39 19	1 605	56 30	68 97
1 305	32 46	39 77	1 610	56 68	69 43
1 310	32 94	40 35	1 615	57 05	69 89
1 315	33 41	40 93	1 620	57 40	70 32
1 320	33 88	41 50	1 625	57 75	70 74
1 325	34 35	42 08	1 630	58 09	71 16
1 330	34 80	42 66	1 635	58 43	71 57
1 335	35 27	43 20	1 640	58 74	71 99
1 340	35 71	43 74	1 645	59 10	72 40
1 345	36 14	44 28	1 650	59 45	72 88
1 350	36 58	44 82	1 655	59 78	73 23
1 355	37 02	45 35	1 660	60 11	73 64
1 360	37 45	45 88	1 665	60 46	74 07
1 365	37 89	46 41	1 670	60 82	74 51
1 370	38 32	46 94	1 675	61 20	74 97
1 375	38 75	47 47	1 680	61 57	75 42
1 380	39 18	48 00	1 685	61 93	75 86
1 385	39 62	48 53	1 690	62 29	76 30
1 390	40 05	49 06	1 695	62 64	76 73
1 395	40 48	49 59	1 700	63 00	77 17
1 400	40 91	50 11	1 705	63 35	77 60
1 405	41 33	50 63	1 710	63 70	78 04
1 410	41 76	51 15	1 715	64 07	78 48
1 415	42 17	51 66	1 720	64 43	78 92
1 420	42 57	52 15	1 725	64 78	79 36
1 425	42 96	52 63	1 730	65 14	79 80
1 430	43 36	53 11	1 735	65 50	80 24
1 435	43 75	53 59	1 740	65 86	80 68
1 440	44 14	54 07	1 745	66 22	81 12
1 445	44 53	54 55	1 750	66 58	81 56
1 450	44 92	55 03	1 755	66 94	82 00

Sp gr of H <sub>2</sub> SO <sub>4</sub> , etc—Continued						Sp gr of conc H <sub>2</sub> SO <sub>4</sub> , etc—Continued				
Sp gr		C <sub>2</sub> O <sub>3</sub>	H <sup>+</sup> C <sub>2</sub> O <sub>3</sub>	Sp gr	C <sub>2</sub> O <sub>3</sub>	H <sup>+</sup> C <sub>2</sub> O <sub>3</sub>	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp g
1 760	67 30	82 44	1 829	75 03	91 90	95 61	1 8414	93 32	1 83	
1 765	67 65	82 88	1 830	75 19	92 10	95 55	1 8413	93 29	1 83	
1 770	68 02	83 32	1 831	75 35	92 30	95 50	1 8412	93 26	1 83	
1 775	68 49	83 90	1 832	75 53	92 52	95 45	1 8411	93 23	1 83	
1 780	68 98	84 50	1 833	75 72	92 75	95 40	1 8410	93 20	1 83	
1 785	69 74	85 10	1 834	75 96	93 05	95 35	1 8409	93 17	1 83	
1 790	69 96	85 70	1 835	76 27	93 43	95 30	1 8408	93 14	1 83	
1 795	70 45	86 30	1 836	76 57	93 80	95 25	1 8407	93 12	1 83	
1 800	70 94	86 90	1 837	76 90	94 20	95 21	1 8406	93 09	1 83	
1 805	71 50	87 60	1 838	77 23	94 60	95 16	1 8405	93 06	1 83	
1 810	72 08	88 30	1 839	77 55	95 00	95 12	1 8404	93 00	1 83	
1 815	72 69	89 05	1 840	78 04	95 60	95 08	1 8403	92 98	1 83	
1 820	73 51	90 05	1 8405	78 33	95 95	95 04	1 8402	92 95	1 83	
1 821	73 63	90 20	1 8415	79 19	97 00	95 00	1 8401	92 93	1 83	
1 822	73 80	90 40	1 8410	79 76	97 70	94 96	1 8400	92 90	1 83	
1 823	73 96	90 60	1 8415	80 16	98 20	94 92	1 8399	92 87	1 83	
1 824	74 12	90 80	1 8400	80 57	98 70	94 88	1 8398	92 84	1 83	
1 825	74 29	91 00	1 8400	80 98	99 20	94 84	1 8397	92 82	1 83	
1 826	74 49	91 25	1 8395	81 18	99 45	94 81	1 8396	92 79	1 83	
1 827	74 69	91 50	1 8390	81 39	99 70	94 77	1 8395	92 77	1 83	
1 828	74 86	91 70	1 8385	81 59	99 95	94 73	1 8394	92 73	1 83	
						94 69	1 8393	92 71	1 83	

(Lunge and Isler, Zeit angew Ch 9 129)

Sp gr of conc H<sub>2</sub>SO<sub>4</sub> + aq at 15°

% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr
100	1 8384	99 02	1 8417
99 98	1 8385	98 98	1 8418
99 96	1 8386	98 94	1 8419
99 94	1 8387	98 84	1 8420
99 92	1 8388	98 84	1 8421
99 90	1 8389	98 78	1 8422
99 88	1 8390	98 71	1 8423
99 86	1 8391	98 63	1 8424
99 84	1 8392	98 56	1 8425
99 81	1 8393	98 48	1 8426
99 78	1 8394	98 40	1 8427
99 76	1 8395	98 32	1 8428
99 73	1 8396	98 22	1 8429
99 70	1 8397	98 08	1 8430
99 67	1 8398	97 85	1 8431
99 64	1 8399	97 50	1 8432
99 61	1 8400	97 10	1 8431
99 58	1 8401	96 93	1 8430
99 55	1 8402	96 76	1 8429
99 52	1 8403	96 65	1 8428
99 49	1 8404	96 55	1 8427
99 46	1 8405	96 46	1 8426
99 43	1 8406	96 39	1 8425
99 40	1 8407	96 31	1 8424
99 37	1 8408	96 24	1 8423
99 33	1 8409	96 16	1 8422
99 29	1 8410	96 09	1 8421
99 25	1 8411	96 02	1 8420
99 22	1 8412	95 95	1 8419
99 19	1 8413	95 88	1 8418
99 16	1 8414	95 81	1 8417
99 11	1 8415	95 74	1 8416
99 06	1 8416	95 67	1 8415

95 61	1 8414	93 32	1 83
95 55	1 8413	93 29	1 83
95 50	1 8412	93 26	1 83
95 45	1 8411	93 23	1 83
95 40	1 8410	93 20	1 83
95 35	1 8409	93 17	1 83
95 30	1 8408	93 14	1 83
95 25	1 8407	93 12	1 83
95 21	1 8406	93 09	1 83
95 16	1 8405	93 06	1 83
95 12	1 8404	93 00	1 83
95 08	1 8403	92 98	1 83
95 04	1 8402	92 95	1 83
95 00	1 8401	92 93	1 83
94 96	1 8400	92 90	1 83
94 92	1 8399	92 87	1 83
94 88	1 8398	92 84	1 83
94 84	1 8397	92 82	1 83
94 81	1 8396	92 79	1 83
94 77	1 8395	92 77	1 83
94 73	1 8394	92 73	1 83
94 69	1 8393	92 71	1 83
94 65	1 8392	92 69	1 83
94 61	1 8391	92 66	1 83
94 57	1 8390	92 63	1 83
94 53	1 8389	92 61	1 83
94 49	1 8388	92 59	1 83
94 46	1 8387	92 56	1 83
94 42	1 8386	92 54	1 83
94 38	1 8385	92 52	1 83
94 34	1 8384	92 49	1 83
94 31	1 8383	92 46	1 83
94 27	1 8382	92 44	1 83
94 24	1 8381	92 41	1 83
94 20	1 8380	92 39	1 83
94 17	1 8379	92 37	1 83
94 13	1 8378	92 34	1 83
94 10	1 8377	92 32	1 83
94 07	1 8376	92 29	1 83
94 03	1 8375	92 27	1 83
94 00	1 8374	92 24	1 83
93 97	1 8373	92 22	1 83
93 93	1 8372	92 19	1 83
93 90	1 8371	92 17	1 83
93 87	1 8370	92 15	1 83
93 83	1 8369	92 12	1 83
93 80	1 8368	92 10	1 83
93 77	1 8367	92 07	1 83
93 74	1 8366	92 05	1 83
93 71	1 8365	92 02	1 83
93 68	1 8364	92 00	1 83
93 65	1 8363	91 98	1 83
93 62	1 8362	91 95	1 82
93 59	1 8361	91 93	1 82
93 56	1 8360	91 91	1 82
93 53	1 8359	91 88	1 82
93 50	1 8358	91 86	1 82
93 47	1 8357	91 84	1 82
93 44	1 8356	91 81	1 82
93 41	1 8355	91 78	1 82
93 38	1 8354	91 76	1 82
93 35	1 8353	91 74	1 82

Sp gr of conc  $\text{H}_2\text{SO}_4$ , etc—*Continued*

% H $\text{SO}_4$	Sp gr	% H $_2\text{SO}_4$	Sp gr
91 72	1 8298	90 78	1 8244
91 70	1 8288	90 76	1 8243
91 68	1 8287	90 74	1 8242
91 65	1 8286	90 72	1 8241
91 63	1 8285	90 70	1 8240
91 61	1 8284	90 68	1 8239
91 59	1 8283	90 66	1 8238
91 56	1 8282	90 64	1 8237
91 54	1 8281	90 62	1 8236
91 52	1 8280	90 60	1 8235
91 50	1 8279	90 59	1 8234
91 47	1 8278	90 57	1 8233
91 45	1 8277	90 55	1 8232
91 43	1 8276	90 53	1 8231
91 41	1 8275	90 51	1 8230
91 39	1 8274	90 49	1 8229
91 37	1 8273	90 47	1 8228
91 35	1 8272	90 46	1 8227
91 32	1 8271	90 44	1 8226
91 30	1 8270	90 42	1 8225
91 28	1 8269	90 40	1 8224
91 26	1 8268	90 38	1 8223
91 24	1 8267	90 37	1 8222
91 22	1 8266	90 35	1 8221
91 20	1 8265	90 33	1 8220
91 18	1 8264	90 31	1 8219
91 16	1 8263	90 29	1 8218
91 14	1 8262	90 28	1 8217
91 12	1 8261	90 26	1 8216
91 10	1 8260	90 24	1 8215
91 08	1 8259	90 23	1 8214
91 06	1 8258	90 20	1 8213
91 04	1 8257	90 18	1 8212
91 02	1 8256	90 17	1 8211
91 00	1 8255	90 15	1 8210
90 98	1 8254	90 13	1 8209
90 96	1 8253	90 11	1 8208
90 94	1 8252	90 10	1 8207
90 92	1 8251	90 08	1 8206
90 90	1 8250	90 06	1 8205
90 88	1 8249	90 04	1 8204
90 86	1 8248	90 02	1 8203
90 84	1 8247	90 01	1 8202
90 82	1 8246	89 99	1 8201
90 80	1 8245	89 97	1 8200

(Richmond calculated from Pickering, Chem Soc 57 [64] Jour Soc Ch Ind 9 479)

Sp gr of conc  $\text{H}_2\text{SO}_4$ +Aq at 15°

% H $\text{SO}_4$	Sp gr	% H $\text{SO}_4$	Sp gr
90	1 8185	96	1 8406
*90 20	1 8195	97	1 8410
91	1 8241	*97 70	1 8413
*91 48	1 8271	98	1 8412
92	1 8294	*98 39	1 8406
*92 83	1 8334	*98 66	1 8409
93	1 8339	99	1 8403
94	1 8372	*99 47	1 8395
*94 84	1 8387	100	1 8384
95	1 8390	*100 35	1 8411
*95 97	1 8406		

\*Determined by experiment

(Lunge and Naef, Dingl 248 91)

Sp gr of  $\text{H}_2\text{SO}_4$ +Aq at room temp containing

7 875                      15 503                      23 429%  $\text{H}_2\text{SO}_4$   
1 0651                      1 1305                      1 2003

(Wagner, W Ann 1883, 18 265)

Sp gr of  $\text{H}_2\text{SO}_4$ +Aq at 25°

Concentration of H $\text{SO}_4$ +Aq	Sp gr
1—normal	1 0303
$\frac{1}{2}$ —“	1 0154
$\frac{1}{4}$ —“	1 0074
$\frac{1}{8}$ —“	1 0035

(Wagner, Z phys Ch 1890, 5 40)

Sp gr of dil  $\text{H}_2\text{SO}_4$ +Aq

G equivalents H $\text{SO}_4$ per liter	t°	Sp gr t/t°
0 005049	17 345	1 0002082
0 01009	17 360	1 0004020
0 01512	17 382	1 0005879
0 02014	17 398	1 000769
0 03014	17 419	1 001125
0 002526	18 039	1 0001065
0 005050	18 040	1 0002084
0 01006	18 040	1 0004009
0 02005	18 040	1 0007668
0 03001	18 039	1 0011208
0 04950	18 040	1 0018096
0 09564	18 045	1 003460
0 146560	18 070	1 005045
0 19354	18 090	1 006550
0 28942	18 092	1 009686
0 47466	18 055	1 015616
0 4980	17 73	1 01634
4 980	17 95	1 15234
0 005176	12 997	1 0002106
0 01035	13 020	1 000411
0 01551	13 005	1 000603
0 12648	13 031	1 00443°
0 25151	13 011	1 008565
0 37672	13 007	1 012639
0 50503	12 998	1 016758

(Kohlrausch, W Ann 1894, 53 28)



Sp gr of H <sub>2</sub> SO <sub>4</sub> +Aq			
% H <sub>2</sub> SO <sub>4</sub>	79 68	60 98	35 77
Sp gr 20°/20°	1 7383	1 5181	1 2719
% H <sub>2</sub> SO <sub>4</sub>	10 10	4 78	
Sp gr 20°/20°	1 0685	1 0317	
(Le Blanc and Rohland, Z phys Ch 1896, 19 268)			

Sp gr of N-H<sub>2</sub>SO<sub>4</sub>+Aq at 18°/4°=1 0306  
(Loomis, W Ann 1896, 60 550)

Sp gr of H<sub>2</sub>SO<sub>4</sub>+Aq at 19 4°, when p =  
percent strength of solution, d = observed  
density, w = volume conc in grams per

$$cc \left( \frac{pd}{100} = w \right)$$

p	d	w
94 10	1 8380	1 7295
84 59	1 7998	1 5223
73 08	1 6743	1 2235
61 35	1 5341	0 9412
40 72	1 3220	0 5383
31 94	1 2430	0 3970
23 77	1 1747	0 2792
14 72	1 1023	0 1623
9 802	1 0670	0 1046
4 826	1 0320	0 0498

(Barnes, J Phys Chem 1898, 2 546)

Sp gr of H<sub>2</sub>SO<sub>4</sub>+Aq at 20°

Normality of H <sub>2</sub> SO <sub>4</sub> +Aq	% H <sub>2</sub> SO <sub>4</sub>	Sp gr
11 53	70 07	1 6129
9 01	59 26	1 4901
6 95	49 10	1 3872
4 77	36 68	1 2756
3 008	25 00	1 1791
1 002	9 25	1 0612

(Forchheimer Z phys Ch 1900, 34 27)

Sp gr of conc and fuming H<sub>2</sub>SO<sub>4</sub> at 15° and 45°

H <sub>2</sub> SO <sub>4</sub>	Total SO <sub>3</sub>	Free SO <sub>3</sub>	Sp gr at 15°	Sp gr at 45°
95 98	78 50		1 8418	
96 68	78 92		1 8429	
96 99	79 18		1 8431	
97 66	79 72		1 8434 max	
98 65	80 53		1 8403	
99 40	81 14		1 8388 min	
99 76	81 44		1 8418	
100 00	81 63	0 00	1 8500	1 822
	85 46	10 00	1 888	1 858
	88 30	20 00	1 920	1 887
	87 14	30 00	1 957	1 920
	88 97	40 00	1 979	1 945
	90 81	50 00	1 964 max	1 964
	92 65	60 00	1 920 max	1 959
	94 48	70 00	1 918	1 942
	96 32	80 00	1 890	1 890
	98 16	90 00	1 864	1 864
	100 00	100 00	1 844	1 814

(Knetsch, B 1901, 34 4102)

Sp gr of fuming H<sub>2</sub>SO<sub>4</sub> at 35°

Total SO <sub>3</sub> %	Free SO <sub>3</sub> %	Sp gr	Total SO <sub>3</sub> %	Free SO <sub>3</sub> %	Sp r
81 63	0	1 8186	91 18	52	1 49
81 99	2	1 8270	91 55	54	1 60
82 36	4	1 8360	91 91	56	1 72
82 73	6	1 8425	92 28	58	1 54
83 09	8	1 8498	92 65	60	1 38
83 46	10	1 8565	93 02	62	1 09
83 82	12	1 8627	93 38	64	1 72
84 20	14	1 8692	93 75	66	1 36
84 56	16	1 8756	94 11	68	1 00
84 92	18	1 8830	94 48	70	1 64
85 30	20	1 8919	94 85	72	1 02
85 66	22	1 9020	95 21	74	1 42
86 03	24	1 9092	95 58	76	1 79
86 40	26	1 9158	95 95	78	1 15
86 76	28	1 9220	96 32	80	1 51
87 14	30	1 9280	96 69	82	1 33
87 50	32	1 9338	97 05	84	1 15
87 87	34	1 9405	97 42	86	1 46
88 24	36	1 9474	97 78	88	1 30
88 60	38	1 9534	98 16	90	1 38
88 97	40	1 9584	98 53	92	1 30
89 33	42	1 9612	98 90	94	1 12
89 70	44	1 9643	99 26	96	1 35
90 07	46	1 9672	99 63	98	1 38
90 44	48	1 9702	100 00	100	1 70
90 81	50	1 9733			

(Knetsch, B 1901, 34 4101)

Sp gr of H<sub>2</sub>SO<sub>4</sub>+Aq at 15°/15° in air

Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>
1 000	0 00	1 028	4 12	1 056	8
1 001	0 15	1 029	4 26	1 057	8
1 002	0 31	1 030	4 41	1 058	8
1 003	0 46	1 031	4 56	1 059	8
1 004	0 60	1 032	4 70	1 060	8
1 005	0 73	1 033	4 85	1 061	8
1 006	0 87	1 034	5 00	1 062	9
1 007	1 01	1 035	5 14	1 063	9
1 008	1 15	1 036	5 29	1 064	9
1 009	1 30	1 037	5 44	1 065	9
1 010	1 45	1 038	5 58	1 066	9
1 011	1 60	1 039	5 73	1 067	9
1 012	1 75	1 040	5 88	1 068	9
1 013	1 89	1 041	6 03	1 069	10
1 014	2 04	1 042	6 17	1 070	10
1 015	2 19	1 043	6 32	1 071	10
1 016	2 34	1 044	6 46	1 072	10
1 017	2 49	1 045	6 60	1 073	10
1 018	2 64	1 046	6 75	1 074	10
1 019	2 79	1 047	6 89	1 075	10
1 020	2 93	1 048	7 04	1 076	11
1 021	3 08	1 049	7 18	1 077	11
1 022	3 23	1 050	7 32	1 078	11
1 023	3 38	1 051	7 47	1 079	11
1 024	3 53	1 052	7 61	1 080	11
1 025	3 67	1 053	7 76	1 081	11
1 026	3 82	1 054	7 90	1 082	11
1 027	3 97	1 055	8 04	1 083	11

Sp gr of H<sub>2</sub>SO<sub>4</sub>+Aq at 15°/15° in air —  
Continued

Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>
1 084	12 11	1 145	20 25	1 206	27 95
1 085	12 24	1 146	20 38	1 207	28 08
1 086	12 38	1 147	20 51	1 208	28 20
1 087	12 52	1 148	20 64	1 209	28 32
1 088	12 66	1 149	20 77	1 210	28 45
1 089	12 79	1 150	20 90	1 211	28 57
1 090	12 93	1 151	21 03	1 212	28 69
1 091	13 07	1 152	21 16	1 213	28 82
1 092	13 20	1 153	21 28	1 214	28 94
1 093	13 34	1 154	21 41	1 215	29 06
1 094	13 48	1 155	21 54	1 216	29 18
1 095	13 61	1 156	21 67	1 217	29 31
1 096	13 75	1 157	21 80	1 218	29 43
1 097	13 89	1 158	21 93	1 219	29 55
1 098	14 02	1 159	22 05	1 220	29 69
1 099	14 16	1 160	22 18	1 221	29 80
1 100	14 29	1 161	22 31	1 222	29 92
1 101	14 43	1 162	22 44	1 223	30 04
1 102	14 56	1 163	22 56	1 224	30 17
1 103	14 70	1 164	22 69	1 225	30 29
1 104	14 83	1 165	22 82	1 226	30 41
1 105	14 97	1 166	22 94	1 227	30 53
1 106	15 10	1 167	23 07	1 228	30 65
1 107	15 24	1 168	23 20	1 229	30 78
1 108	15 37	1 169	23 32	1 230	30 90
1 109	15 51	1 170	23 45	1 231	31 02
1 110	15 64	1 171	23 57	1 232	31 14
1 111	15 78	1 172	23 71	1 233	31 26
1 112	15 91	1 173	23 83	1 234	31 38
1 113	16 05	1 174	23 96	1 235	31 50
1 114	16 18	1 175	24 08	1 236	31 62
1 115	16 31	1 176	24 21	1 237	31 75
1 116	16 45	1 177	24 34	1 238	31 87
1 117	16 58	1 178	24 46	1 239	31 99
1 118	16 71	1 179	24 59	1 240	32 11
1 119	16 84	1 180	24 71	1 241	32 23
1 120	16 98	1 181	24 84	1 242	32 35
1 121	17 11	1 182	24 97	1 243	32 47
1 122	17 24	1 183	25 09	1 244	32 59
1 123	17 37	1 184	25 22	1 245	32 71
1 124	17 51	1 185	25 34	1 246	32 83
1 125	17 64	1 186	25 47	1 247	32 95
1 126	17 77	1 187	25 59	1 248	33 07
1 127	17 90	1 188	25 72	1 249	33 19
1 128	18 03	1 189	25 84	1 250	33 31
1 129	18 16	1 190	25 97	1 251	33 43
1 130	18 30	1 191	26 09	1 252	33 55
1 131	18 43	1 192	26 22	1 253	33 67
1 132	18 56	1 193	26 34	1 254	33 79
1 133	18 69	1 194	26 47	1 255	33 91
1 134	18 82	1 195	26 59	1 256	34 02
1 135	18 95	1 196	26 71	1 257	34 14
1 136	19 08	1 197	26 84	1 258	34 26
1 137	19 22	1 198	26 96	1 259	34 38
1 138	19 34	1 199	27 09	1 260	34 50
1 139	19 47	1 200	27 21	1 261	34 62
1 140	19 60	1 201	27 33	1 262	34 74
1 141	19 73	1 202	27 46	1 263	34 86
1 142	19 86	1 203	27 58	1 264	34 98
1 143	19 99	1 204	27 71	1 265	35 09
1 144	20 12	1 205	27 83	1 266	35 21

Sp gr of H<sub>2</sub>SO<sub>4</sub>+Aq at 15°/15° in air —  
Continued

Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>
1 267	35 33	1 328	42 35	1 389	48 92
1 268	35 45	1 329	42 46	1 390	49 02
1 269	35 57	1 330	42 57	1 391	49 13
1 270	35 68	1 331	42 68	1 392	49 23
1 271	35 80	1 332	42 79	1 393	49 34
1 272	35 92	1 333	42 90	1 394	49 44
1 273	36 04	1 334	43 01	1 395	49 54
1 274	36 15	1 335	43 12	1 396	49 65
1 275	36 27	1 336	43 23	1 397	49 75
1 276	36 39	1 337	43 35	1 398	49 86
1 277	36 51	1 338	43 46	1 399	49 96
1 278	36 62	1 339	43 57	1 400	50 06
1 279	36 70	1 340	43 68	1 401	50 16
1 280	36 86	1 341	43 79	1 402	50 26
1 281	36 97	1 342	43 90	1 403	50 37
1 282	37 09	1 343	44 01	1 404	50 47
1 283	37 21	1 344	44 12	1 405	50 57
1 284	37 32	1 345	44 23	1 406	50 67
1 285	37 44	1 346	44 34	1 407	50 77
1 286	37 56	1 347	44 45	1 408	50 88
1 287	37 68	1 348	44 56	1 409	50 98
1 288	37 79	1 349	44 67	1 410	51 08
1 289	37 91	1 350	44 77	1 411	51 18
1 290	38 03	1 351	44 88	1 412	51 28
1 291	38 14	1 352	44 99	1 413	51 38
1 292	38 26	1 353	45 10	1 414	51 48
1 293	38 37	1 354	45 21	1 415	51 58
1 294	38 49	1 355	45 32	1 416	51 68
1 295	38 60	1 356	45 43	1 417	51 78
1 296	38 72	1 357	45 53	1 418	51 89
1 297	38 83	1 358	45 64	1 419	51 99
1 298	38 95	1 359	45 75	1 420	52 09
1 299	39 06	1 360	45 86	1 421	52 19
1 300	39 18	1 361	45 97	1 422	52 29
1 301	39 29	1 362	46 07	1 423	52 39
1 302	39 41	1 363	46 18	1 424	52 49
1 303	39 52	1 364	46 29	1 425	52 59
1 304	39 64	1 365	46 39	1 426	52 69
1 305	39 75	1 366	46 50	1 427	52 79
1 306	39 86	1 367	46 61	1 428	52 89
1 307	39 98	1 368	46 71	1 429	52 98
1 308	40 09	1 369	46 82	1 430	53 08
1 309	40 20	1 370	46 92	1 431	53 18
1 310	40 32	1 371	47 03	1 432	53 28
1 311	40 43	1 372	47 14	1 433	53 38
1 312	40 54	1 373	47 24	1 434	53 48
1 313	40 66	1 374	47 35	1 435	53 58
1 314	40 77	1 375	47 45	1 436	53 68
1 315	40 88	1 376	47 56	1 437	53 78
1 316	40 99	1 377	47 67	1 438	53 88
1 317	41 11	1 378	47 77	1 439	53 97
1 318	41 22	1 379	47 88	1 440	54 07
1 319	41 33	1 380	47 98	1 441	54 17
1 320	41 45	1 381	48 09	1 442	54 27
1 321	41 56	1 382	48 10	1 443	54 36
1 322	41 67	1 383	48 30	1 444	54 46
1 323	41 79	1 384	48 40	1 445	54 56
1 324	41 90	1 385	48 50	1 446	54 65
1 325	42 01	1 386	48 61	1 447	54 75
1 326	42 12	1 387	48 71	1 448	54 85
1 327	42 23	1 388	48 82	1 449	54 94

Sp gr of $\text{H}_2\text{SO}_4 + \text{Aq}$			
% $\text{H}_2\text{SO}_4$	79 68	60 98	35 77
Sp gr 20°/20°	1 7383	1 5181	1 2719
% $\text{H}_2\text{SO}_4$	10 10	4 78	
Sp gr 20°/20°	1 0685	1 0317	
(Le Blanc and Rohland, Z phys Ch 1896, 19 268)			

Sp gr of  $\text{N-H}_2\text{SO}_4 + \text{Aq}$  at 18°/4° = 1 0306  
(Loomis, W Ann 1896, 60 550)

Sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at 19 4°, when p = percent strength of solution d = observed density, w = volume conc in grams per cc  
 $\left(\frac{pd}{100} = w\right)$

p	d	w
94 10	1 8380	1 7295
84 59	1 7998	1 5223
73 08	1 6743	1 2235
61 35	1 5341	0 9412
40 72	1 3220	0 5383
31 94	1 2430	0 3970
23 77	1 1747	0 2792
14 72	1 1023	0 1623
9 802	1 0670	0 1046
4 826	1 0320	0 0498

(Barnes, J Phys Chem 1898, 2 546)

Sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at 20°

Normality of $\text{H}_2\text{SO}_4 + \text{Aq}$	% $\text{H}_2\text{SO}_4$	Sp gr
11 53	70 07	1 6129
9 01	59 26	1 4901
6 95	49 10	1 3872
4 77	36 68	1 2756
3 008	25 00	1 1791
1 002	9 25	1 0612

(Forchheimer, Z phys Ch 1900, 34 27)

Sp gr of total and fuming  $\text{H}_2\text{SO}_4$  at 15° and 45°

$\text{H}_2\text{SO}_4$	Total $\text{SO}_4$ %	Free $\text{SO}_4$ %	Sp gr at 15	Sp gr at 45
95 98	78 50	1 8418		
96 68	78 92	1 8429		
96 99	79 18	1 8431		
97 66	79 72	1 8434 max		
98 15	80 53	1 8403		
99 40	81 14	1 8388 min		
99 76	81 44	1 8415		
100 00	81 65	0 0	1 8500	1 822
	85 46	10 01	1 858	1 855
	85 30	20 01	1 920	1 887
	87 14	30 01	1 957	1 920
	88 97	40 01	1 979	1 945
	90 81	50 02	1 009	1 964 max
	92 65	60 02	1 020 max	1 959
	94 48	70 02	1 018	1 942
	96 32	80 02	1 008	1 890
	98 16	90 01	1 990	1 864
	100 00	100 01	1 984	1 814

(Knietzsch B 1901, 34 4102)

Sp gr of fuming  $\text{H}_2\text{SO}_4$  at 35°

Total $\text{SO}_4$ %	Free $\text{SO}_4$ %	Sp gr	Total $\text{SO}_4$ %	Free $\text{SO}_4$ %	Sp gr
81 63	0	1 8186	91 18	52	1 49
81 99	2	1 8270	91 55	54	1 60
82 36	4	1 8360	91 91	56	1 72
82 73	6	1 8425	92 28	58	1 54
83 09	8	1 8498	92 65	60	1 38
83 46	10	1 8565	93 02	62	1 09
83 82	12	1 8627	93 38	64	1 72
84 20	14	1 8692	93 75	66	1 36
84 56	16	1 8756	94 11	68	1 00
84 92	18	1 8830	94 48	70	1 64
85 30	20	1 8919	94 85	72	1 02
85 66	22	1 9020	95 21	74	1 42
86 03	24	1 9092	95 58	76	1 79
86 40	26	1 9158	95 95	78	1 15
86 76	28	1 9220	96 32	80	1 51
87 14	30	1 9280	96 69	82	1 33
87 50	32	1 9338	97 05	84	1 15
87 87	34	1 9405	97 42	86	1 46
88 24	36	1 9474	97 78	88	1 30
88 60	38	1 9534	98 16	90	1 38
88 97	40	1 9584	98 53	92	1 30
89 33	42	1 9612	98 90	94	1 32
89 70	44	1 9643	99 26	96	1 35
90 07	46	1 9672	99 63	98	1 38
90 44	48	1 9702	100 00	100	1 38
90 81	50	1 9733			1 70

(Knietzsch, B 1901, 34 4101)

Sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at 15°/15° in air

Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$
1 000	0 00	1 028	4 12	1 056	8
1 001	0 15	1 029	4 26	1 057	8
1 002	0 31	1 030	4 41	1 058	8
1 003	0 46	1 031	4 56	1 059	8
1 004	0 60	1 032	4 70	1 060	8
1 005	0 73	1 033	4 85	1 061	8
1 006	0 87	1 034	5 00	1 062	9
1 007	1 01	1 035	5 14	1 063	9
1 008	1 15	1 036	5 29	1 064	9
1 009	1 30	1 037	5 44	1 065	9
1 010	1 45	1 038	5 58	1 066	9
1 011	1 60	1 039	5 73	1 067	9
1 012	1 75	1 040	5 88	1 068	9
1 013	1 89	1 041	6 03	1 069	10
1 014	2 04	1 042	6 17	1 070	10
1 015	2 19	1 043	6 32	1 071	10
1 016	2 34	1 044	6 46	1 072	10
1 017	2 49	1 045	6 60	1 073	10
1 018	2 64	1 046	6 75	1 074	10
1 019	2 79	1 047	6 89	1 075	10
1 020	2 93	1 048	7 04	1 076	11
1 021	3 08	1 049	7 18	1 077	11
1 022	3 23	1 050	7 32	1 078	11
1 023	3 38	1 051	7 47	1 079	11
1 024	3 53	1 052	7 61	1 080	11
1 025	3 67	1 053	7 76	1 081	11
1 026	3 82	1 054	7 90	1 082	11
1 027	3 97	1 055	8 04	1 083	11

Sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at 15°/15° in air —  
Continued

Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$
1 084	12 11	1 145	20 25	1 206	27 95
1 085	12 24	1 146	20 38	1 207	28 08
1 086	12 38	1 147	20 51	1 208	28 20
1 087	12 52	1 148	20 64	1 209	28 32
1 088	12 66	1 149	20 77	1 210	28 45
1 089	12 79	1 150	20 90	1 211	28 57
1 090	12 93	1 151	21 03	1 212	28 69
1 091	13 07	1 152	21 16	1 213	28 82
1 092	13 20	1 153	21 28	1 214	28 94
1 093	13 34	1 154	21 41	1 215	29 06
1 094	13 48	1 155	21 54	1 216	29 18
1 095	13 61	1 156	21 67	1 217	29 31
1 096	13 75	1 157	21 80	1 218	29 43
1 097	13 89	1 158	21 93	1 219	29 55
1 098	14 02	1 159	22 05	1 220	29 69
1 099	14 16	1 160	22 18	1 221	29 80
1 100	14 29	1 161	22 31	1 222	29 92
1 101	14 43	1 162	22 44	1 223	30 04
1 102	14 56	1 163	22 56	1 224	30 17
1 103	14 70	1 164	22 69	1 225	30 29
1 104	14 83	1 165	22 82	1 226	30 41
1 105	14 97	1 166	22 94	1 227	30 53
1 106	15 10	1 167	23 07	1 228	30 65
1 107	15 24	1 168	23 20	1 229	30 78
1 108	15 37	1 169	23 32	1 230	30 90
1 109	15 51	1 170	23 45	1 231	31 02
1 110	15 64	1 171	23 57	1 232	31 14
1 111	15 78	1 172	23 71	1 233	31 26
1 112	15 91	1 173	23 83	1 234	31 38
1 113	16 05	1 174	23 96	1 235	31 50
1 114	16 18	1 175	24 08	1 236	31 62
1 115	16 31	1 176	24 21	1 237	31 75
1 116	16 45	1 177	24 34	1 238	31 87
1 117	16 58	1 178	24 46	1 239	31 99
1 118	16 71	1 179	24 59	1 240	32 11
1 119	16 84	1 180	24 71	1 241	32 23
1 120	16 98	1 181	24 84	1 242	32 35
1 121	17 11	1 182	24 97	1 243	32 47
1 122	17 24	1 183	25 09	1 244	32 59
1 123	17 37	1 184	25 22	1 245	32 71
1 124	17 51	1 185	25 34	1 246	32 83
1 125	17 64	1 186	25 47	1 247	32 95
1 126	17 77	1 187	25 59	1 248	33 07
1 127	17 90	1 188	25 72	1 249	33 19
1 128	18 03	1 189	25 84	1 250	33 31
1 129	18 16	1 190	25 97	1 251	33 43
1 130	18 30	1 191	26 09	1 252	33 55
1 131	18 43	1 192	26 22	1 253	33 67
1 132	18 56	1 193	26 34	1 254	33 79
1 133	18 69	1 194	26 47	1 255	33 91
1 134	18 82	1 195	26 59	1 256	34 02
1 135	18 95	1 196	26 71	1 257	34 14
1 136	19 08	1 197	26 84	1 258	34 26
1 137	19 22	1 198	26 96	1 259	34 38
1 138	19 34	1 199	27 09	1 260	34 50
1 139	19 47	1 200	27 21	1 261	34 62
1 140	19 60	1 201	27 33	1 262	34 74
1 141	19 73	1 202	27 46	1 263	34 86
1 142	19 86	1 203	27 58	1 264	34 98
1 143	19 99	1 204	27 71	1 265	35 09
1 144	20 12	1 205	27 83	1 266	35 21

Sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at 15°/15° in air —  
Continued

Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>
1 267	35 33	1 328	42 35	1 389	48 92
1 268	35 45	1 329	42 46	1 390	49 02
1 269	35 57	1 330	42 57	1 391	49 13
1 270	35 68	1 331	42 68	1 392	49 23
1 271	35 80	1 332	42 79	1 393	49 34
1 272	35 92	1 333	42 90	1 394	49 44
1 273	36 04	1 334	43 01	1 395	49 54
1 274	36 15	1 335	43 12	1 396	49 65
1 275	36 27	1 336	43 23	1 397	49 75
1 276	36 39	1 337	43 35	1 398	49 86
1 277	36 51	1 338	43 46	1 399	49 96
1 278	36 62	1 339	43 57	1 400	50 06
1 279	36 70	1 340	43 68	1 401	50 16
1 280	36 86	1 341	43 79	1 402	50 26
1 281	36 97	1 342	43 90	1 403	50 37
1 282	37 09	1 343	44 01	1 404	50 47
1 283	37 21	1 344	44 12	1 405	50 57
1 284	37 32	1 345	44 23	1 406	50 67
1 285	37 44	1 346	44 34	1 407	50 77
1 286	37 56	1 347	44 45	1 408	50 88
1 287	37 68	1 348	44 56	1 409	50 98
1 288	37 79	1 349	44 67	1 410	51 08
1 289	37 91	1 350	44 77	1 411	51 18
1 290	38 03	1 351	44 88	1 412	51 28
1 291	38 14	1 352	44 99	1 413	51 38
1 292	38 26	1 353	45 10	1 414	51 48
1 293	38 37	1 354	45 21	1 415	51 58
1 294	38 49	1 355	45 32	1 416	51 68
1 295	38 60	1 356	45 43	1 417	51 78
1 296	38 72	1 357	45 53	1 418	51 89
1 297	38 83	1 358	45 64	1 419	51 99
1 298	38 95	1 359	45 75	1 420	52 09
1 399	39 06	1 360	45 86	1 421	52 19
1 300	39 18	1 361	45 97	1 422	52 29
1 301	39 29	1 362	46 07	1 423	52 39
1 302	39 41	1 363	46 18	1 424	52 49
1 303	39 52	1 364	46 29	1 425	52 59
1 304	39 64	1 365	46 39	1 426	52 69
1 305	39 75	1 366	46 50	1 427	52 79
1 306	39 86	1 367	46 61	1 428	52 89
1 307	39 98	1 368	46 71	1 429	52 98
1 308	40 09	1 369	46 82	1 430	53 08
1 309	40 20	1 370	46 92	1 431	53 18
1 310	40 32	1 371	47 03	1 432	53 28
1 311	40 43	1 372	47 14	1 433	53 38
1 312	40 54	1 373	47 24	1 434	53 48
1 313	40 66	1 374	47 35	1 435	53 58
1 314	40 77	1 375	47 45	1 436	53 68
1 315	40 88	1 376	47 56	1 437	53 78
1 316	40 99	1 377	47 67	1 438	53 88
1 317	41 11	1 378	47 77	1 439	53 97
1 318	41 22	1 379	47 88	1 440	54 07
1 319	41 33	1 380	47 98	1 441	54 17
1 320	41 45	1 381	48 09	1 442	54 27
1 321	41 56	1 382	48 10	1 443	54 36
1 322	41 67	1 383	48 30	1 444	54 46
1 323	41 79	1 384	48 40	1 445	54 56
1 324	41 90	1 385	48 50	1 446	54 65
1 325	42 01	1 386	48 61	1 447	54 75
1 326	42 12	1 387	48 71	1 448	54 85
1 327	42 23	1 388	48 82	1 449	54 94

Sp gr of H <sub>2</sub> SO <sub>4</sub> +Aq at 15°/15° in air — Continued						Sp gr of H <sub>2</sub> SO <sub>4</sub> +Aq at 15°/15° in air — Continued					
Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>
1 450	55 04	1 511	60 78	1 572	66 23	1 633	71 48	1 694	76 65	1 755	81 11
1 451	55 14	1 512	60 87	1 573	66 31	1 634	71 57	1 695	76 74	1 756	81 11
1 452	55 24	1 513	60 96	1 574	66 40	1 635	71 65	1 696	76 82	1 757	81 11
1 453	55 33	1 514	61 05	1 575	66 49	1 636	71 74	1 697	76 91	1 758	81 11
1 454	55 43	1 515	61 14	1 576	66 57	1 637	71 82	1 698	76 99	1 759	81 11
1 455	55 53	1 516	61 24	1 577	66 66	1 638	71 91	1 699	77 08	1 760	81 11
1 456	55 62	1 517	61 33	1 578	66 75	1 639	71 99	1 700	77 17	1 761	81 11
1 457	55 72	1 518	61 42	1 579	66 83	1 640	72 07	1 701	77 25	1 762	81 11
1 458	55 82	1 519	61 51	1 580	66 92	1 641	72 16	1 702	77 34	1 763	81 11
1 459	55 91	1 520	61 60	1 581	67 01	1 642	72 25	1 703	77 42	1 764	81 11
1 460	56 01	1 521	61 69	1 582	67 10	1 643	72 33	1 704	77 51	1 765	81 11
1 461	56 11	1 522	61 78	1 583	67 18	1 644	72 42	1 705	77 60	1 766	81 11
1 462	56 20	1 523	61 87	1 584	67 27	1 645	72 50	1 706	77 68	1 767	81 11
1 463	56 30	1 524	61 96	1 585	67 36	1 646	72 59	1 707	77 77	1 768	81 11
1 464	56 39	1 525	62 05	1 586	67 44	1 647	72 67	1 708	77 85	1 769	81 11
1 465	56 49	1 526	62 14	1 587	67 53	1 648	72 76	1 709	77 94	1 770	81 11
1 466	56 59	1 527	62 23	1 588	67 62	1 649	72 84	1 710	78 03	1 771	81 11
1 467	56 68	1 528	62 32	1 589	67 70	1 650	72 93	1 711	78 11	1 772	81 11
1 468	56 78	1 529	62 41	1 590	67 79	1 651	73 01	1 712	78 20	1 773	81 11
1 469	56 87	1 530	62 50	1 591	67 88	1 652	73 10	1 713	78 28	1 774	81 11
1 470	56 97	1 531	62 59	1 592	67 97	1 653	73 18	1 714	78 37	1 775	81 11
1 471	57 07	1 532	62 68	1 593	68 05	1 654	73 27	1 715	78 46	1 776	81 11
1 472	57 16	1 533	62 77	1 594	68 14	1 655	73 35	1 716	78 54	1 777	81 11
1 473	57 25	1 534	62 86	1 595	68 23	1 656	73 43	1 717	78 63	1 778	81 11
1 474	57 35	1 535	62 95	1 596	68 31	1 657	73 52	1 718	78 72	1 779	81 11
1 475	57 44	1 536	63 04	1 597	68 40	1 658	73 60	1 719	78 80	1 780	81 11
1 476	57 54	1 537	63 13	1 598	68 49	1 659	73 69	1 720	78 89	1 781	81 11
1 477	57 63	1 538	63 22	1 599	68 57	1 660	73 77	1 721	78 97	1 782	81 11
1 478	57 73	1 539	63 31	1 600	68 66	1 661	73 86	1 722	79 06	1 783	81 11
1 479	57 82	1 540	63 40	1 601	68 74	1 662	73 94	1 723	79 15	1 784	81 11
1 480	57 92	1 541	63 49	1 602	68 83	1 663	74 02	1 724	79 23	1 785	81 11
1 481	58 01	1 542	63 58	1 603	68 92	1 664	74 11	1 725	79 32	1 786	81 11
1 482	58 10	1 543	63 67	1 604	69 00	1 665	74 19	1 726	79 41	1 787	81 11
1 483	58 20	1 544	63 76	1 605	69 09	1 666	74 27	1 727	79 49	1 788	81 11
1 484	58 29	1 545	63 85	1 606	69 17	1 667	74 36	1 728	79 58	1 789	81 11
1 485	58 38	1 546	63 94	1 607	69 26	1 668	74 44	1 729	79 67	1 790	81 11
1 486	58 48	1 547	64 03	1 608	69 35	1 669	74 53	1 730	79 75	1 791	81 11
1 487	58 57	1 548	64 12	1 609	69 43	1 670	74 61	1 731	79 84	1 792	81 11
1 488	58 66	1 549	64 20	1 610	69 52	1 671	74 69	1 732	79 93	1 793	81 11
1 489	58 75	1 550	64 29	1 611	69 60	1 672	74 78	1 733	80 02	1 794	81 11
1 490	58 85	1 551	64 38	1 612	69 69	1 673	74 86	1 734	80 11	1 795	81 11
1 491	58 94	1 552	64 47	1 613	69 78	1 674	74 95	1 735	80 20	1 796	81 11
1 492	59 03	1 553	64 55	1 614	69 86	1 675	75 03	1 736	80 29	1 797	81 11
1 493	59 12	1 554	64 64	1 615	69 95	1 676	75 12	1 737	80 38	1 798	81 11
1 494	59 22	1 555	64 73	1 616	70 03	1 677	75 20	1 738	80 47	1 799	81 11
1 495	59 31	1 556	64 82	1 617	70 12	1 678	75 29	1 739	80 56	1 800	81 11
1 496	59 41	1 557	64 91	1 618	70 20	1 679	75 37	1 740	80 65	1 801	81 11
1 497	59 50	1 558	65 00	1 619	70 29	1 680	75 46	1 741	80 74	1 802	81 11
1 498	59 59	1 559	65 08	1 620	70 38	1 681	75 54	1 742	80 84	1 803	81 11
1 499	59 68	1 560	65 17	1 621	70 46	1 682	75 63	1 743	80 92	1 804	81 11
1 500	59 78	1 561	65 26	1 622	70 55	1 683	75 71	1 744	81 01	1 805	81 11
1 501	59 87	1 562	65 35	1 623	70 63	1 684	75 80	1 745	81 10	1 806	81 11
1 502	59 96	1 563	65 44	1 624	70 72	1 685	75 88	1 746	81 19	1 807	81 11
1 503	60 05	1 564	65 52	1 625	70 80	1 686	75 97	1 747	81 28	1 808	81 11
1 504	60 14	1 565	65 61	1 626	70 89	1 687	76 05	1 748	81 37	1 809	81 11
1 505	60 23	1 566	65 70	1 627	70 97	1 688	76 14	1 749	81 46	1 810	81 11
1 506	60 33	1 567	65 79	1 628	71 06	1 689	76 22	1 750	81 55	1 811	81 11
1 507	60 42	1 568	65 88	1 629	71 14	1 690	76 31	1 751	81 64	1 812	81 11
1 508	60 51	1 569	65 96	1 630	71 23	1 691	76 39	1 752	81 73	1 813	81 11
1 509	60 60	1 570	66 05	1 631	71 31	1 692	76 48	1 753	81 82	1 814	81 11
1 510	60 69	1 571	66 14	1 632	71 40	1 693	76 56	1 754	81 92	1 815	81 11

Continued on page 917

Sp gr of H <sub>2</sub> SO <sub>4</sub> +Aq at t° Sp gr of H <sub>2</sub> O at 15°=1									
% H <sub>2</sub> SO <sub>4</sub>	0°	10°	15°	20°	25°	30°	40°	50°	60°
0	1 00074	1 00060	1 00000	0 99910	0 99794	0 99654	0 99311	0 98895	0 98418
1	1 00833	1 00773	1 00698	1 00594	1 00465	1 00312	0 99950	0 99522	0 99034
2	1 01563	1 01466	1 01381	1 01266	1 01126	1 00963	1 00585	1 00143	0 99644
3	1 02281	1 02153	1 02055	1 01928	1 01777	1 01607	1 01216	1 00761	1 00252
4	1 03001	1 02841	1 02728	1 02590	1 02428	1 02251	1 01848	1 01383	1 00865
5	1 03728	1 03533	1 03406	1 03258	1 03086	1 02902	1 02487	1 02013	1 01484
6	1 04461	1 04232	1 04092	1 03934	1 03756	1 03565	1 03138	1 02653	1 02114
7	1 05199	1 04939	1 04786	1 04618	1 04434	1 04235	1 03796	1 03302	1 02752
8	1 05942	1 05652	1 05486	1 05308	1 05116	1 04910	1 04458	1 03952	1 03393
9	1 06689	1 06370	1 06192	1 06002	1 05799	1 05585	1 05119	1 04605	1 04041
10	1 07439	1 07093	1 06903	1 06702	1 06490	1 06267	1 05787	1 05264	1 04696
11	1 08194	1 07821	1 07619	1 07408	1 07186	1 06955	1 06462	1 05930	1 05357
12	1 08954	1 08555	1 08342	1 08120	1 07890	1 07650	1 07145	1 06604	1 06027
13	1 09718	1 09294	1 09071	1 08839	1 08600	1 08352	1 07834	1 07284	1 06703
14	1 10488	1 10040	1 09805	1 09564	1 09316	1 09061	1 08530	1 07971	1 07385
15	1 11261	1 10790	1 10546	1 10295	1 10039	1 09776	1 09233	1 08666	1 08075
16	1 12040	1 11547	1 11292	1 11033	1 10768	1 10498	1 09944	1 09368	1 08772
17	1 12823	1 12309	1 12045	1 11777	1 11505	1 11228	1 10661	1 10077	1 09476
18	1 13610	1 13076	1 12803	1 12526	1 12246	1 11963	1 11385	1 10792	1 10186
19	1 14402	1 13848	1 13566	1 13282	1 12995	1 12704	1 12115	1 11514	1 10902
20	1 15199	1 14625	1 14335	1 14043	1 13748	1 13451	1 12851	1 12242	1 11625
21	1 15998	1 15407	1 15109	1 14809	1 14508	1 14205	1 13594	1 12977	1 12353
22	1 16803	1 16194	1 15888	1 15581	1 15273	1 14964	1 14343	1 13718	1 13089
23	1 17611	1 16986	1 16673	1 16359	1 16045	1 15731	1 15100	1 14467	1 13832
24	1 18424	1 17784	1 17464	1 17143	1 16823	1 16503	1 15862	1 15221	1 14579
25	1 19240	1 18586	1 18260	1 17933	1 17607	1 17282	1 16631	1 15982	1 15335
26	1 20061	1 19393	1 19060	1 18728	1 18396	1 18066	1 17406	1 16749	1 16096
27	1 20885	1 20204	1 19865	1 19527	1 19190	1 18854	1 18186	1 17522	1 16862
28	1 21710	1 21019	1 20675	1 20332	1 19990	1 19650	1 18973	1 18302	1 17635
29	1 22539	1 21838	1 21489	1 21142	1 20796	1 20452	1 19767	1 19087	1 18414
30	1 23370	1 22661	1 22308	1 21957	1 21607	1 21259	1 20566	1 19879	1 19198
31	1 24204	1 23487	1 23131	1 22776	1 22423	1 22071	1 21371	1 20677	1 19989
32	1 25038	1 24316	1 23957	1 23600	1 23244	1 22887	1 22179	1 21476	1 20779
33	1 25878	1 25151	1 24789	1 24429	1 24069	1 23712	1 22999	1 22292	1 21589
34	1 26723	1 25990	1 25626	1 25263	1 24901	1 24540	1 23822	1 23109	1 22400
35	1 27571	1 26834	1 26468	1 26102	1 25738	1 25375	1 24652	1 23933	1 23219
36	1 28424	1 27683	1 27314	1 26947	1 26580	1 26214	1 25487	1 24763	1 24045
37	1 29283	1 28538	1 28167	1 27797	1 27429	1 27061	1 26329	1 25 01	1 24878
38	1 30149	1 29400	1 29027	1 28655	1 28284	1 27915	1 27179	1 26448	1 25721
39	1 31022	1 30268	1 29894	1 29520	1 29148	1 28776	1 28038	1 27304	1 26575
40	1 31901	1 31144	1 30767	1 30392	1 30018	1 29646	1 28905	1 28169	1 27440
41	1 32788	1 32027	1 31648	1 31271	1 30896	1 30522	1 29779	1 29042	1 28311
42	1 33683	1 32917	1 32537	1 32158	1 31782	1 31407	1 30662	1 29924	1 29193
43	1 34587	1 33817	1 33435	1 33054	1 32676	1 32300	1 31553	1 30813	1 30081
44	1 35501	1 34727	1 34342	1 33960	1 33580	1 33202	1 32452	1 31710	1 30976
45	1 36425	1 35647	1 35261	1 34877	1 34496	1 34116	1 33363	1 32618	1 31881
46	1 37361	1 36579	1 36191	1 35805	1 35422	1 35040	1 34284	1 33535	1 32797
47	1 38308	1 37522	1 37132	1 36744	1 36359	1 35975	1 35215	1 34464	1 33721
48	1 39267	1 38476	1 38084	1 37694	1 37306	1 36921	1 36157	1 35401	1 34655
49	1 40238	1 39441	1 39047	1 38654	1 38264	1 37877	1 37108	1 36349	1 35600
50	1 41219	1 40418	1 40021	1 39627	1 39235	1 38845	1 38073	1 37310	1 36556
51	1 42214	1 41407	1 41007	1 40610	1 40215	1 39823	1 39047	1 38280	1 37524
52	1 43220	1 42408	1 42005	1 41605	1 41208	1 40814	1 40033	1 39262	1 38502

Sp gr of H<sub>2</sub>SO<sub>4</sub>+Aq at 15°/15° in air —  
Continued

Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	% H <sub>2</sub> SO <sub>4</sub>
1 450	55 04	1 511	60 78	1 572	66 23
1 451	55 14	1 512	60 87	1 573	66 31
1 452	55 24	1 513	60 96	1 574	66 40
1 453	55 33	1 514	61 05	1 575	66 49
1 454	55 43	1 515	61 14	1 576	66 57
1 455	55 53	1 516	61 24	1 577	66 66
1 456	55 62	1 517	61 33	1 578	66 75
1 457	55 72	1 518	61 42	1 579	66 83
1 458	55 82	1 519	61 51	1 580	66 92
1 459	55 91	1 520	61 60	1 581	67 01
1 460	56 01	1 521	61 69	1 582	67 10
1 461	56 11	1 522	61 78	1 583	67 18
1 462	56 20	1 523	61 87	1 584	67 27
1 463	56 30	1 524	61 96	1 585	67 36
1 464	56 39	1 525	62 05	1 586	67 44
1 465	56 49	1 526	62 14	1 587	67 53
1 466	56 59	1 527	62 23	1 588	67 62
1 467	56 68	1 528	62 32	1 589	67 70
1 468	56 78	1 529	62 41	1 590	67 79
1 469	56 87	1 530	62 50	1 591	67 88
1 470	56 97	1 531	62 59	1 592	67 97
1 471	57 07	1 532	62 68	1 593	68 05
1 472	57 16	1 533	62 77	1 594	68 14
1 473	57 25	1 534	62 86	1 595	68 23
1 474	57 35	1 535	62 95	1 596	68 31
1 475	57 44	1 536	63 04	1 597	68 40
1 476	57 54	1 537	63 13	1 598	68 49
1 477	57 63	1 538	63 22	1 599	68 57
1 478	57 73	1 539	63 31	1 600	68 66
1 479	57 82	1 540	63 40	1 601	68 74
1 480	57 92	1 541	63 49	1 602	68 83
1 481	58 01	1 542	63 58	1 603	68 92
1 482	58 10	1 543	63 67	1 604	69 00
1 483	58 20	1 544	63 76	1 605	69 09
1 484	58 29	1 545	63 85	1 606	69 17
1 485	58 38	1 546	63 94	1 607	69 26
1 486	58 48	1 547	64 03	1 608	69 35
1 487	58 57	1 548	64 12	1 609	69 43
1 488	58 66	1 549	64 20	1 610	69 52
1 489	58 75	1 550	64 29	1 611	69 60
1 490	58 85	1 551	64 38	1 612	69 69
1 491	58 94	1 552	64 47	1 613	69 78
1 492	59 03	1 553	64 55	1 614	69 86
1 493	59 12	1 554	64 64	1 615	69 95
1 494	59 22	1 555	64 73	1 616	70 03
1 495	59 31	1 556	64 82	1 617	70 12
1 496	59 41	1 557	64 91	1 618	70 20
1 497	59 50	1 558	65 00	1 619	70 29
1 498	59 59	1 559	65 09	1 620	70 38
1 499	59 68	1 560	65 17	1 621	70 46
1 500	59 78	1 561	65 26	1 622	70 55
1 501	59 87	1 562	65 35	1 623	70 63
1 502	59 96	1 563	65 44	1 624	70 72
1 503	60 05	1 564	65 52	1 625	70 80
1 504	60 14	1 565	65 61	1 626	70 89
1 505	60 23	1 566	65 70	1 627	70 97
1 506	60 33	1 567	65 79	1 628	71 06
1 507	60 42	1 568	65 88	1 629	71 14
1 508	60 51	1 569	65 96	1 630	71 23
1 509	60 60	1 570	66 05	1 631	71 31
1 510	60 69	1 571	66 14	1 632	71 40

Sp gr of H<sub>2</sub>SO<sub>4</sub>+Aq at 15°/15° in air —  
Continued

Sp gr	% H <sub>2</sub> SO	Sp gr	% H <sub>2</sub> SO <sub>4</sub>	Sp gr	%	SO <sub>4</sub>
1 633	71 48	1 694	76 65	1 755	8	01
1 634	71 57	1 695	76 74	1 756	8	11
1 635	71 65	1 696	76 82	1 757	8	21
1 636	71 74	1 697	76 91	1 758	8	31
1 637	71 82	1 698	76 99	1 759	8	41
1 638	71 91	1 699	77 08	1 760	8	51
1 639	71 99	1 700	77 17	1 761	8	61
1 640	72 07	1 701	77 25	1 762	8	71
1 641	72 16	1 702	77 34	1 763	8	80
1 642	72 25	1 703	77 42	1 764	8	90
1 643	72 33	1 704	77 51	1 765	8	00
1 644	72 42	1 705	77 60	1 766	8	10
1 645	72 50	1 706	77 68	1 767	8	20
1 646	72 59	1 707	77 77	1 768	8	29
1 647	72 67	1 708	77 85	1 769	8	39
1 648	72 76	1 709	77 94	1 770	8	49
1 649	72 84	1 710	78 03	1 771	8	59
1 650	72 93	1 711	78 11	1 772	8	69
1 651	73 01	1 712	78 20	1 773	8	78
1 652	73 10	1 713	78 28	1 774	8	88
1 653	73 18	1 714	78 37	1 775	8	98
1 654	73 27	1 715	78 46	1 776	8	08
1 655	73 35	1 716	78 54	1 777	8	18
1 656	73 43	1 717	78 63	1 778	8	29
1 657	73 52	1 718	78 72	1 779	8	39
1 658	73 52	1 719	78 80	1 780	8	50
1 659	73 69	1 720	78 89	1 781	8	60
1 660	73 77	1 721	78 97	1 782	8	71
1 661	73 86	1 722	79 06	1 783	8	81
1 662	73 94	1 723	79 15	1 784	8	92
1 663	74 02	1 724	79 23	1 785	8	03
1 664	74 11	1 725	79 32	1 786	8	14
1 665	74 19	1 726	79 41	1 787	8	25
1 666	74 27	1 727	79 49	1 788	8	36
1 667	74 36	1 728	79 58	1 789	8	47
1 668	74 44	1 729	79 67	1 790	8	60
1 669	74 53	1 730	79 75	1 791	8	72
1 670	74 61	1 731	79 84	1 792	8	84
1 671	74 69	1 732	79 93	1 793	8	96
1 672	74 78	1 733	80 02	1 794	8	08
1 673	74 86	1 734	80 11	1 795	8	20
1 674	74 95	1 735	80 20	1 796	8	32
1 675	75 03	1 736	80 29	1 797	8	45
1 676	75 12	1 737	80 38	1 798	8	58
1 677	75 20	1 738	80 47	1 799	8	71
1 678	75 29	1 739	80 56	1 800	8	84
1 679	75 37	1 740	80 65	1 801	8	97
1 680	75 46	1 741	80 74	1 802	8	10
1 681	75 54	1 742	80 84	1 803	8	23
1 682	75 63	1 743	80 92	1 804	8	36
1 683	75 71	1 744	81 01	1 805	8	50
1 684	75 80	1 745	81 10	1 806	8	64
1 685	75 88	1 746	81 19	1 807	8	78
1 686	75 97	1 747	81 28	1 808	8	92
1 687	76 05	1 748	81 37	1 809	8	06
1 688	76 14	1 749	81 46	1 810	8	20
1 689	76 22	1 750	81 55	1 811	8	34
1 690	76 31	1 751	81 64	1 812	8	49
1 691	76 39	1 752	81 73	1 813	8	64
1 692	76 48	1 753	81 82	1 814	8	79
1 693	76 56	1 754	81 92	1 815	8	95

Continued on page 917

Sp gr of H<sub>2</sub>SO<sub>4</sub>+Aq at t° Sp gr of H<sub>2</sub>O at 15°=1

% H <sub>2</sub> SO <sub>4</sub>	0	10°	15°	20°	25°	30°	40°	50°	60°
0	1 00074	1 00060	1 00000	0 99910	0 99794	0 99654	0 99311	0 98895	0 98418
1	1 00833	1 00773	1 00698	1 00594	1 00465	1 00312	0 99950	0 99522	0 99034
2	1 01563	1 01466	1 01381	1 01266	1 01126	1 00963	1 00585	1 00143	0 99644
3	1 02281	1 02153	1 02055	1 01928	1 01777	1 01607	1 01216	1 00761	1 00252
4	1 03001	1 02841	1 02728	1 02590	1 02428	1 02251	1 01848	1 01383	1 00865
5	1 03728	1 03533	1 03406	1 03258	1 03086	1 02902	1 02487	1 02013	1 01484
6	1 04461	1 04232	1 04092	1 03934	1 03756	1 03565	1 03138	1 02653	1 02114
7	1 05199	1 04939	1 04786	1 04618	1 04434	1 04235	1 03796	1 03302	1 02752
8	1 05942	1 05652	1 05486	1 05308	1 05116	1 04910	1 04458	1 03952	1 03393
9	1 06689	1 06370	1 06192	1 06002	1 05799	1 05585	1 05119	1 04605	1 04041
10	1 07439	1 07093	1 06903	1 06702	1 06490	1 06267	1 05787	1 05264	1 04696
11	1 08194	1 07821	1 07619	1 07408	1 07186	1 06955	1 06462	1 05930	1 05357
12	1 08954	1 08555	1 08342	1 08120	1 07890	1 07650	1 07145	1 06604	1 06027
13	1 09718	1 09294	1 09071	1 08839	1 08600	1 08352	1 07834	1 07284	1 06703
14	1 10488	1 10040	1 09805	1 09564	1 09316	1 09061	1 08530	1 07971	1 07385
15	1 11261	1 10790	1 10546	1 10295	1 10039	1 09776	1 09233	1 08666	1 08075
16	1 12040	1 11547	1 11292	1 11033	1 10768	1 10498	1 09944	1 09368	1 08772
17	1 12823	1 12309	1 12045	1 11777	1 11505	1 11228	1 10661	1 10077	1 09476
18	1 13610	1 13076	1 12803	1 12526	1 12246	1 11963	1 11385	1 10792	1 10186
19	1 14402	1 13848	1 13566	1 13282	1 12995	1 12704	1 12115	1 11514	1 10902
20	1 15199	1 14625	1 14335	1 14043	1 13748	1 13451	1 12851	1 12242	1 11625
21	1 15998	1 15407	1 15109	1 14809	1 14508	1 14205	1 13594	1 12977	1 12353
22	1 16803	1 16194	1 15888	1 15581	1 15273	1 14964	1 14343	1 13718	1 13089
23	1 17611	1 16986	1 16673	1 16359	1 16045	1 15731	1 15100	1 14467	1 13832
24	1 18424	1 17784	1 17464	1 17143	1 16823	1 16503	1 15862	1 15221	1 14579
25	1 19240	1 18586	1 18260	1 17933	1 17607	1 17282	1 16631	1 15982	1 15335
26	1 20061	1 19393	1 19060	1 18728	1 18396	1 18066	1 17406	1 16749	1 16096
27	1 20885	1 20204	1 19865	1 19527	1 19190	1 18854	1 18186	1 17522	1 16862
28	1 21710	1 21019	1 20675	1 20332	1 19990	1 19650	1 18973	1 18302	1 17635
29	1 22539	1 21838	1 21489	1 21142	1 20796	1 20452	1 19767	1 19087	1 18414
30	1 23370	1 22661	1 22308	1 21957	1 21607	1 21259	1 20566	1 19879	1 19198
31	1 24204	1 23487	1 23131	1 22776	1 22423	1 22071	1 21371	1 20677	1 19989
32	1 25038	1 24316	1 23957	1 23600	1 23244	1 22887	1 22179	1 21476	1 20779
33	1 25878	1 25151	1 24789	1 24429	1 24069	1 23712	1 22999	1 22292	1 21589
34	1 26723	1 25990	1 25626	1 25263	1 24901	1 24540	1 23822	1 23109	1 22400
35	1 27571	1 26834	1 26468	1 26102	1 25738	1 25375	1 24652	1 23933	1 23219
36	1 28424	1 27683	1 27314	1 26947	1 26580	1 26214	1 25487	1 24763	1 24045
37	1 29283	1 28538	1 28167	1 27797	1 27429	1 27061	1 26329	1 25 01	1 24878
38	1 30149	1 29400	1 29027	1 28655	1 28284	1 27915	1 27179	1 26448	1 25721
39	1 31022	1 30268	1 29894	1 29520	1 29148	1 28776	1 28038	1 27304	1 26575
40	1 31901	1 31144	1 30767	1 30392	1 30018	1 29646	1 28905	1 28169	1 27440
41	1 32788	1 32027	1 31648	1 31271	1 30896	1 30522	1 29779	1 29042	1 28311
42	1 33683	1 32917	1 32537	1 32158	1 31782	1 31407	1 30662	1 29924	1 29193
43	1 34587	1 33817	1 33435	1 33054	1 32676	1 32300	1 31553	1 30813	1 30081
44	1 35501	1 34727	1 34342	1 33960	1 33580	1 33202	1 32452	1 31710	1 30976
45	1 36425	1 35647	1 35261	1 34877	1 34496	1 34116	1 33363	1 32618	1 31881
46	1 37361	1 36579	1 36191	1 35805	1 35422	1 35040	1 34284	1 33535	1 32797
47	1 38308	1 37522	1 37132	1 36744	1 36359	1 35975	1 35215	1 34464	1 33721
48	1 39267	1 38476	1 38084	1 37694	1 37306	1 36921	1 36157	1 35401	1 34655
49	1 40238	1 39441	1 39047	1 38654	1 38264	1 37877	1 37108	1 36349	1 35600
50	1 41219	1 40418	1 40021	1 39627	1 39235	1 38845	1 38073	1 37310	1 36556
51	1 42214	1 41407	1 41007	1 40610	1 40215	1 39823	1 39047	1 38280	1 37524
52	1 43220	1 42408	1 42005	1 41605	1 41208	1 40814	1 40033	1 39262	1 38502

Sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $t^\circ$  Sp gr of  $\text{H}_2\text{O}$  at  $15^\circ = 1$  *Continued*

$\frac{\text{H}_2\text{SO}_4}{\text{H}_2\text{O}}$	$0^\circ$	$10^\circ$	$15^\circ$	$20^\circ$	$25^\circ$	$30^\circ$	$40^\circ$	$50^\circ$	
53	1 44239	1 43420	1 43014	1 42611	1 42211	1 41814	1 41028	1 40254	1 40
54	1 45269	1 44443	1 44034	1 43628	1 43225	1 42825	1 42034	1 41255	1 48
55	1 46311	1 45477	1 45065	1 44656	1 44250	1 43847	1 43051	1 42268	1 49
56	1 47364	1 46523	1 46107	1 45695	1 45285	1 44880	1 44078	1 43290	1 51
57	1 48427	1 47578	1 47159	1 46743	1 46331	1 45922	1 45115	1 44322	1 54
58	1 49499	1 48643	1 48221	1 47802	1 47387	1 46975	1 46162	1 45364	1 57
59	1 50583	1 49719	1 49292	1 48870	1 48452	1 48037	1 47218	1 46415	1 62
60	1 51676	1 50804	1 50374	1 49949	1 49527	1 49109	1 48285	1 47476	1 68
61	1 52778	1 51899	1 51465	1 51036	1 50611	1 50190	1 49360	1 48546	1 74
62	1 53889	1 53002	1 52564	1 52132	1 51703	1 51278	1 50442	1 49622	1 81
63	1 55008	1 54113	1 53672	1 53236	1 52804	1 52376	1 51533	1 50708	1 90
64	1 56135	1 55233	1 54788	1 54348	1 53913	1 53481	1 52632	1 51801	1 98
65	1 57270	1 56360	1 55912	1 55469	1 55030	1 54595	1 53740	1 52903	1 08
66	1 58414	1 57496	1 57044	1 56597	1 56154	1 55716	1 54854	1 54011	1 18
67	1 59565	1 58640	1 58184	1 57733	1 57287	1 56846	1 55978	1 55128	1 29
68	1 60724	1 59792	1 59332	1 58878	1 58427	1 57981	1 57104	1 56246	1 40
69	1 61892	1 60951	1 60488	1 60030	1 59577	1 59129	1 58247	1 57384	1 54
70	1 63068	1 62118	1 61651	1 61189	1 60732	1 60280	1 59391	1 58521	1 67
71	1 64251	1 63293	1 62821	1 62355	1 61894	1 61437	1 60540	1 59663	1 80
72	1 65439	1 64473	1 63997	1 63527	1 63062	1 62601	1 61696	1 60811	1 94
73	1 66633	1 65658	1 65178	1 64704	1 64234	1 63769	1 62855	1 61961	1 08
74	1 67831	1 66847	1 66362	1 65883	1 65408	1 64939	1 64015	1 63111	1 22
75	1 69030	1 68037	1 67547	1 67063	1 66584	1 66109	1 65175	1 64260	1 36
76	1 70228	1 69225	1 68731	1 68242	1 67757	1 67278	1 66332	1 65405	1 49
77	1 71424	1 70411	1 69911	1 69416	1 68926	1 68439	1 67481	1 66540	1 61
78	1 72615	1 71589	1 71083	1 70582	1 70085	1 69591	1 68616	1 67658	1 71
79	1 73798	1 72758	1 72243	1 71735	1 71231	1 70731	1 69741	1 68767	1 80
80	1 74970	1 73909	1 73386	1 72868	1 72356	1 71847	1 70842	1 69854	1 88
81	1 76120	1 75038	1 74504	1 73979	1 73458	1 72942	1 71921	1 70916	1 93
82	1 77244	1 76140	1 75595	1 75057	1 74524	1 73998	1 72962	1 71945	1 95
83	1 78312	1 77193	1 76642	1 76097	1 75557	1 75022	1 73972	1 72943	1 93
84	1 79316	1 78191	1 77636	1 77087	1 76543	1 76006	1 74943	1 73902	1 88
85	1 80250	1 79123	1 78567	1 78016	1 77470	1 76929	1 75863	1 74816	1 78
86	1 81108	1 79982	1 79428	1 78878	1 78331	1 77789	1 76721	1 75674	1 64
87	1 81887	1 80767	1 80214	1 79666	1 79123	1 78584	1 77519	1 76473	1 44
88	1 82589	1 81476	1 80926	1 80381	1 79839	1 79302	1 78242	1 77199	1 17
89	1 83216	1 82111	1 81564	1 81022	1 80484	1 79950	1 78895	1 77856	1 83
90	1 83771	1 82677	1 82135	1 81597	1 81063	1 80532	1 79483	1 78448	1 42
91	1 84263	1 83179	1 82642	1 82109	1 81580	1 81054	1 80013	1 78985	1 97
92	1 84691	1 83619	1 83088	1 82561	1 82037	1 81516	1 80487	1 79471	1 47
93	1 85059	1 83997	1 83471	1 82950	1 82432	1 81918	1 80902	1 79900	1 91
94	1 85363	1 84311	1 83790	1 83275	1 82763	1 82255	1 81253	1 80266	1 29
95	1 85598	1 84555	1 84040	1 83526	1 83022	1 82520	1 81528	1 80553	1 59
96	1 85765	1 84729	1 84217	1 83709	1 83207	1 82708	1 81724	1 80758	1 80
97	1 85854	1 84816	1 84305	1 83798	1 83297	1 82800	1 81822	1 80863	1 92
98	1 85836	1 84789	1 84275	1 83766	1 83264	1 82767	1 81792	1 80840	1 91
99	1 85671	1 84612	1 84093	1 83581	1 83076	1 82578	1 81604	1 80658	1 74
100	(1 85330)	(1 84255)	(1 83729)	(1 83213)	(1 82705)	(1 82205)	(1 81231)	(1 80288)	(1 38)

Auszug aus Band 5 der wissenschaftlichen Abhandlungen der Normalrechnungskommission  
 Berlin 1904, P 237 Springer's publication

Sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ/15^\circ$  in air —  
Continued from page 915

Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$	Sp gr	% $\text{H}_2\text{SO}_4$
816	89 11	1 828	91 30	1 840	94 57
817	89 27	1 829	91 52	1 841	94 96
818	89 44	1 830	91 74	1 842	95 40
819	89 61	1 831	91 98	1 843	96 02
820	89 79	1 832	92 22	1 844	96 93
821	89 97	1 833	92 46	1 8442	97 50
822	90 15	1 834	92 71	1 844	99 08
823	90 33	1 835	92 98	1 843	99 84
824	90 51	1 836	93 26	1 842	99 29
825	90 70	1 837	93 56	1 841	98 61
826	90 90	1 838	93 87	1 840	98 88
827	91 10	1 839	94 20	18 394	100 00

Lunge, calculated by Marshall, J Soc Chem Ind 1902, 21 1509

Sp gr at  $20^\circ$  of  $\text{H}_2\text{SO}_4 + \text{Aq}$  containing  
M g mols  $\text{H}_2\text{SO}_4$  per liter

M	0 01	0 025	0 05
Sp gr	1 000719	1 001907	1 003551
M	0 075	0 10	0 25
Sp gr	1 005152	1 00677	1 01618
M	0 50	0 75	1 0
Sp gr	1 03218	1 04760	1 06307
M	1 5	2 0	
Sp gr	1 09345	1 12316	

(Jones and Pearce, Am Ch J 1907, 38 733)

Boiling-point of  $\text{H}_2\text{SO}_4 + \text{Aq}$

% $\text{H}_2\text{SO}_4$	B pt	% $\text{H}_2\text{SO}_4$	B pt
5	101 0°	70	170 0°
10	102 0	72	174 5
15	105 5	74	180 5
20	105 0	76	189 0
25	106 5	78	199 0
30	108 0	80	207 0
35	110 0	82	218 5
40	114 0	84	227 0
45	118 5	86	238 5
50	124 0	88	251 5
53	128 5	90	262 5
56	133 0	91	268 0
60	141 5	92	274 5
62 5	147 0	93	281 5
65	153 5	94	288 5
67 5	161 0	95	295 0

(Lunge, B 11 370)

Freezing- and melting-points of  $\text{H}_2\text{SO}_4 + \text{Aq}$

Sp gr at $15^\circ$	F pt	M pt
1 671	lq at $-20^\circ$	
1 691	"	
1 712	"	
1 727	-7 5	-7 5
1 732	-8 5	-8 5
1 749	-0 2	+4 5
1 767	+1 6	+6 5
1 790	+4 5	+8 0
1 807	-9 0	-6 0
1 822	lq at $-20^\circ$	
1 842		

(Lunge, B 15 2644)

Effect of impurities on sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$

The figures show the increase in sp gr of  $\text{H}_2\text{SO}_4 + \text{Aq}$  caused by adding 0.1% of an impurity to acid of different strengths

Salt	100 %	98 %	94 %	80 %	70 %
$\text{Na}_2\text{SO}_4$	0 0011	0 0010	0 0007	0 0008	0 0007
$\text{CaSO}_4$	0 0012	0 0011	0 0009	0 0007	0 0006
$\text{Al}_2(\text{SO}_4)_3$	insol	insol	insol	0 0012	0 0011
$\text{Fe}(\text{SO}_4)_2$			0 0006	0 0008	0 0007
$\text{PbSO}_4$	0 0017	0 0014	0 0015	insol	insol
$\text{MgSO}_4$	0 0011	0 0010	0 0012	0 0009	0 0009
$\text{As}_2\text{O}_3$		0 0013		0 0010	
$\text{HSNO}_3$	0 0002	0 00027		0 00023	

(Marshall, J Soc Chem Ind 1902, 21 1508)

Sp gr of mixtures of  $\text{H}_2\text{SO}_4$  (96.5%) and  
 $\text{HNO}_3$  (94%) at  $18^\circ/18^\circ$  in air

% $\text{HNO}_3$ in mixture	Sp gr	% $\text{HNO}_3$ in mixture	Sp gr
0 00	1 8437	22 51	1 8215
0 57	1 8456	25 56	1 8112
1 05	1 8476	27 29	1 8053
4 67	1 8586	32 53	1 7863
7 17	1 8618	37 03	1 7700
7 37	1 8620	39 49	1 7601
7 75	1 8619	37 78	1 6879
9 10	1 8603	72 59	1 6227
11 33	1 8557	90 76	1 5408
12 71	1 8520	98 19	1 5080
16 52	1 8414	100 00	1 5009

(Marshall, J Soc Chem Ind 1902, 21 1508)

Miscible with alcohol, with evolution of heat and formation of ethylsulphuric acid  
 $+\text{H}_2\text{O} = \text{H}_2\text{SO}_5$ , also called tetrahydroxyl sulphuric acid (Marignac, A ch (3) 39 184)

Mpt  $8.35^\circ$  (Pickering)  
 $+2\text{H}_2\text{O} = \text{H}_2\text{SO}_6$ , also called perhydroxyl sulphuric acid

Mpt  $-38.9^\circ$  (Biron, J Russ Phys Chem Soc 1899, 31 517)

$+3\text{H}_2\text{O}$  (Pickering, Chem Soc 1890, 57 331)



+4H<sub>2</sub>O Mpt -75° (Pickering, Chem Soc 1890, 57 331)

Sp gr and fr pt of hydrates of H<sub>2</sub>SO<sub>4</sub>

Hydrate	% H <sub>2</sub> SO <sub>4</sub>	Sp gr of the liquid	Fr pt
H <sub>2</sub> SO <sub>4</sub> (pure)	100	1.842	+10.5
H <sub>2</sub> SO <sub>4</sub> +H <sub>2</sub> O	84.48	1.777	+3.5
H <sub>2</sub> SO <sub>4</sub> +2H <sub>2</sub> O	73.08	1.650	-70.0
H <sub>2</sub> SO <sub>4</sub> +4H <sub>2</sub> O	57.65	1.476	-40.0
H <sub>2</sub> SO <sub>4</sub> +6H <sub>2</sub> O	47.57	1.376	-50.0
H <sub>2</sub> SO <sub>4</sub> +8H <sub>2</sub> O	40.50	1.311	-65.0
H <sub>2</sub> SO <sub>4</sub> +10H <sub>2</sub> O	35.25	1.268	-88.0
H <sub>2</sub> SO <sub>4</sub> +11H <sub>2</sub> O	33.11	1.249	-75.0
H <sub>2</sub> SO <sub>4</sub> +12H <sub>2</sub> O	31.21	1.233	-55.0
H <sub>2</sub> SO <sub>4</sub> +13H <sub>2</sub> O	29.52	1.219	-45.0
H <sub>2</sub> SO <sub>4</sub> +14H <sub>2</sub> O	28.00	1.207	-40.0
H <sub>2</sub> SO <sub>4</sub> +15H <sub>2</sub> O	26.63	1.196	-34.0
H <sub>2</sub> SO <sub>4</sub> +16H <sub>2</sub> O	25.39	1.187	-25.6
H <sub>2</sub> SO <sub>4</sub> +18H <sub>2</sub> O	23.22	1.170	-19.0
H <sub>2</sub> SO <sub>4</sub> +20H <sub>2</sub> O	21.40	1.157	-17.0
H <sub>2</sub> SO <sub>4</sub> +25H <sub>2</sub> O	17.88	1.129	-8.5
H <sub>2</sub> SO <sub>4</sub> +50H <sub>2</sub> O	9.82	1.067	-3.5
H <sub>2</sub> SO <sub>4</sub> +75H <sub>2</sub> O	6.77	1.045	0.0
H <sub>2</sub> SO <sub>4</sub> +100H <sub>2</sub> O	5.16	1.032	+2.5
H <sub>2</sub> SO <sub>4</sub> +300H <sub>2</sub> O	1.78	1.007	+4.5
H <sub>2</sub> SO <sub>4</sub> +1000H <sub>2</sub> O	0.54	1.001	+0.5

(Pictet, C R 1894, 119 645)

Sulphuric acid, anhydrous, SO<sub>3</sub>

See Sulphur trioxide

Disulphuric (Pyrosulphuric) acid, H<sub>2</sub>S<sub>2</sub>O<sub>7</sub>

Very deliquescent Miscible with H<sub>2</sub>O  
Sol in fuming H<sub>2</sub>SO<sub>4</sub> Miscible in liquid SO (Schultz-Sellack)

H<sub>2</sub>O, 2H<sub>2</sub>SO<sub>4</sub> Fumes on air (Jacquellam, A ch (3) 30 343)

Tetrasulphuric acid, H<sub>2</sub>S<sub>4</sub>O<sub>13</sub>

Fumes on air (Weber, Pogg 159 313)

Sulphates

Most sulphates are easily sol in H<sub>2</sub>O, but Ag<sub>2</sub>SO<sub>4</sub>, Hg<sub>2</sub>SO<sub>4</sub>, and CaSO<sub>4</sub> are only sl sol, while BaSO<sub>4</sub>, SrSO<sub>4</sub>, and PbSO<sub>4</sub> are nearly insol therein. All sulphates are sol in conc H<sub>2</sub>SO<sub>4</sub>. Basic sulphates are insol in H<sub>2</sub>O. Most sulphates are insol in alcohol. Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 823)

Aluminum sulphate, basic, 2Al<sub>2</sub>O<sub>3</sub>.SO<sub>3</sub>+5H<sub>2</sub>O

Slowly sol in 10 mols HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> (Schlumberger, Bull Soc 1895, (3) 13 41)  
+7H<sub>2</sub>O Easily sol in 8 mols dil HCl+Aq or in 10 mols 10% acetic acid in 24 hours (Schlumberger)

+10H<sub>2</sub>O Insol in H<sub>2</sub>O, easily sol in cold dil mineral acids, and HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq (Crum, A 89 174)

Min *Felsobanyite*  
+15H<sub>2</sub>O Min *Paraluminite*  
8Al<sub>2</sub>O<sub>3</sub>.5SO<sub>3</sub>+25H<sub>2</sub>O Insol in H<sub>2</sub>C in dil acids (Lowe, J pr 79 428)

5Al<sub>2</sub>O<sub>3</sub>.3SO<sub>3</sub>+20H<sub>2</sub>O Easily sol in (Debray, Bull Soc (2) 7 9)

3Al<sub>2</sub>O<sub>3</sub>.2SO<sub>3</sub>+9H<sub>2</sub>O Nearly ins conc H<sub>2</sub>SO<sub>4</sub> (Bayer, Dingl 263 211)

+20H<sub>2</sub>O Ppt  
4Al<sub>2</sub>O<sub>3</sub>.3SO<sub>3</sub>+36H<sub>2</sub>O Insol in Easily sol in dil mineral acids, and

HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq (Debray, Bull Soc (2) 1)

Al<sub>2</sub>O<sub>3</sub>.SO<sub>3</sub>+6H<sub>2</sub>O=(AlO)<sub>2</sub>SO<sub>4</sub>+ hot HCl, easily sol in warm KOH (Bottinger, A 244 225)

+9H<sub>2</sub>O (Athanasesco, C R 103)

Min *Aluminite*  
[Al<sub>2</sub>(OH)<sub>6</sub>SO<sub>4</sub>+2H<sub>2</sub>O

Sol in HCl+Aq in the cold with de Very unstable (Schlumberger, Bull Soc 1895, (3) 13 60)

3Al<sub>2</sub>O<sub>3</sub>.4SO<sub>3</sub>+9H<sub>2</sub>O (Athanasesco, 103 271)

+30H<sub>2</sub>O Sol in 144 pts cold, an pts boiling H<sub>2</sub>O Easily sol in HC

HNO<sub>3</sub>+Aq (Rammelsberg, Pogg 43 2)

2Al<sub>2</sub>O<sub>3</sub>.3SO<sub>3</sub> Decomp by H<sub>2</sub>C 3Al<sub>2</sub>O<sub>3</sub>.SO<sub>3</sub> and Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> (Maus)

Al<sub>2</sub>O<sub>3</sub>.2SO<sub>3</sub>=Al<sub>2</sub>O(SO<sub>4</sub>)<sub>2</sub>

Min *Alumaine*  
+H<sub>2</sub>O Sol in small quantity of H<sub>2</sub> decomp by a large quantity into (Al and Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> (Maus, Pogg 11 80)

+12H<sub>2</sub>O Easily sol in hot or cold Sat solution contains 45% salt at 15°, h crystallises unchanged on evaporating (M guerite, C R 90 354)

Above basic compounds are mi in (Pickering, C N 45 121, 133, 146)

Aluminum sulphate, Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>

100 pts H<sub>2</sub>O dissolve (a) pts Al<sub>2</sub> O and (b) pts Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+18H<sub>2</sub>O at

	0°	10°	20°	30°	40°	50°
a	31.3	33.5	36.15	40.36	45.73	52.0
b	86.85	95.8	107.35	127.6	167.6	0

	60°	70°	80°	90°	0°
a	59.09	66.23	73.14	80.83	9.1
b	262.6	348.2	467.3	678.8	1.2

(Poggiale, A ch (3) 8 467)

See also +18H<sub>2</sub>O

Sp gr of Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+Aq

Al (SO <sub>4</sub> ) <sub>3</sub>	Sp gr at			
	15	25°	35	45
5	1.0569	1.0503	1.045	0
10	1.1071	1.1022	1.096	08
15	1.1574	1.1522	1.146	1
20	1.2074	1.2004	1.192	18
25	1.2572	1.2487	1.2407	22

(Reuss, B 17 2888)

Sp gr of  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$  at  $15^\circ$  containing  
 10 20 30%  $\text{Al}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$ ,  
 1 0535 1 1105 1 1710  
 40 50%  $\text{Al}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$   
 1 2355 1 3050  
 Sp gr of sat solution = 1.34  
 (Gerlach, Z anal 28 493)

Sp gr of  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$  at  $25^\circ$

Strength of $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$	Sp gr
1 normal	1 0550
$\frac{1}{2}$ "	1 0278
$\frac{1}{4}$ "	1 0138
$\frac{1}{8}$ "	1 0068

(Wagner, Z phys Ch 1890, 5 35)

100 pts of a mixture of 1 vol  $\text{H}_2\text{SO}_4 + 2$   
 vols  $\text{H}_2\text{O}$  dissolve only 6.45 pts  
 $\text{Al}_2(\text{SO}_4)_3$  (Baud, C R 1903, 137 494)

$\text{Al}_2(\text{SO}_4)_3$  is completely pptd from  
 $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$  by an excess of glacial  
 $\text{HCl}$  (Persoz, A ch (2) 63 444)

Solubility of  $\text{Al}_2(\text{SO}_4)_3 + (\text{NH}_4)_2\text{Al}_2(\text{SO}_4)_4$   
 See under  $(\text{NH}_4)_2\text{Al}_2(\text{SO}_4)_4$

Solubility of  $\text{Al}_2(\text{SO}_4)_3 + \text{K}_2\text{Al}_2(\text{SO}_4)_4$  See  
 under  $\text{K}_2\text{Al}_2(\text{SO}_4)_4$

Solubility in  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$  at  $25^\circ$

100 g of the solution contain

g $\text{Al}_2(\text{SO}_4)_3$	g $\text{Fe}(\text{SO}_4)_3$
27 82	0
26 01	6 064
24 21	9 819
21 64	13 02
15 22	23 28
*10 70	31 91
10 23	31 90

\*Solution sat with respect to both salts  
 (Wirth and Bakke, Z anorg 1914, 87 48)  
 See also under  $\text{Fe}_2(\text{SO}_4)_3$

Solubility of  $\text{Al}_2(\text{SO}_4)_3 + \text{Li}_2\text{SO}_4$  at  $30^\circ$

Composition of

Solution		Residuc		Solid phase
% $\text{Li}_2\text{SO}_4$	% $\text{Al}(\text{SO}_4)_3$	% $\text{Li}_2\text{SO}_4$	% $\text{Al}(\text{SO}_4)_3$	
25 1	0			$\text{Li}_2\text{SO}_4, \text{H}_2\text{O}$
21 93	5 34			"
16 10	14 89	63 70	4 02	"
13 63	20 76	14 72	31 17	$\text{Li}_2\text{SO}_4, \text{H}_2\text{O} +$ $\text{Al}_2(\text{SO}_4)_3, 18\text{H}_2\text{O}$
13 24	21 71	61 24	7 22	$\text{Li}_2\text{SO}_4, 4\text{H}_2\text{O}$
11 73	22 08	6 92	33 54	$\text{Al}_2(\text{SO}_4)_3, 18\text{H}_2\text{O}$
6 75	24 34	3 77	37 06	"
3 44	26 12			"
0 00	28 0			"

(Schreinemakers and de Waal, Ch Weekbl  
 1906, 3 539)

100 g of sat solution of  $\text{Al}(\text{SO}_4)_3$  in glycol  
 contain 14.4 g  $\text{Al}_2(\text{SO}_4)_3$  (de Coninck, Bull  
 Ac Roy Belg 1905 359)

Insol in ethyl acetate (Naumann, B  
 1910, 43 314)

Insol in acetone (Naumann, B 1904,  
 37 4328)

+  $6\text{H}_2\text{O}$  Very slowly sol in cold, com-  
 pletely sol in hot  $\text{H}_2\text{O}$

+  $8\text{H}_2\text{O}$  (Margueritte-Delarcharbonny,  
 C R 112 229)

+  $10\text{H}_2\text{O}$  Deliquescent (v Hauer, W  
 A B 13 449)

+  $16\text{H}_2\text{O}$  Sol in conc  $\text{H}_2\text{SO}_4$  (Baud, C  
 R 1903, 137 494)

+  $17\text{H}_2\text{O}$  (Gawalowski, C C 1885  
 721)

+  $18\text{H}_2\text{O}$  Permanent (Berzelius)

100 g of the aqueous solution contain  
 27.82 g  $\text{Al}_2(\text{SO}_4)_3$  at  $25^\circ$  (Wirth, Z anorg  
 1913, 79 361)

Solubility of  $\text{Al}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$   
 at  $25^\circ$

$\text{H}_2\text{SO}_4 + \text{Aq}$ % $\text{H}_2\text{SO}_4$	100 g of the solution contain g $\text{Al}(\text{SO}_4)_3$
0	27 82
5 23	29 21
9 90	26 21
18 70	20 44
25 50	15 40
40 70	5 07
52 25	1 216
63 70	1 243
73 64	2 915

(Wirth, Z anorg 1913, 79 361)

Hydrous salt is scarcely sol in alcohol  
 (Berzelius)

Min *Alumogen*

+  $27\text{H}_2\text{O}$  Efflorescent (Margueritte-  
 Delarcharbonny, C R 99 800)

Aluminum sulphate, acid,  $\text{Al}_2\text{O}_3, 4\text{SO}_3 +$   
 $4\text{H}_2\text{O}$

Extremely slowly sol in cold, more rapidly  
 in hot  $\text{H}_2\text{O}$  (Baud, C R 1903, 137 493)

$\text{Al}_2\text{O}_3, 6\text{SO}_3 + 10\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , solu-  
 tion soon decomp into  $\text{Al}_2(\text{SO}_4)_3 + \text{H}_2\text{SO}_4$   
 (Silberberger, M 1904, 25 221)

Aluminum ammonium sulphate (Ammonia  
 alum),  $(\text{NH}_4)_2\text{Al}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve 2.9 pts anhydrous  
 salt at  $0^\circ$ , 207.7 pts anhydrous salt at  $110.6^\circ$   
 (Mulder)

100 pts  $\text{H}_2\text{O}$  dissolve 8.74 pts anhydrous  
 salt at  $17.5^\circ$  (Pohl, W A B 6 597)



100 pts  $H_2O$  at  $t^\circ$  dissolve pts  
 $(NH_4)_2Al_2(SO_4)_4$

$t^\circ$	Pts $(NH_4)_2Al_2(SO_4)_4$	Pts $(NH_4)_2Al_2(SO_4)_4 + 24H_2O$
0	2 10	3 90
10	4 99	9 52
20	7 74	15 13
30	10 94	22 01
40	14 88	30 92
50	20 09	44 11
60	26 70	66 65
70	35 11	90 67
80	45 66	134 47
90	58 68	209 31
100	74 53	357 48

(Poggiale, A ch (3) 8 467)

According to Locke (Am Ch J 1901, 26 174), Poggiale's tables for  $NH_4$  and K alums are evidently transposed, and the above data are applied by Poggiale to K alum

1 l  $H_2O$  dissolves 91.9 g anhydrous, or 191.9 g hydrated salt, or 0.387 mols anhydrous salt at  $25^\circ$  (Locke, Am Ch J 1901, 26 175)

Solubility in  $H_2O$  at  $t^\circ$

t	G $(NH_4)_2Al_2(SO_4)_4$ per 100 g $H_2O$	G $(NH_4)_2Al_2(SO_4)_4 + 24H_2O$ per 100 g $H_2O$	G mol $(NH_4)_2Al_2(SO_4)_4$ per 100 g $H_2O$
0	2 10	3 90	0 0044
5	3 50	6 91	0 0074
10	4 99	9 52	0 0105
15	6 25	12 66	0 0132
20	7 74	15 13	0 0163
25	9 19	19 19	0 0194
30	10 94	22 01	0 0231
40	14 88	30 92	0 0314
50	20 10	44 10	0 0424
60	26 70	66 65	0 0569
95	109 7	00	0 2312

(Mulder, Poggiale Locke, Marino, Gazz ch it 1905, 35 II, 351, Berkeley, Trans Roy Soc 1904, 203 A, 214 calc by Seidell solubilities)

B-pt of sat solution is  $110.6^\circ$

M-pt of  $(NH_4)_2Al_2(SO_4)_4 + 24H_2O = 92^\circ$  (Tilden, Chem Soc 45 409),  $= 95^\circ$  (Locke, l c)

Sp gr of aqueous solution at  $15^\circ$  containing

3% 6% 9%  
1.0423 1.0141 1.0282 hydrous salt

(Gerlach, Z anal 28 495)

Solubility of  $NH_4$  alum in presence of  $(NH_4)_2SO_4$  and  $Al_2(SO_4)_3$

Mixture used	100 g sat solution contains	
	g $(NH_4)_2SO_4$	g $Al_2(SO_4)_3$
Sat $NH_4$ alum at $18.5^\circ$	1 42	3
20 cc above solution + 6 g cryst $Al_2(SO_4)_3$	0 45	16
20 cc above solution + 4 g $(NH_4)_2SO_4$	20 81	0

(Rudorff, 1885, B 18 1160)

Insol in alcohol (Mulder)

Solubility of  $Al(NH_4)(SO_4)_2 + 12H_2O$  mixture of 93.3 g  $H_2O$  and 23.33 g glycerol = 6.15 g (Dunlop, Pharm J 1910, 81 6)

Solubility in 93.3 g  $H_2O$  + 23.3 g glycerol + 3.9 g phenol = 5.59 g  $Al(NH_4)(SO_4)_2 + 12H_2O$  (Dunlop)

Min *Tschermakite*

Aluminum ammonium chromium sulphate  $Al_2(SO_4)_3, (NH_4)_2SO_4, Cr_2(SO_4)_3 + 48H_2O$

Sol in  $H_2O$ , decomp by boiling (A 94 71)

Aluminum caesium sulphate,  $Al_2Cs_2(SO_4)_4 + 24H_2O$

100 pts  $H_2O$  at  $17^\circ$  dissolve 0.61 pt caesium alum (Redtenbacher, J 1 94 442)

Solubility in 100 pts  $H_2O$  at  $t^\circ$  (calculated for salt dried at  $130^\circ$ )

t	Pts alum	t	Pts alum	t	ts um
0	0 19	25	0 49	65	38
10	0 29	35	0 69	80	29
17	0 38	50	1 235		

(Setterberg, A 211 104)

Solubility in  $H_2O$

t	Pts anhydrous salt per litre	G anhydrous salt per li
25	4 7	0 01
30	5 89	0 01
35	7 29	0 02
40	9 00	0 02

(Locke, Am Ch J 1901, 26 180)

Solubility of  $\text{Al}_2\text{Cs}_2(\text{SO}_4)_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$   
 G  $\text{Al}_2\text{Cs}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$  in 100 g solution )

$t^\circ$	% salt	$t^\circ$	% salt
0	0 21	75	4 12
15	0 35	80	5 21
30	0 60	90	9 50
45	1 04	100 4	18 60
60	1 96		

Berkeley, Trans Roy Soc 1904, 203 A, 214 )

Solubility in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	G $\text{AlCs}(\text{SO}_4)_2$	$t^\circ$	G $\text{AlCs}(\text{SO}_4)_2$	$t^\circ$	G $\text{AlCs}(\text{SO}_4)_2$	$t^\circ$	G $\text{AlCs}(\text{SO}_4)_2$
0	0 19	26	0 50	52	1 45	78	5 15
1	0 20	27	0 51	53	1 51	79	5 40
2	0 21	28	0 52	54	1 58	80	5 78
3	0 22	29	0 55	55	1 65	81	6 05
4	0 23	30	0 57	56	1 71	82	6 4
5	0 24	31	0 59	57	1 77	83	6 7
6	0 25	32	0 60	58	1 86	84	7 0
7	0 26	33	0 62	59	1 92	85	7 4
8	0 27	34	0 65	60	2 06	86	7 7
9	0 28	35	0 69	61	2 14	87	8 0
10	0 29	36	0 72	62	2 25	88	8 3
11	0 30	37	0 75	63	2 37	89	8 6
12	0 31	38	0 77	64	2 50	90	8 8
13	0 32	39	0 80	65	2 65	91	9 0
14	0 34	40	0 85	66	2 78	92	9 2
15	0 35	41	0 87	67	2 96	93	9 5
16	0 36	42	0 91	68	3 13	94	9 9
17	0 38	43	0 96	69	3 34	95	10 1
18	0 39	44	1 01	70	3 50	96	10 4
19	0 40	45	1 06	71	3 67	97	10 8
20	0 41	46	1 10	72	3 85	98	11 1
21	0 42	47	1 17	73	4 07	99	11 5
22	0 43	48	1 21	74	4 30	100	12 0
23	0 45	49	1 27	75	4 50		
24	0 47	50	1 30	76	4 72		
25	0 49	51	1 39	77	4 95		

Values from  $0-7^\circ$  obtained by interpolation using Setterberg's values for  $0^\circ$  (A 1882, 211 100)

From  $80-100^\circ$  they were calculated by extrapolation

(Hart and Huselton, J Am Chem Soc 1914, 36 2084 )

Melts in crystal  $\text{H}_2\text{O}$  at  $106^\circ$  (Tilden, Chem Soc 45 409), at  $120.5^\circ$  (Erdmann), at  $122^\circ$  (Locke)

Aluminum calcium sulphate, basic,  $\text{Al}_2\text{O}_3$ ,  $6\text{CaO}$ ,  $3\text{SO}_3 + 32\text{H}_2\text{O}$

Min *Etringite* Mostly sol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl} + \text{Aq}$

Aluminum chromium sulphate,  $\text{Al}_2\text{Cr}_2(\text{SO}_4)_6$   
 Insol in  $\text{H}_2\text{O}$   
 $\text{Al}_2\text{Cr}_2(\text{SO}_4)_6 \cdot \text{H}_2\text{SO}_4$  Insol in  $\text{H}_2\text{O}$  (Étard C R 86 1400)

Aluminum chromium potassium sulphate,  $\text{Al}_2(\text{SO}_4)_3$ ,  $\text{Cr}_2(\text{SO}_4)_3$ ,  $2\text{K}_2\text{SO}_4 + 48\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$ , but decomp on boiling (Vohl)

Aluminum copper sulphate,  $2\text{Al}_2\text{O}_3$ ,  $9\text{CuO}$ ,  $3\text{SO}_3 + 21\text{H}_2\text{O}$   
 Min *Cyanotrichite* (Percy, Phil Mag (3) 36 103)

Aluminum hydroxylamine sulphate,  $\text{Al}_2(\text{SO}_4)_3$ ,  $(\text{NH}_2\text{OH})_2\text{SO}_4 + 24\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Meyerinhg, B 10 1946)

Aluminum iron (ferrous) sulphate,  $\text{Al}_2(\text{SO}_4)_3$ ,  $\text{FeSO}_4 + 24\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Klauser, A 14 261)

Min *Halotrichite*  
 $\text{Al}_2(\text{SO}_4)_3$ ,  $2\text{FeSO}_4 + 27\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Berthier)  
 $\text{Al}_2\text{O}_3$ ,  $2\text{SO}_3$ ,  $6\text{FeSO}_4$  Easily sol in  $\text{H}_2\text{O}$  (Phillips)  
 $\text{Al}_2(\text{SO}_4)_3$ ,  $2\text{FeSO}_4$ ,  $\text{H}_2\text{SO}_4$  Insol in  $\text{H}_2\text{O}$  (Étard, C R 87 602)

Aluminum iron (ferric) sulphate,  $\text{Al}(\text{SO}_4)_3$ ,  $\text{Fe}_2(\text{SO}_4)_3$   
 Insol in  $\text{H}_2\text{O}$  (Étard, C R 86 1399)  
 $\text{Al}_2(\text{SO}_4)_3$ ,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{H}_2\text{SO}_4$  As above (Étard)  
 See  $\text{Al}_2(\text{SO}_4)_3 + \text{Fe}(\text{SO}_4)_3$ , under  $\text{Al}_2(\text{SO}_4)_3$  and  $\text{Fe}_2(\text{SO}_4)_3$

Aluminum ferrous potassium sulphate,  $\text{Al}_2(\text{SO}_4)_3$ ,  $12\text{FeSO}_4$ ,  $2\text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}$   
 Permanent Sl sol in  $\text{H}_2\text{O}$  (Dufrenoy)

Aluminum lead sulphate,  $\text{AlPb}_2(\text{SO}_4)_5 + 20\text{H}_2\text{O}$   
 Permanent, insol in  $\text{H}_2\text{O}$  (G H Bailey J Chem Soc Ind 6 415)

Aluminum lithium sulphate,  $\text{LiAl}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$

Sol in 24 pts cold, and 0.87 pt hot  $\text{H}_2\text{O}$  (Kralovanský, Schw J 54 349)  
 Does not exist (Rammelsberg, J B 1847-48 394, Arfvedson, Gmelin)

Aluminum lithium potassium sulphate (?)  
 Sol in  $\text{H}_2\text{O}$ , from which it crystallises on cooling (Joss, J pr 1 142)

Aluminum magnesium sulphate,  $\text{MgSO}_4$ ,  $\text{Al}_2(\text{SO}_4)_3 + 22\text{H}_2\text{O}$

Min *Pickeringite*  
 $2\text{MgSO}_4$ ,  $\text{Al}_2(\text{SO}_4)_3 + 22\text{H}_2\text{O}$  Min *Proruminite*  
 $3\text{MgSO}_4$ ,  $\text{Al}_2(\text{SO}_4)_3 + 36\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Klauser, A 14 264)

**Aluminum magnesium manganous sulphate,**  
 $\text{Al}_2(\text{SO}_4)_3, \text{MgSO}_4, \text{MnSO}_4 + 25\text{H}_2\text{O}$   
 As sol in  $\text{H}_2\text{O}$  as K alum (Kane) Very  
 sol in  $\text{H}_2\text{O}$  (Smith, Sil Am J (2) 18 379)  
 Min *Bosjemanite*

**Aluminum manganous sulphate,**  $\text{Al}_2(\text{SO}_4)_3,$   
 $\text{MnSO}_4 + 25\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Berzelius)  
 +  $24\text{H}_2\text{O}$  Min *Apjohnite*

**Aluminum manganic sulphate,**  $2\text{Al}_2(\text{SO}_4)_3,$   
 $\text{Mn}_2(\text{SO}_4)_3$

Insol in  $\text{H}_2\text{O}$  (Étard, C R 86 1399)

**Aluminum nickel sulphate,**  $\text{Al}_2(\text{SO}_4)_3, 2\text{NiSO}_4,$   
 $\text{H}_2\text{SO}_4$

Insol in  $\text{H}_2\text{O}$ , but gradually decomp  
 thereby (Étard, C R 87 602)

**Aluminum potassium sulphate, basic,**  
 $3(\text{Al}_2\text{O}_3, \text{SO}_3), \text{K}_2\text{SO}_4 + 6\text{H}_2\text{O} = \text{K}_2\text{SO}_4,$   
 $3\text{Al}_2(\text{SO}_4)_3(\text{OH})_4$

Min *Alumite* Insol in  $\text{H}_2\text{O}$  Insol in  
 conc  $\text{HCl} + \text{Aq}$

Sol in boiling  $\text{H}_2\text{SO}_4$  of 1 845 sp. gr, but  
 more easily in a mixture of 12 g  $\text{H}_2\text{SO}_4$  and  
 15 g  $\text{H}_2\text{O}$ , and also in weaker acids, if heated  
 to  $210^\circ$  (Mitscherlich, J pr 81 108)

+  $9\text{H}_2\text{O}$  Min *Louvirite* Sl sol in boil-  
 ing  $\text{HCl} + \text{Aq}$  (Mitscherlich, J pr 83 455)

Nearly insol in  $\text{HCl}$  or conc  $\text{HNO}_3 + \text{Aq}$ ,  
 but sol in a mixture of 1 pt  $\text{H}_2\text{SO}_4$  and 1 pt  
 $\text{H}_2\text{O}$  (Debray, Bull Soc (2) 7 9)

$\text{Al}_2\text{O}(\text{SO}_4)_2, \text{K}_2\text{SO}_4$  Sol in  $\text{H}_2\text{O}$ , but de-  
 comp by heating

With varying composition Precipitates  
 Insol in  $\text{H}_2\text{O}$  Very sl sol in cold, gradually  
 in hot acids (Bley, J pr 39 17) Very  
 difficultly sol in warm conc  $\text{HCl} + \text{Aq}$ , but  
 easily sol in  $\text{KOH} + \text{Aq}$  (Naumann, B 8  
 1630)

**Aluminum potassium sulphate (Potash alum),**  
 $\text{KAl}(\text{SO}_4)_2 + 12\text{H}_2\text{O}$  or  $\text{K}_2\text{Al}_2(\text{SO}_4)_4 =$   
 $\text{K}_2\text{SO}_4, \text{Al}(\text{SO}_4)_3 + 24\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with absorption of heat

When 100 pts  $\text{H}_2\text{O}$  at  $10.8^\circ$  are mixed with  
 14 pts alum, the temp is lowered  $1.4^\circ$   
 (Rudorff, B 2 68)

Burnt alum is very slowly sol in  $\text{H}_2\text{O}$

100 pt  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve P pts  $\text{K}_2\text{Al}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$

t	P	t	P
12 °	7 6	50 0	46 7
21 °	10 4	62 °	230 0
25 °	22 0	70 °	920 0
37 °	44 1	87 °	1566 6

(Brand s 1822)

Sol in 15 pt cold and 16 pts boiling  $\text{H}_2\text{O}$  (Four-  
 croix) in 14 12 pts cold and 0 75 pt boiling  $\text{H}_2\text{O}$   
 (Bergmann) in 15 pts cold and 0 75 pt boiling  $\text{H}_2\text{O}$   
 (Dumas) in 11 7 pts  $\text{H}_2\text{O}$  at  $15.75^\circ$  (Abl)

100 pt  $\text{H}_2\text{O}$  dissolve 14 79 pts alum at  $15.56^\circ$  and  
 133 33 pts at  $100^\circ$  (Lres Diet)

$\text{KAl}(\text{SO}_4)_2 + \text{Aq}$  sat at  $15^\circ$  contains 10 9 9 pts alum  
 in every 100 pts  $\text{H}_2\text{O}$  (Miehl and Kneff)

$\text{KAl}(\text{SO}_4)_2 + \text{Aq}$  sat in cold contains 0 2% alum  
 (Fourcroy) 6 7% (Boerhave)

100 pts  $\text{H}_2\text{O}$  dissolve (a) pts anhy-  
 alum, and (b) pts crystallised at  $t^\circ$

	0°	10°	20°	30°	40°	50°
a	2 62	4 50	6 57	9 05	12 35	15 9
b	5 22	9 16	13 66	19 29	27 3	35 5

	60°	70°	80°	90°	100°
a	21 1	26 95	35 2	50 3	70
b	51 3	71 97	103 1	187 8	421

(Poggiale, A ch (3) 8 467)

According to Locke (Am Ch J 190 26  
 174), Poggiale's tables for  $\text{NH}_4$  and  $\text{K}$  salts  
 are evidently transposed, and the data  
 date are applied by Poggiale to  $\text{NH}_4$  salts

100 pts  $\text{H}_2\text{O}$  dissolve  $\text{K}_2\text{Al}_2(\text{SO}_4)_4 + 2$   
 corresponding to pts anhy-  
 $\text{K}_2\text{Al}_2(\text{SO}_4)_4$

Temp	Pts $\text{K}_2\text{Al}_2(\text{SO}_4)_4$	Temp	Pts $\text{K}_2\text{Al}_2(\text{SO}_4)_4$
0	3 0	60	25
5	3 5	70	40
10	4 0	80	71
15	5 0	90	109
20	5 9	92 5	119
30	7 9	100	154
40	11 7	110	200
50	17 0	111 9	210

(Mulder, Scheik Verhandel 1864 9)

100 pts  $\text{H}_2\text{O}$  at  $17^\circ$  dissolve 13 pts  
 $\text{K}_2\text{Al}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ , or 7 36 pts  $\text{K}_2\text{Al}_2(\text{SO}_4)_4$   
 (Redtenbacher, J pr 94 442)

Forms supersaturated solutions very easily  
 Supersat solutions are brought to crystal-  
 lization by addition of a crystal of alum or  
 isomorphous substance, as chrome or iron  
 alum Other substances as  $\text{NaCl}$ , etc have  
 no action (Thomson, Chem Soc 35 99)

1 l  $\text{H}_2\text{O}$  dissolves 72 3 g anhydro,  
 138 4 g hydrated salt, or 0 28 g m  
 anhydrous salt at  $25^\circ$  (Locke, Am Ch  
 J 1901, 26 175)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$   
 (g alum in 1000 g  $\text{H}_2\text{O}$ )

$t^\circ$	g alum	t	g alum
0	57 0	75	1280
5	76 3	76	1412
10	84 9	77	1517
15	103 6	78	1680
20	120 3	79	1775
25	131 3	80	1950
30	184 9	82	2273
36	204 3	84	2661
40	250 0	84 6	2816
45	290 2	85 1	3166
50	367 8	85 3	3337
55	457 7	85 6	3372
60	585 4	86	3997
65	708 4	87	4825
70	943 8	88	6639

(Marino, Gazz ch it 1905, 35 (2) 1)

Solubility in H<sub>2</sub>O at t°

t°	g K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> per 100 g H <sub>2</sub> O	g K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +24H <sub>2</sub> O per 100 g H <sub>2</sub> O	g mol K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> per 100 g H <sub>2</sub> O
0	3 0	5 65	0 0058
5	3 5	6 62	0 0038
10	4 0	7 60	0 0077
15	5 0	9 59	0 0097
20	5 9	11 40	0 0114
25	7 23	14 14	0 0140
30	8 39	16 58	0 0162
40	11 70	23 83	0 0227
50	17 00	36 40	0 0329
60	24 75	57 35	0 0479
70	40 00	110 5	0 0774
80	71 0	321 3	0 01374
90	109 0	2,275 0	0 2110
92 5	119 0	∞	0 2318

(Mulder, Poggiale, Locke, Marino, Gazz ch it 1905, **35** (2) 351, and Berkeley, Proc Roy Soc 1904, **203** A, 214, calc by Seidell, Solubilities, 1st Ed.)

M-pt of K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O=84 5° (Tilden, Chem Soc **45** 409), =92 5° (Erdmann), =91° (Locke)

Sp gr of sat K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq at 8°=1 045 (Anthon), at 15°=1 0488 (Michel and Krafft), at 15°=1 0456 (Stolba)

Sp gr of K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq at 15° containing 5% K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>=1 0477 (Kohlrausch, W Ann **1879** 1)

Sp gr of K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq at 15° a=pts K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O in 100 pts solution, b=pts K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> in 100 pts solution, c=pts K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> for 100 pts H<sub>2</sub>O

a	b	c	Sp gr
4	2 1792	2 2277	1 0210
8	4 3584	4 5570	1 0420
12	6 5376	6 9950	1 0641
13	7 083	7 622	1 0690

(Gerlach, Z anal **27** 280)

Saturated solution boils at 111 9°, and contains 210 6 pts K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O to 100 pts H<sub>2</sub>O (Mulder)

100 pts H<sub>2</sub>O contain 52 pts K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>, and boils at 104 5° (Griffiths) Crust forms at 106 3°, when the solution contains 114 2 pts K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> to 100 pts H<sub>2</sub>O (Gerlach, Z anal **26** 426)

B-pt of K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq containing pts K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> to 100 pts H<sub>2</sub>O

B pt	Pts K <sub>2</sub> Al(SO <sub>4</sub> ) <sub>4</sub>	B pt	Pts K <sub>2</sub> Al(SO <sub>4</sub> ) <sub>4</sub>
100 5°	17 0	104 0°	83 9
101 0	30 2	104 5	90 7
101 5	41 8	105 0	97 6
102 0	51 6	105 5	103 9
102 5	60 4	106 0	110 5
103 0	68 7	106 5	116 9
103 5	76 7	106 7	120 55

(Gerlach, Z anal **26** 435)

K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>  
K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> is nearly insol in sat Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+Aq (Crum, A **89** 156)

Solubility in Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+Aq Solhd Phase=K alum+Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>

t°	g Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> +18H <sub>2</sub> O in 1000 g H <sub>2</sub> O	g K <sub>2</sub> SO <sub>4</sub> in 1000 g H <sub>2</sub> O
0	234 73	23 45
20	824 25	30 85
35	911 02	35 29
50	1,243 21	59 55
65	1,598 00	119 43
77	1,872 11	183 80

(Marino, Gazz ch it 1905, **35** (2) 351)

Solubility is decreased by presence of Na alum (Venable, C N 1879, **40** 198)

Nearly completed pptd from sat aq solution by addition of Fe or Cr alum (v Hauer, J B **1866** 59)

K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+MgSO<sub>4</sub>

K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq sat at 10° and then sat with MgSO<sub>4</sub> at 9°, contains for 100 pts H<sub>2</sub>O—

	At 10		At 9
Alum (anhydrous)	4 0	2 7	
MgSO <sub>4</sub>		31 2	31 1
		33 9	

(Mulder)

K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+K<sub>2</sub>SO<sub>4</sub>

K<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq at 10°, and then sat with K<sub>2</sub>SO<sub>4</sub> at same temp, contains for 100 pts H<sub>2</sub>O—

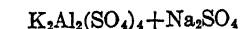
	At 10		At 9°
Alum (anhydrous)	4 0	0 86	
K <sub>2</sub> SO <sub>4</sub>		9 16	9 7
		10 20	

(Mulder)

Solubility in  $K_2SO_4 + Aq$  Solid phase =  
K alum +  $K_2SO_4$

t°	Al (SO <sub>4</sub> ) <sub>3</sub> + 18H <sub>2</sub> O in 1000 g H <sub>2</sub> O	g K <sub>2</sub> SO <sub>4</sub> in 1000 g H <sub>2</sub> O	t°	Al (SO <sub>4</sub> ) <sub>3</sub> + 18H <sub>2</sub> O in 1000 g H <sub>2</sub> O	g K <sub>2</sub> SO <sub>4</sub> in 1000 g H <sub>2</sub> O
0	5 06	75 83	40	73 88	163 10
5	8 658	75 18	50	126 00	195 40
10	16 07	85 78	60	249 70	238 80
15	18 52	96 50	70	529 01	323 74
30	20 56	109 30	80	1,044 04	517 27
	39 60	147 80			

(Marino, l c)



$K_2Al_2(SO_4)_4 + Aq$  sat at 10°, and then sat  
with  $Na_2SO_4$  at 9°, contains for 100 pts  
H<sub>2</sub>O—

	At 10		At 9
Alum (anhydrous)	4 0	4 1	
Na <sub>2</sub> SO <sub>4</sub>		8 8	8 4
		12 9	

(Mulder)

Solubility of  $K_2Al(SO_4)_3 + Ti_2Al_2(SO_4)_4$  in  
H<sub>2</sub>O at 25°

G K <sub>2</sub> Al(SO <sub>4</sub> ) <sub>3</sub> per l	G TiAl <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> per l	Solid phase Mol % KAl(SO <sub>4</sub> ) <sub>3</sub>	Sp gr
69 90	0 00	100	1 0591
74 56	0 48	99 61	1 0601
67 90	1 72	98 48	1 0598
65 30	4 52	95 45	1 0603
64 95	9 60	91 73	1 0605
53 23	18 44	82 54	1 0609
45 32	24 60	75 12	1 0609
38 02	32 48	65 73	1 0611
34 54	35 59	61 36	1 0611
25 35	42 99	51 93	1 0623
10 94	66 12	21 34	1 0654
0 00	75 46	0 00	1 0674

(Foch Z Kryst Min 1897, 28 397)

Insol in alcohol of 0.905 sp gr or less  
(Anthon, J p 14 125)

Insol in acetone (Naumann, B 1904,  
37 428)

Insol in methyl acetate (Naumann, B  
1909, 42 3790)

Solubility in H<sub>2</sub>O is increased by glycerine  
(Dunlop, Pharm J, 1910, 31 6)

Min *Kalmit*

+8H<sub>2</sub>O Stable in dry air (Marino, l c)

+14H<sub>2</sub>O Converted into ord alum in  
air (Marino)

Aluminum rubidium sulphate,  $Al_2Rb_2(SO_4)_4 + 24H_2O$

100 pts H<sub>2</sub>O dissolve 2.27 pts at 7°  
very sol in hot H<sub>2</sub>O (Redtenbacher  
pr 94 442)

Solubility in 100 pts H<sub>2</sub>O at t° (calculated  
for salt dried at 130°)

t°	Pts alum	t°	Pts alum	t°	Pts alum
0	0 71	25	1 85	65	2 3
10	1 09	35	2 67	80	2 10
17	1 42	50	4 98		

(Setterberg, A 211 104)

Solubility in H<sub>2</sub>O

t	Pts per litre	G mols anhydrous per litre
25	18 1	0 059
30	21 9	0 072
35	26 6	0 087
40	32 2	0 106

(Locke, Am Ch J 1901, 26 180)

Melts in crystal H<sub>2</sub>O at 99° (Tilden,  
Chem Soc 45 409), at 105° (Erdmann,  
at 109° (Locke))

Aluminum silver sulphate,  $Al_2Ag_2(SCO_3)_4 + 24H_2O$

Decomposed by H<sub>2</sub>O (Church and North  
cote, C N 9 155)

Aluminum sodium sulphate,  $Al_2Na_2(SCO_3)_4 + 24H_2O$

Very slightly efflorescent

Sol in 2.14 pts H<sub>2</sub>O at 13° or 100 pts H<sub>2</sub>O dissolve  
46.7 pts soda alum Sol in 1 pt boiling H<sub>2</sub>O (Zellner  
Schw J 36 183)

100 pts H<sub>2</sub>O dissolve 110 pts at 13° and in a  
liquid of 1.296 sp gr (Ur)

100 pts H<sub>2</sub>O dissolve 51 pts soda alum at  
16° (Augé, C R 110 1139)

100 pts H<sub>2</sub>O dissolve 110 pts soda alum  
at 0° (Tilden, Chem Soc 45 409)

100 g H<sub>2</sub>O dissolve at  
10° 15° 20° 25° 30°

36 7 38 7 40 9 43 145 8 g anhydrous salt  
(Smith, J Am Chem Soc 1909, 31 47)

M-ppt of  $Na_2Al_2(SO_4)_4 + 24H_2O =$   
(Tilden, Chem Soc 45 409), = 63° (I ke,  
Am Ch J 1901, 26 183)

Insol in absolute alcohol (Zellner  
Min *Mendocite*)

**Aluminum thalious sulphate,  $\text{TiAl}(\text{SO}_4)_2$** 

0.177 g mols of anhydrous salt are sol in 1 l  $\text{H}_2\text{O}$  at  $25^\circ$ , or 1 l  $\text{H}_2\text{O}$  dissolves 75 g of the anhydrous, or 117.8 g of the hydrated salt at  $25^\circ$  (Locke, Am Ch J 1901, 26 175)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

t	G $\text{Al}_2\text{Ti}_2(\text{SO}_4)_4$ in 100 g $\text{H}_2\text{O}$	G $\text{Al}_2\text{Ti}(\text{SO}_4)_4$ + 24H <sub>2</sub> O in 100 g $\text{H}_2\text{O}$
0	3 15	4 84
5	3 80	5 86
10	4 60	7 12
20	6 40	10 00
25	7 60	11 95
30	9 38	14 89
40	14 40	23 57
50	22 50	38 41
60	35 36	65 19

(Seidell, Solubilities, 1st Ed, p 15)

$3\text{Al}_2(\text{SO}_4)_3, \text{Ti}_2\text{SO}_4 + 96\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Lamy)

**Aluminum zinc sulphate,  $\text{Al}_2(\text{SO}_4)_3, \text{ZnSO}_4 + 24\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  (Kane)

**Aluminum sulphate chromium chloride,  $\text{Al}(\text{OH})_3, (\text{SO}_4)_2\text{CrCl}_2(\text{OH})_4 + 2\text{H}_2\text{O}$**   
(Werner, B 1906, 39 337)

**Aluminum sulphate sodium fluoride**

Decomp by  $\text{H}_2\text{O}$  (Weber, Dingl 263 112)

**Ammonium sulphate,  $(\text{NH}_4)_2\text{SO}_4$**

Sol in  $\text{H}_2\text{O}$  with absorption of heat  
75 pts  $(\text{NH}_4)_2\text{SO}_4$  mixed with 100 pts  $\text{H}_2\text{O}$  lower the temperature from  $13.2^\circ$  to  $6.8^\circ$ , that is,  $6.4^\circ$  (Rudorff, B 2 68)

Sol in 1.31 pts  $\text{H}_2\text{O}$  at  $19^\circ$  (Schuff A 109 326)  
Sol in 2 pts  $\text{H}_2\text{O}$  at  $18.7^\circ$  (Abl)  
Sol in 2 pts  $\text{H}_2\text{O}$  at  $15.6^\circ$  and in 1 pt boiling  $\text{H}_2\text{O}$  (Foureroy)  
100 pts  $\text{H}_2\text{O}$  at  $62.6^\circ$  dissolve 78 pts  $(\text{NH}_4)_2\text{SO}_4$  (Wenzel)  
100 pts  $\text{H}_2\text{O}$  at  $15^\circ$  dissolve 66.739 pts  $(\text{NH}_4)_2\text{SO}_4$  (Michel and Krafft)

Sol in 1.3 pts cold  $\text{H}_2\text{O}$  (Vogel, N Rep Pharm 10 9)

Sol in 1.37 pts cold  $\text{H}_2\text{O}$  at  $10^\circ$  (Mulder, J B 1866 67)

Sol in 1.34 pts  $\text{H}_2\text{O}$  at  $16-17^\circ$  (v Hauer, W A B 53, 2 221)

100 pts  $\text{H}_2\text{O}$  dissolve at

$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$	
71 00	73 65	76 30	78 95	pts $(\text{NH}_4)_2\text{SO}_4$
40°	50°	60°	70°	
81 60	84 25	86 90	89 55	pts $(\text{NH}_4)_2\text{SO}_4$
	80°	90°	100°	
92 20	94 85	97 50		pts $(\text{NH}_4)_2\text{SO}_4$

(Alluard, C R 59 500)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $(\text{NH}_4)_2\text{SO}_4$	$t^\circ$	Pts $(\text{NH}_4)_2\text{SO}_4$	$t^\circ$	Pts $(\text{NH}_4)_2\text{SO}_4$
0	70 6	37	80 1	74	93 1
1	70 9	38	80 4	75	93 4
2	71 1	39	80 7	76	93 8
3	71 4	40	81 0	77	94 2
4	71 6	41	81 3	78	94 5
5	71 8	42	81 7	79	94 9
6	72 1	43	82 0	80	95 3
7	72 3	44	82 3	81	96 6
8	72 5	45	82 7	82	96 0
9	72 8	46	83 0	83	96 4
10	73 0	47	83 3	84	96 8
11	73 2	48	83 7	85	97 2
12	73 5	49	84 0	86	97 6
13	73 7	50	84 4	87	98 0
14	74 0	51	84 7	88	98 4
15	74 2	52	85 1	89	98 8
16	74 4	53	85 5	90	99 2
17	74 7	54	85 8	91	99 6
18	74 9	55	86 2	92	100 0
19	75 1	56	86 6	93	100 4
20	75 4	57	86 9	94	100 8
21	75 7	58	87 3	95	101 2
22	75 9	59	87 7	96	101 6
23	76 2	60	88 0	97	102 1
24	76 4	61	88 4	98	102 5
25	76 7	62	88 7	99	102 9
26	76 9	63	89 1	100	103 3
27	77 2	64	89 5	101	103 8
28	77 5	65	89 9	102	104 2
29	77 8	66	90 2	103	104 6
30	78 0	67	90 6	104	105 1
31	78 3	68	90 9	105	105 5
32	78 6	69	91 3	106	106 0
33	78 9	70	91 6	107	106 5
34	79 2	71	92 0	108	107 0
35	79 5	72	92 4	108 9	107 5
36	79 8	73	92 7		

(Mulder, calculated from his own and other observations, Scheik Verhandl 1864 60)

100 g  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  contain 41.4 g  $(\text{NH}_4)_2\text{SO}_4$  at  $0^\circ$  (de Waal, Dissert 1910),  
44.27 g at  $30^\circ$  (Schreinemakers, Z phys Ch 71 110), 47.81 g at  $70^\circ$  (de Waal)  
 $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  sat at  $15^\circ$  has sp gr 1.248  
(Michel and Krafft, A ch (3) 41 471)

Sp gr of $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ at $15^\circ$					
% $(\text{NH}_4)_2\text{SO}_4$	Sp gr	% $(\text{NH}_4)_2\text{SO}_4$	Sp gr	% $(\text{NH}_4)_2\text{SO}_4$	Sp gr
1	1 0057	18	1 1035	35	1 2004
2	1 0115	19	1 1092	36	1 2060
3	1 0172	20	1 1149	37	1 2116
4	1 0230	21	1 1207	38	1 2172
5	1 0287	22	1 1265	39	1 2228
6	1 0345	23	1 1323	40	1 2284
7	1 0403	24	1 1381	41	1 2343
8	1 0460	25	1 1439	42	1 2402
9	1 0518	26	1 1496	43	1 2462
10	1 0575	27	1 1554	44	1 2522
11	1 0632	28	1 1612	45	1 2583
12	1 0690	29	1 1670	46	1 2644
13	1 0747	30	1 1724	47	1 2705
14	1 0805	31	1 1780	48	1 2766
15	1 0862	32	1 1836	49	1 2828
16	1 0920	33	1 1892	50	1 2890
17	1 0977	34	1 1948		

(Schiff, calculated by Gerlach, Z anal 8 280)

Sp gr of $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ at $15^\circ$					
% $(\text{NH}_4)_2\text{SO}_4$	Sp gr	% $(\text{NH}_4)_2\text{SO}_4$	Sp gr	% $(\text{NH}_4)_2\text{SO}_4$	Sp gr
5	1 0292	20	1 1160	31	1 1787
10	1 0381	30	1 1730		

(Kohlrausch, W Ann 1879 1)

Sp gr of $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ at $15^\circ$					
% $(\text{NH}_4)_2\text{SO}_4$	Sp gr	% $(\text{NH}_4)_2\text{SO}_4$	Sp gr	% $(\text{NH}_4)_2\text{SO}_4$	Sp gr
3	1 0181	10	1 0600	30	1 1773
6	1 0359	20	1 1190	40	1 2352

(Gerlach, Z anal 28 493)

Sp gr of sat solution = 1 248 (Gerlach)

Sp gr of $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$	
$\frac{1}{2}(\text{NH}_4)_2\text{SO}_4$ g mol in 1000 g of solution	Sp gr $16^\circ/16^\circ$
0	1 000000
0 5514	1 000347
1 1251	1 000704
2 3114	1 001436
4 5840	1 002823
10 0893	1 006093
20 0138	1 012023
40 5236	1 024117
56 8536	1 033690

(Dijken, Z phys Ch 1897, 24 107)

Sp gr of $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ at $20^\circ$		
Normality of $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$	% $(\text{NH}_4)_2\text{SO}_4$	Sp gr
3 75	40 28	1 228
2 964	32 99	1 184
1 978	23 01	1 13
0 876	10 88	1 06
0 492	6 275	1 03

(Forchheimer, Z phys Ch 1900, 34 22)

Sp gr of $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ at $20^\circ$			
Solution	Sp gr	weight of 10 cem of the solution	(NH) <sub>2</sub> SO <sub>4</sub>
sat	1 248	12 5062 g	5 2
$\frac{3}{4}$ "	1 196	11 9034 "	3 9
$\frac{1}{2}$ "	1 139	11 3377 "	2 6
$\frac{1}{4}$ "	1 077	10 7232 "	1 3
$\frac{1}{8}$ "	1 039		65

(Wiener, Z phys Chem 1911, 71 1)

B-pt of sat solution crust form 1 at 106  $2^\circ$  solution containing 88 2 pts  $(\text{NH}_4)_2\text{SO}_4$  to 100 pts  $\text{H}_2\text{O}$ , highest mp observed, 108  $2^\circ$  (Gerlach, Z anal 26 126)

B-pt of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  containing pts  $(\text{NH}_4)_2\text{SO}_4$  to 100 pts  $\text{H}_2\text{O}$

B pt	Pts $(\text{NH}_4)_2\text{SO}_4$	B pt	Pts $(\text{NH}_4)_2\text{SO}_4$
100 $5^\circ$	7 8	105 $0^\circ$	71
101 0	15 4	105 5	78
101 5	22 8	106 0	85
102 0	30 1	106 5	92
102 5	37 2	107 0	99
103 0	44 2	107 5	105
103 5	51 1	108 0	112
104 0	58 0	108 2	115
104 5	64 9		

(Gerlach, Z anal 26 431)

Sol with decomp in  $\text{HCl} + \text{Aq}$

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

100 g of the solution contain		Solid phase
Mol $\text{H}_2\text{SO}_4$	Mol $(\text{NH}_4)_2\text{SO}_4$	
0 00	2 28	$(\text{NH}_4)_2\text{SO}_4$
0 24	3 25	
0 47	3 19	
0 97	3 15	
1 19	3 15	
1 43	3 22	$(\text{NH}_4)_2\text{H}(\text{SO}_4)_2$
1 72	3 18	
2 20	3 02	
2 60	2 97	
2 71	3 00	
2 82	3 03	
2 96	3 10	
3 20	3 19	
3 32	3 25	
3 47	3 32	$(\text{NH}_4)\text{HSO}_4$
3 54	3 20	
3 76	2 84	
4 22	2 26	
5 09	1 44	

(D'Ans, Z anorg 1909, 65 229)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$ 

Composition of the solution			Solid phase
% by wt $\text{H}_2\text{SO}_4$	% by wt $(\text{NH}_4)_2\text{SO}_4$	% by wt $\text{H}_2\text{O}$	
10 63	43 59	45 79	$(\text{NH}_4)_2\text{SO}_4$
10 70	43 25	46 05	
13 18	44 10	42 72	
16 67	42 06	41 27	$(\text{NH}_4)_2\text{SO}_4 + 3(\text{NH}_4)_2\text{SO}_4 \cdot \text{H}_2\text{SO}_4$
25 82	41 15	33 03	
27 33	41 16	31 51	
32 32	44 63	22 26	$(\text{NH}_4)\text{HSO}_4$
33 12	45 50	21 83	
33 84	45 52	20 64	
33 96	45 31	20 73	
38 51	35 37	26 12	
42 12	30 10	27 78	
45 80	24 88	29 32	
45 77	24 30	29 93	
56 55	16 98	26 37	
62 43	20 41	17 16	
62 46	24 40	13 14	
63 12	24 20	12 68	
62 57	27 67	9 76	
62 83	29 75	8 42	
62 56	30 26	7 28	
62 67	31 86	5 47	
62 59	33 70	3 71	
61 63	36 75	1 72	
62 23	36 95	0 82	

(Van Dorp, Z phys Ch 1910, 73 285)

Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

In 1000 g of the solution		Solid phase
Mol $\text{SO}_3$	Mol $(\text{NH}_4)_2\text{SO}_4$	
4 29	2 17	$(\text{NH}_4)\text{HSO}_4$
4 57	1 83	
4 85	1 60	
5 25	1 36	
5 66	1 22	
6 16	1 26	$(\text{NH}_4)\text{HSO}_4$
6 47	1 55	
6 51	1 95	
6 50	2 37	
6 43	2 50	
7 28	1 64	$(\text{NH}_4)_2\text{H}_2(\text{SO}_4)_2$
7 99	1 38	
(7 60)	(1 74)	$(\text{NH}_4)_2\text{H}_2(\text{SO}_4)_2$
(8 00)	(1 42)	
9 02	0 96	$(\text{NH}_4)\text{HS}_2\text{O}_7$
9 21	0 832	
9 60	0 977	
9 68	1 00	$(\text{NH}_4)\text{HS}_2\text{O}_7 + ?$
9 67	1 26	
10 43	0 894	

(D'Ans, Z anorg 1913, 80 241)

Very easily sol, even in conc  $\text{NH}_4\text{OH} + \text{Aq}$  (Girard, Bull Soc (2) 43 522)Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ 

In 1000 g of the solution	
Mol $(\text{NH}_4)_2\text{SO}_4$	Mol $(\text{NH}_3)$
3 28	0
2 60	1 02
2 13	1 95
1 59	3 44
1 16	5 35
0 78	7 13
0	9 47

(D'Ans and Schreiner Z anorg 1910, 67 438)

100 pts  $\text{H}_2\text{O}$  dissolve 46.5 pts  $(\text{NH}_4)_2\text{SO}_4$  and 26.8 pts  $\text{NH}_4\text{Cl}$  at  $21.5^\circ$ Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $30^\circ$ 

% $\text{NH}_4\text{Cl}$	% $(\text{NH}_4)_2\text{SO}_4$	Solid phase
0	44	$(\text{NH}_4)_2\text{SO}_4$
6 86	36 15	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{Cl}$
14 62	28 6	
17 60	25 69	
17 93	25 81	
19 07	23 22	
19 97	21 3	$\text{NH}_4\text{Cl}$
22 3	16 33	
24 06	12 72	
29 5	0	

(Schreinemakers, Arch Néer Sc 1910, (2) 15 92)

See also under  $\text{NH}_4\text{Cl}$



$(\text{NH}_4)_2\text{SO}_4 + \text{CuSO}_4$   
Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{CuSO}_4$  in  $\text{H}_2\text{O}$  at  
 $16^\circ$

Solution	% $\text{CuSO}_4$	% $(\text{NH}_4)_2\text{SO}_4$
Both salts in excess	8 55	7 12
15 cc sat sol + 3 g $(\text{NH}_4)_2\text{SO}_4$	1 77	18 16
15 cc sat sol + 3 g $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	15 85	5 65

(Rudorff, B 6 482)

Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{CuSO}_4$  in  $\text{H}_2\text{O}$  at  
 $30^\circ$

% $(\text{NH}_4)_2\text{SO}_4$	% $\text{CuSO}_4$	Solid phase
0	20 32	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
2 45	20 19	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} + \text{CuSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
5 79	20 53	
6 98	16 77	
8 19	13 65	
9 33	11 03	
17 53	4 05	$\text{CuSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
29 27	1 57	
38 52	0 77	
43 29	0 49	
44	0	

(Schreinemakers, Arch Néer Sc 1910, 15  
12)

See also under  $\text{CuSO}_4$

$(\text{NH}_4)_2\text{SO}_4 + \text{FeSO}_4$   
Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{FeSO}_4$  in  $\text{H}_2\text{O} +$   
Aq at  $30^\circ$

Composition of the solution		Solid phase
by wt $\text{FeSO}_4$	by wt $(\text{NH}_4)_2\text{SO}_4$	
24 90	0	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
27 24	7 24	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O} +$ $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
27 22	7 95	
27 26	7 89	
23 99	6 44	
17 64	5 90	
15 15	11 45	$\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
7 95	16 29	
7 70	19 64	
1 72	34 24	
0 79	43 86	
0 79	43 90	$\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O} +$ $(\text{NH}_4)_2\text{SO}_4$
0	44 27	$(\text{NH}_4)_2\text{SO}_4$

(Schreinemakers, Z phys Ch 1910, 71 111)

$(\text{NH}_4)_2\text{SO}_4 + \text{Li}_2\text{SO}_4$   
Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{Li}_2\text{SO}_4$

Temp = $30^\circ$		
% $(\text{NH}_4)_2\text{SO}_4$	% $\text{Li}_2\text{SO}_4$	Solid phase
44 1	0	$(\text{NH}_4)_2\text{SO}_4$
40 8	3	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{LiSO}_4$
39 5	6 6	
30	10	
21 6	15	
15	20	
12 5	21 9	$\text{NH}_4\text{LiSO}_4 + \text{Li}_2\text{SO}_4$
8 9	23	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
0	25 1	"

Temp = $50^\circ$		
% $(\text{NH}_4)_2\text{SO}_4$	% $\text{Li}_2\text{SO}_4$	Solid phase
45 7	1	$(\text{NH}_4)_2\text{SO}_4$
43 05	5 86	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{LiSO}_4$
19 65	16 35	$\text{NH}_4\text{LiSO}_4$
13 90	21 20	"
13 97	21 23	$\text{NH}_4\text{LiSO}_4 + \text{Li}_2\text{SO}_4$
11 45	21 75	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
9 63	22 79	"
8 58	23 09	"
7 56	23 86	"
0	24 3	"

(Schreinemakers and Cocheret, Che  
Weekbl 1905, 2 771)

$(\text{NH}_4)_2\text{SO}_4 + \text{MnSO}_4$   
Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{MnSO}_4$  in 100  
G per 100 g sat solution

Temp = $30^\circ$		
% $\text{MnSO}_4$	% $(\text{NH}_4)_2\text{SO}_4$	Solid phase
39 3	0	$\text{MnSO}_4 \cdot 5\text{H}_2\text{O}$
38 49	3 64	$\text{MnSO}_4 \cdot 5\text{H}_2\text{O} + \text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
33 44	4 91	"
22 06	9 65	"
9 02	20 36	"
2 91	37 42	"
1 75	42 58	$\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
1 77	43 24	$+$ $(\text{NH}_4)_2\text{SO}_4$
0	43 4	$(\text{NH}_4)_2\text{SO}_4$

Temp = $50^\circ$		
% $\text{MnSO}_4$	% $(\text{NH}_4)_2\text{SO}_4$	Solid phase
36 26	0	$\text{MnSO}_4 \cdot \text{H}_2\text{O}$
35 35	2 95	$\text{MnSO}_4 \cdot \text{H}_2\text{O} + 2\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
30 57	5 14	$(\text{NH}_4)_2\text{SO}_4$
16 86	17 62	$2\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4$
6 92	35 98	"
6 29	39 71	"
5 70	43 24	$2\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 +$ $(\text{NH}_4)_2\text{SO}_4$
3 49	44 02	$(\text{NH}_4)_2\text{SO}_4$
0	45 7	"

(Schreinemakers, Chem Weekbl 1909, 131)

$(\text{NH}_4)_2\text{SO}_4 + \text{K}_2\text{SO}_4$   
 100 pts  $(\text{NH}_4)_2\text{SO}_4 + \text{K}_2\text{SO}_4 + \text{Aq}$  sat at  $17^\circ$  contain 38.41 pts of the two salts, which 5.45 pts are  $\text{K}_2\text{SO}_4$ , and 32.96 pts  $(\text{NH}_4)_2\text{SO}_4$  (v Hauer, J pr 28 137)  
 100 pts  $\text{H}_2\text{O}$  dissolve 50.6 pts  $(\text{NH}_4)_2\text{SO}_4$  and 7.2 pts  $\text{K}_2\text{SO}_4$  at  $11^\circ$  (Mulder, J B 166 67)  
 $(\text{NH}_4)_2\text{SO}_4$  and  $\text{K}_2\text{SO}_4$  replace each other in solution, so that by adding one of these salts to a seemingly saturated solution of the other, it is dissolved with pptn of the other lt (Rudorff, B 6 485)

Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{K}_2\text{SO}_4$  at  $19.1^\circ$

Solution	% $\text{K}_2\text{SO}_4$	% $(\text{NH}_4)_2\text{SO}_4$
th salts in excess	39.3	37.97
cc sat sol + 4 g $\text{K}_2\text{SO}_4$	4.94	33.26
cc sat sol + 4 g $(\text{NH}_4)_2\text{SO}_4$	2.05	40.80

(Rudorff, B 6 482)

solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{K}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at  $25^\circ$

$\text{K}_2\text{SO}_4$ per l	g $(\text{NH}_4)_2\text{SO}_4$ per l	g $\text{K}_2\text{SO}_4$ per l	g $(\text{NH}_4)_2\text{SO}_4$ per l
127.9	0.0	59.28	355.0
135.7	115.7	40.27	482.7
84.2	281.1	0.0	542.3

Results are also given for  $14^\circ$ ,  $15^\circ$ ,  $16^\circ$ ,  $30^\circ$ , and  $47^\circ$

(Fock, Z Kryst Min 1897, 28 365)

$(\text{NH}_4)_2\text{SO}_4 + \text{Th}(\text{SO}_4)_2$

solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{Th}(\text{SO}_4)_2$  at  $16^\circ$

Pts per 100 pts  $\text{H}_2\text{O}$

	$\text{Th}(\text{SO}_4)_2$	Solubility
13	3.361	$\text{Th}(\text{SO}_4)_2 \cdot 9\text{H}_2\text{O}$
30	5.269	"
32	8.947	"
36	13.330	$\text{Th}(\text{SO}_4)_2 \cdot 9\text{H}_2\text{O} + \text{Th}(\text{SO}_4)_2 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$
40	10.359	$\text{Th}(\text{SO}_4)_2 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$
40	9.821	" + $\text{Th}(\text{SO}_4)_2 \cdot 2(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$
44	6.592	$\text{Th}(\text{SO}_4)_2 \cdot 2(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$
51	5.750	"
84	4.583	$\text{Th}(\text{SO}_4)_2 \cdot 3(\text{NH}_4)_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$
44	1.653	"

(Barre, A ch 1911, (8) 24 239)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 826)

Insol in absolute alcohol Sol in 500 pts alcohol of 0.872 sp gr, and in 62.5 pts of 0.905 sp gr (Anthon, J pr 14 125)

Sol in 217.4 pts of 66.8% alcohol (sp gr = 0.88) at  $24.3^\circ$  (Pohl, J pr 56 219)

Tolerably sol in alcohol, the sp gr of which is greater than 0.860 Insol in alcohol of sp gr less than 0.850

### Solubility in dil alcohol

When  $(\text{NH}_4)_2\text{SO}_4$  is dissolved in dil alcohol, two layers are formed, the compositions of which are as follows

Sp gr	Lower layer 100 ccm contain in g		
	alcohol	water	salt
1.2240		71.43	74.16
1.1775	8.85	68.26	59.54
1.1661	10.62	67.70	56.56
1.1655	11.29	67.34	56.30
1.1735	11.42	66.54	59.20

Sp gr	Upper layer 100 ccm containing		
	alcohol	water	salt
0.9530	41.37	48.47	5.45
0.9512	44.20	45.95	4.97
0.9440	44.27	45.61	4.51
0.9098	52.64	36.78	1.56
0.8750	62.61	24.60	0.30
0.8549	67.04	18.36	0.09
0.8308	77.55	5.53	0.00

(Bodlander Z phys Ch 7 3 8)

### Solubility in ethyl alcohol + Aq

Upper layer			
Temp	% $\text{H}_2\text{O}$	% alcohol	g salt
16 $6^\circ$	52.80	40.21	6.99
33 $0^\circ$	47.99	46.75	7.26
41 $8^\circ$	47.34	47.67	4.99
55 $7^\circ$	45.90	49.47	4.63
Lower layer			
16 $6^\circ$	60.33	10.19	29.48
33 $0^\circ$	61.02	9.80	29.18
41 $8^\circ$	61.16	9.74	29.10
55 $7^\circ$	61.59	9.46	28.95

(Traube, Z phys Ch 1887, 1 509)

Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in alcohol at  $30^\circ$   
Two liquid layers are formed between alcohol concentrations of 5.8 and 62%

## Composition of layers

Upper layer			Lower layer		
% $(\text{NH}_4)_2\text{SO}_4$	% alcohol	% $\text{H}_2\text{O}$	% $(\text{NH}_4)_2\text{SO}_4$	% alcohol	% $\text{H}_2\text{O}$
2.2	56.6	41.2	37.1	5.8	57.1
2.6	54.5	42.9	35.7	6.3	58
3.4	52.3	44.3	33.8	7.4	58.8
13.2	31.8	55	21.7	18.4	59.9
17	25	58	17	25	58

At concentration of 62% alcohol, the liquid is homogeneous and contains 1.3%  $(\text{NH}_4)_2\text{SO}_4$

(Wibaut, Chem Weekbl 1909, 6 401)

Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in alcohol at  $60^\circ$ 

% $(\text{NH}_4)_2\text{SO}_4$	% alcohol	% $\text{H}_2\text{O}$
43.02	2.32	54.66
41.1	4.1	54.8
1.2	64.5	34.3
0.2	75.5	24.3

Between  $41^\circ$  and  $64.5^\circ$ , two liquid layers are formed

## Composition of layers

Upper layer			Lower layer		
% $(\text{NH}_4)_2\text{SO}_4$	% alcohol	% $\text{H}_2\text{O}$	% $(\text{NH}_4)_2\text{SO}_4$	% alcohol	% $\text{H}_2\text{O}$
1.2	64.5	34.3	41.1	4.1	54.8
1.6	60	38.4	36.8	6	57.2
3.8	50	46.2	30.8	9	60.2
7.4	40	52.6	26.6	12	61.4
10	34.4	55.6	23.6	15	61.4

(Schreinemakers, Z phys Ch 1907, 59 641)

Solubility in alcohol + Aq at  $0^\circ$ 

% $(\text{NH}_4)_2\text{SO}_4$	% alcohol	% $\text{H}_2\text{O}$
41.4	0	58.6
50.0	9.41	60.59
0.14	73.03	26.83

Two layers are formed between alcohol concentrations of 9.41 and 73.03%

(de Waal, Dissert 1910)

Solubility in propyl alcohol + Aq at  $20^\circ$ 

% propyl alcohol	% $(\text{NH}_4)_2\text{SO}_4$
20	6.7
30	4.8
40	3.2
50	2.0
60	1.0
70	0.4

(Linebarger, Am Ch J 1892, 14 38)

100 g 95% formic acid dissolve 2  $(\text{NH}_4)_2\text{SO}_4$  at  $16.5^\circ$  (Aschan, Ch Ztg 37 1117)

Insol in acetone (Eidmann, C C 1909, 42 3790), ethyl acetate (Naum B 1910, 43 314)

Insol in methyl acetate (Naum B 1910, 43 314)  
Insol in  $\text{CS}_2$  (Arcowski, Z anorg 6 257)

Ammonium hydrogen sulphate,  $\text{NH}_4\text{HSO}_4$ 

Sl deliquescent Sol in 1 pt cold H<sub>2</sub>O (Link)

Very sl sol in alcohol (Gerhardt, (3) 20 255)

Insol in acetone (Naumann, B 37 4329, Eidmann, C C 1899, II, 101)  
 $(\text{NH}_4)_2\text{H}(\text{SO}_4)_2$  Not deliquescent in  $\text{H}_2\text{O}$  (Mitscherlich, Pogg 39 198)  
 $(\text{NH}_4)_2\text{SO}_4 \cdot 3\text{H}_2\text{SO}_4$  D'Ans and Sch Z anorg 1913, 80 241)

Ammonium pyrosulphate,  $(\text{NH}_4)_2\text{S}_2\text{O}_8$ 

Decomp by  $\text{H}_2\text{O}$  (Schulze)  
 $\text{NH}_4\text{HS}_2\text{O}_8$  (D'Ans and Schreier, anorg 1913, 80 241)

Ammonium octosulphate,  $(\text{NH}_4)_8\text{S}_8\text{O}_{48}$ 

Decomp by  $\text{H}_2\text{O}$  (Weber, B 17 4)

Ammonium antimony sulphate,  $(\text{NH}_4)_3\text{Sb}_2(\text{SO}_4)_3$ 

Behaves toward  $\text{H}_2\text{O}$  and abs alc a mixture of the components (M Z anorg 1905, 48 152)

Decomp very slowly by  $\text{H}_2\text{O}$  (Mann, Arch Pharm 1898, 236 479)

Ammonium bismuth sulphate,  $\text{NH}_4\text{BiS}_4 + 4\text{H}_2\text{O}$ 

Easily sol in  $\text{HCl}$ , and  $\text{HNO}_3$  + sol in conc  $\text{H}_2\text{SO}_4$ , and hot dil acids decomp by cold  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$ , and dil Aq (Luddecke, A 140 277)

Ammonium cadmium sulphate,  $(\text{NH}_4)_2\text{CdSO}_4 + 6\text{H}_2\text{O}$ 

Can be recrystallised from a little (v Hauer)  
1 l  $\text{H}_2\text{O}$  dissolves 723 g anhyd at  $25^\circ$  (Locke, Am Ch J 1902, 27 5)

$3(\text{NH}_4)_2\text{SO}_4$ ,  $\text{CdSO}_4 + 10\text{H}_2\text{O}$  (André, C 104 987)

**ammonium calcium sulphate**,  
 $(\text{NH}_4)_2\text{Ca}(\text{SO}_4)_2 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Fassbender, B 11 68)  
Sol in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (Rose, Pogg 0 292)

This double salt is stable between  $0^\circ$  and  $0^\circ$  in solutions containing an excess of  $(\text{H}_4)_2\text{SO}_4$ . It is not formed if the solution contains less than 35%  $(\text{NH}_4)_2\text{SO}_4$  (Barre, R 1909, 148 1605)

$(\text{SO}_4)_2\text{Ca}_2(\text{NH}_4)_2$  Decomp by  $\text{H}_2\text{O}$   
'Ans, B 1907, 40 192)

This double salt is formed in the presence of an excess of  $\text{CaSO}_4$  and at temp above  $80^\circ$  (Barre, C R 1909, 148 1605)

$\text{Ca}_2(\text{NH}_4)_2(\text{SO}_4)_4 + \text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$   
'Ans, B 1907, 40 192)

**ammonium calcium cupric sulphate**,  
 $\text{Ca Cu}(\text{NH}_4)_2(\text{SO}_4)_4 + 2\text{H}_2\text{O}$

Very stable (D'Ans, B 1908, 41 1778)

**ammonium calcium potassium sulphate**,  
 $\text{NH}_4\text{CaK}(\text{SO}_4)_2 + \text{H}_2\text{O}$

Decomp by cold  $\text{H}_2\text{O}$  (Fassbender, B 1968)

**ammonium cerous sulphate**,  $(\text{NH}_4)_2\text{Ce}_2(\text{SO}_4)_4 + 8\text{H}_2\text{O}$

More sol in cold than in hot  $\text{H}_2\text{O}$  (Czudwicz)

100 g  $\text{H}_2\text{O}$  dissolve at

$3^\circ$  22  $35^\circ$  35  $1^\circ$  45  $2^\circ$

331 5 328 5 184 4 993 g anhydrous salt,

$45^\circ$  55  $3^\circ$  55  $2^\circ$

2 994 2 240 2 187 g anhydrous salt

75  $4^\circ$  85  $2^\circ$

1 482 1 184 g anhydrous salt

(Wolff, Z anorg 1905, 45 102)

$5(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Cr}_2(\text{SO}_4)_3$  (Barre, C R 10, 151 873)

**ammonium ceric sulphate**,  $3(\text{NH}_4)_2\text{SO}_4$ ,  
 $\text{Ce}(\text{SO}_4)_3 + 4\text{H}_2\text{O}$

Slightly efflorescent. Easily sol in  $\text{H}_2\text{O}$  (Mendeleeff, A 168 50)

$3(\text{NH}_4)_2\text{SO}_4$ ,  $2\text{Ce}(\text{SO}_4)_3 + 3\text{H}_2\text{O}$  Sl sol  
 $\text{H}_2\text{O}$  (Mendeleeff)

**ammonium chromous sulphate**,  $\text{NH}_4\text{Cr}(\text{SO}_4)_2$

0.407 g mol anhydrous salt is sol in 1 l  $\text{O}$  at  $25^\circ$  (Locke, Am Ch J 1901, 26 5)

+ $6\text{H}_2\text{O}$  100 cem of sat aqueous solution contain 55 g of the salt at  $20^\circ$  Insol in  $\text{H}_2\text{O}$  (Laurent, C R 1911, 131 112)

**Ammonium chromic sulphate**,  $(\text{NH}_4)_2\text{SO}_4$ ,  
 $\text{Cr}_2(\text{SO}_4)_3$

Not attacked by boiling  $\text{H}_2\text{O}$  or conc  $\text{HCl}$  + Aq. Very slowly attacked by boiling  $\text{KOH}$  + Aq (sp gr = 1.3). Insol in  $\text{CrCl}_3$  + Aq or  $\text{SnCl}_2$  + Aq (Klobb, Bull Soc (3) 9 664). + $5\text{H}_2\text{O}$  Is ammonium chromosulphate, which see

+ $24\text{H}_2\text{O}$  **Chrome Alum**

*Violet modification* Efflorescent Sol in cold  $\text{H}_2\text{O}$ , but solution is decomp on heating with formation of green modification. The dil solution of green modification is gradually converted into violet modification by standing. Alcohol ppts it from aqueous solution (Schrotter, Pogg 53 526)

100 cc  $\text{H}_2\text{O}$  dissolve 10.78 g anhydrous, or 21.21 g hydrated salt at  $25^\circ$ . Melts in crystal  $\text{H}_2\text{O}$  at  $45^\circ$  (Locke, Am Ch J 1901 26 174)

Solubility in  $\text{H}_2\text{O}$

Saturation is very slowly reached owing to transition between violet and green modifications. If time of saturation is taken at  $2\frac{1}{2}$  hours, 100 g of the solution contain at

$0^\circ$   $30^\circ$   $40^\circ$

3.77 10.6 15.5 g  $(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4$

This is assumed to be the solubility of the violet modification

In 300 hours, 15.96 g salt are dissolved at  $30^\circ$ , and 24.64 g in 250 hours at  $40^\circ$  (Koppel, B 1906, 39 3741)

Calc from electrical conductivity measurements, a solution containing 3.8 g of the sulphate in 100 g contains 48% of the green compound at  $40^\circ$  and 61% at  $55^\circ$ . With solutions of 6-7 times the above concentration equilibrium is reached at  $40^\circ$  with 30-40% green alum (Koppel)

Sp gr of aqueous solution of violet modification at  $15^\circ$ , containing

4 8 12%  $(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$   
1.020 1.0405 1.0610

Sat solution at  $15^\circ$  has sp gr = 1.070 (Geilach)

*Green modification* Sol in  $\text{H}_2\text{O}$  and alcohol. When in aqueous solution, it gradually changes to violet modification

Sp gr of aqueous solution of green modification at  $15^\circ$ , containing

10 20 30%  $(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ ,  
1.044 1.091 1.142

40 50 60%  $(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ ,  
1.197 1.255 1.317

70 80 90%  $(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$   
1.384 1.456 1.532

(Gerlach, Z anal 28 498)

Insol in acetone (Naumann, B 1904, 37 4329)

$3(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Cr}_2(\text{SO}_4)_3$  Only sl attacked by boiling  $\text{H}_2\text{O}$ . Not attacked by boiling conc  $(\text{NH}_4)_2\text{SO}_4$  + Aq (Klobb, Bull Soc (3) 9 663)

**Ammonium cobaltous sulphate,**  
 $(\text{NH}_4)_2\text{Co}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ 100 pts  $\text{H}_2\text{O}$  dissolve at0° 10° 18° 23° 35°  
8.9 11.6 15.2 17.1 19.6 pts anhydrous salt,40° 45° 50° 60° 75°  
22.3 25 28.7 34.5 43.3 pts anhydrous salt  
(Tobler, A 95 193)100 pts saturated solution contain at  
20° 40° 60° 80°  
14.9 20.8 25.6 33 pts anhydrous salt  
(v Hauer, J pr 74 433)1 l  $\text{H}_2\text{O}$  dissolves 147.2 g anhydrous salt  
at 25° Tobler's results are inaccurate  
(Locke, Am Ch J 1902, 27 459)  
Pptd from aqueous solution by alcohol**Ammonium cobaltic sulphate,**  
 $(\text{NH}_4)_2\text{Co}_2(\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  with decomp (Marshall,  
Chem Soc 39 760)**Ammonium cobaltous cupric sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CoSO}_4 \cdot \text{CuSO}_4 \cdot 12\text{H}_2\text{O}$ Quite easily sol in hot  $\text{H}_2\text{O}$ , but on long  
boiling a basic salt is pptd (Vohl, A 94 58)**Ammonium cobaltous ferrous sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CoSO}_4 \cdot \text{FeSO}_4 \cdot 12\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)**Ammonium cobaltous magnesium sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CoSO}_4 \cdot \text{MgSO}_4 \cdot 12\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)**Ammonium cobaltous manganous sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CoSO}_4 \cdot \text{MnSO}_4 \cdot 12\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)**Ammonium cobaltous nickel sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CoSO}_4 \cdot \text{NiSO}_4 \cdot 12\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)**Ammonium cobaltous zinc sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CoSO}_4 \cdot \text{ZnSO}_4 \cdot 12\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)**Ammonium cupric sulphate,  $(\text{NH}_4)_2\text{CuSO}_4$** 

Efflorescent in warm air

Sol in 150 pt boiling  $\text{H}_2\text{O}$  and separates almost  
wholly on cooling (Vohl, J pr 2 194)  
Sol in 150 pts  $\text{H}_2\text{O}$  at 18° (Abl)100 pts  $\text{H}_2\text{O}$  at 19° dissolve 26.6 pts, and  
sat solution has sp gr = 1.1337 (Schiff, A  
109 426)100 g sat solution at 30° contain 30.36 g  
anhydrous salt (Schreinemakers, Arch Néer  
Sci 1910, (2) 15 92)Solubility of  $(\text{NH}_4)_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$   
 $(\text{NH}_4)_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at 13-14°  
Mols per 100 mols  $\text{H}_2\text{O}$ 

Cu salt	Ni salt	% Cu salt solid pha
0	0 521	0
0 1476	0 295	10 29
0 2664	0 2089	30 59
0 4165	0 1449	52 23
0 4785	0 1202	78 80
1 0350	0	100

(Fock, Z Kryst Min 1897, 28 365)

Solubility of  $(\text{NH}_4)_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$   
 $\text{K}_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at 13-14°  
Mols per 100 mols  $\text{H}_2\text{O}$ 

K salt	$\text{NH}_4$ salt	% K salt solid pha
0	1 035	0
0 897	0 8618	5.0
0 2269	0 6490	16.7
0 2570	0 5887	30.4
0 2946	0 5096	38.6
0 3339	0 3319	50.1
0 4560	0 1961	69.9
0 4374	0	100

(Fock)

Solubility of  $(\text{NH}_4)_2\text{Cu}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$   
 $(\text{NH}_4)_2\text{Zn}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at 13-14°  
Mols per 100 mols  $\text{H}_2\text{O}$ 

Cu salt	Zn salt	% Cu salt solid ph
0 0422	0 8069	2.2
0 0666	0 5638	4.5
0 1218	0 5115	9.0
0 2130	0 4924	14.6
0 3216	0 4022	22.6
1 035	0	100

(Fock)

 $(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{CuSO}_4$  Very sol in  $\text{H}_2\text{O}$   
(Klobb, C R 115 230)**Ammonium cupric ferrous sulphate**Sol in  $\text{H}_2\text{O}$  without decomposition  
A 94 61)**Ammonium cupric magnesium sulphate** $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CuSO}_4 \cdot \text{MgSO}_4 \cdot 12\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)**Ammonium cupric magnesium potassium sulphate,  $(\text{NH}_4)_2\text{CuSO}_4 \cdot \text{MgSO}_4 \cdot \text{K}_2\text{SO}_4 \cdot 12\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  (Schiff)  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CuSO}_4 \cdot 2\text{MgSO}_4 \cdot \text{K}_2\text{SO}_4 \cdot 18\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Schiff)

**ammonium cupric manganous sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CuSO}_4, \text{MnSO}_4 + 12 \text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)

**ammonium cupric nickel sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CuSO}_4, \text{NiSO}_4 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Vohl)

**ammonium cupric potassium sulphate,**  
 $\text{NH}_4\text{KSO}_4, \text{CuSO}_4 + 6\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Schiff)

**ammonium cupric zinc sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CuSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Vohl)

**ammonium cupric sulphate ammonia,**  
 $(\text{NH}_4)_2\text{SO}_4, \text{CuO}, 2\text{NH}_3$   
 Sol in 15 pts cold  $\text{H}_2\text{O}$ , but decomp on  
 posure to air or dilution Insol in alcohol  
 uhn)

**ammonium didymium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,**  
 $\text{D}_{12}(\text{SO}_4)_3 + 8\text{H}_2\text{O}$   
 Sol in 18 pts  $\text{H}_2\text{O}$ , and less easily in  
 $(\text{H}_4)_2\text{SO}_4 + \text{Aq}$  (Marignac)  
 Moderately sol in  $\text{H}_2\text{O}$  (Cleve, Bull Soc  
 ) 43 362)

**ammonium erbium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,**  
 $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Cleve)

**ammonium gallium sulphate,**  
 $(\text{NH}_4)_2\text{Ga}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$   
 Sol in cold water and dilute alcohol Conc  
 ution clouds up on boiling, but clears on  
 cling Dil solution separates out a basic  
 t, insol in hot or cold  $\text{H}_2\text{O}$  (Boisbaudran)

**ammonium glucinum sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,**  
 $\text{GISO}_4 + 2\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Atterberg)

**ammonium indium sulphate,**  
 $(\text{NH}_4)_2\text{In}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$   
 100 pts  $\text{H}_2\text{O}$  dissolve 200 pts salt at  $16^\circ$ ,  
 d 400 pts at  $30^\circ$   
 Insol in alcohol  
 Melts in crystal  $\text{H}_2\text{O}$  at  $36^\circ$  (Rossler, J  
 (2) 7 14)  
 $+8\text{H}_2\text{O}$  (Rossler)

**ammonium iridium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,**  
 $\text{Ir}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$   
 Easily sol in  $\text{H}_2\text{O}$  (Marino, Z anorg  
 04, 42 221)

**ammonium iron (ferrous) sulphate,**  
 $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$   
 Much less sol in  $\text{H}_2\text{O}$  than  $\text{FeSO}_4 + 7\text{H}_2\text{O}$   
 ogel, J pr 2 192)

100 pts  $\text{H}_2\text{O}$  dissolve at  
 $0^\circ \quad 12^\circ \quad 20^\circ \quad 30^\circ \quad 36^\circ$   
 12 2 17 5 21 6 28 1 31 8 pts anhydrous salt,  
 $45^\circ \quad 55^\circ \quad 60^\circ \quad 65^\circ \quad 75^\circ$   
 36 2 40 3 44 6 49 8 56 7 pts anhydrous salt  
 (Tobler, A 95 193)

100 pts  $\text{H}_2\text{O}$  at  $16.5^\circ$  dissolve 35.9 pts  
 hydrous salt  
 1 l  $\text{H}_2\text{O}$  dissolves 351 pts or 1.044 g mol  
 anhydrous salt at  $25^\circ$  (Locke, Am Ch J  
 1902, 27 459)  
 Sol in  $\text{H}_2\text{O}$  without decomp Aq solution  
 at  $30^\circ$  contains 13.13%  $\text{FeSO}_4$  and 11.45%  
 $(\text{NH}_4)_2\text{SO}_4$  (Schreinemakers, C C 1910, I  
 801)

Sp gr of  $(\text{NH}_4)_2\text{FeSO}_4 + \text{Aq}$  at  $19^\circ$   
 $\% = \%(\text{NH}_4)_2\text{FeSO}_4 + 6\text{H}_2\text{O}$

%	Sp gr	%	Sp gr	%	Sp gr
1	1.006	11	1.066	21	1.130
2	1.013	12	1.073	22	1.136
3	1.018	13	1.080	23	1.143
4	1.024	14	1.085	24	1.150
5	1.030	15	1.092	25	1.156
6	1.036	16	1.097	26	1.164
7	1.042	17	1.104	27	1.171
8	1.047	18	1.110	28	1.179
9	1.054	19	1.116	29	1.185
10	1.060	20	1.124	30	1.193

(Schiff calculated by Gerlach, Z anal 8  
 280)

Insol in acetone

#### Ammonium ferric sulphate, basic

Extremely difficultly sol in  $\text{HCl} + \text{Aq}$  Not  
 decomp by  $\text{KOH} + \text{Aq}$  (Berzelius)  
 $5(\text{NH}_4)_2\text{O}, 3\text{Fe}_2\text{O}_3, 12\text{SO}_3 + 18\text{H}_2\text{O}$  or  
 $2(\text{NH}_4)_3\text{O}, \text{Fe}_2\text{O}_3, 4\text{SO}_3 + 4\text{H}_2\text{O}$  Sol in 24  
 pts cold  $\text{H}_2\text{O}$  (Maus, Pogg 11 79)

**Ammonium iron (ferric) sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,**  
 $\text{Fe}_2(\text{SO}_4)_3$

Attacked slowly by cold  $\text{H}_2\text{O}$  (Lachaud  
 and Lepierre)

Nearly insol in  $\text{H}_2\text{O}$  (Weinland, Z anorg  
 1913, 84 363)

$+24\text{H}_2\text{O}$  Iron alum Sol in 3 pts  $\text{H}_2\text{O}$   
 at  $15^\circ$  (Forchhammer, Ann Phil 5 406)

100 cc  $\text{H}_2\text{O}$  dissolve 44.15 g anhydrous, or  
 124.40 g hydrated salt at  $25^\circ$ , or 1.659 g  
 mols anhydrous salt are sol in 1 l  $\text{H}_2\text{O}$  at  
 $25^\circ$  (Locke, Am Ch J 1901, 26 174)

Sp gr of aqueous solution at  $15^\circ$  contain-

5 10 15%  $(\text{NH}_4)_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ ,  
 1.023 1.047 1.071

20 25 30%  $(\text{NH}_4)_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ ,  
 1.096 1.122 1.148

35 40%  $(\text{NH}_4)_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$   
 1.175 1.203

40% solution is sat at 15° (Gerlach, Z anal 28 496)  
 Melts in crystal H<sub>2</sub>O at 40° (Locke)  
 3(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> Insol in cold H<sub>2</sub>O (Lachaud and Lepierre)

**Ammonium iron (ferroferric) sulphate,**  
 4(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, FeSO<sub>4</sub>, Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+3H<sub>2</sub>O  
 Sl sol in cold H<sub>2</sub>O, decomp into basic salt by hot H<sub>2</sub>O, insol in alcohol (Lachaud and Lepierre, C R 114 916)

**Ammonium ferrous magnesium sulphate,**  
 4(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, 3FeSO<sub>4</sub>, MgSO<sub>4</sub>+24H<sub>2</sub>O  
 Sol in H<sub>2</sub>O (Schiff, A 107 64)  
 2(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, FeSO<sub>4</sub>, MgSO<sub>4</sub>+12H<sub>2</sub>O Sol in H<sub>2</sub>O (Vohl, A 94 57)

**Ammonium ferrous manganous sulphate,**  
 2(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, FeSO<sub>4</sub>, MnSO<sub>4</sub>+12H<sub>2</sub>O  
 Sol in H<sub>2</sub>O (Vohl, A 94 57)

**Ammonium ferrous nickel sulphate,**  
 2(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, FeSO<sub>4</sub>, NiSO<sub>4</sub>+12H<sub>2</sub>O  
 Sol in H<sub>2</sub>O (Vohl, A 94 57)

**Ammonium ferrous zinc sulphate,**  
 2(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, FeSO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O  
 Sol in H<sub>2</sub>O (Bette, A 14 286)

**Ammonium lanthanum sulphate, (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O**  
 Sl sol in H<sub>2</sub>O (Marignac)  
 Quite sol in H<sub>2</sub>O (Cleve)  
 +2H<sub>2</sub>O (Barre, C R 1910, 151 872)  
 5(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, 2La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> Sl sol in (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq of concentrations above 60% (Barre, A ch 1911, (8) 24 246)  
 5(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> (Barre)

**Ammonium lead sulphate, (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, PbSO<sub>4</sub>**  
 Decomp by H<sub>2</sub>O into its constituents (Wohler and Litton, A 43 126)  
 Decomp by H<sub>2</sub>O Only stable in contact with solutions containing  
 13 86 pts (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> per 100 pts H<sub>2</sub>O at 20°  
 19 25 pts (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> per 100 pts H<sub>2</sub>O at 50°  
 24 31 pts (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> per 100 pts H<sub>2</sub>O at 75°  
 29 42 pts (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> per 100 pts H<sub>2</sub>O at 100°  
 (Barre, C R 1909, 149 294)

**Ammonium lithium sulphate, NH<sub>4</sub>LiSO<sub>4</sub>**  
 Solubility in H<sub>2</sub>O=35 25% at -10°, and 36 18% at 70° (Schreinemakers, C C 1906, I 217)  
 This is the only double salt which (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> forms with Li<sub>2</sub>SO<sub>4</sub> below 100° (Spielrein, C R 1913, 157 48)

**Ammonium magnesium sulphate,**  
 (NH<sub>4</sub>)<sub>2</sub>Mg(SO<sub>4</sub>)<sub>2</sub>+6H<sub>2</sub>O  
 100 pts H<sub>2</sub>O dissolve 15 9 pts anhydrous double salt at 13° (Mulder)  
 100 pts H<sub>2</sub>O dissolve at  
 0° 10° 15° 20° 30°  
 9 0 14 2 15 7 17 9 19 1 pts anhydrous salt,  
 45° 50° 55° 60° 75°  
 25 6 30 0 31 9 36 1 45 3 pts anhydrous salt  
 (Tobler, A 96 193)

More sol in H<sub>2</sub>O than (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> or MgSO<sub>4</sub> (Graham)  
 1 l H<sub>2</sub>O dissolves 199 pts anhydrous salt at 25° Tobler's results are inaccurate (Locke, Am Ch J 1902, 27 459)  
 100 g H<sub>2</sub>O dissolve at  
 34° 41° F  
 18 22 20 72 g (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, 6H<sub>2</sub>O  
 50° 59° F  
 22 48 24 08 g (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, 6H<sub>2</sub>O,  
 60° 70° F  
 24 81 28 26 g (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, 6H<sub>2</sub>O,  
 81° F  
 33 33 g (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, 6H<sub>2</sub>O  
 (Lothian, Pharm J 1910, (4) 30 546)

Lothian's results for solubility in H<sub>2</sub>O probably incorrect because of inaccuracy of experimental method (Seidell, Pharm J 1911, (4) 33 846)

Solubility of (NH<sub>4</sub>)<sub>2</sub>Mg(SO<sub>4</sub>)<sub>2</sub> in H<sub>2</sub>O at t°

t	g anhydrous salt p r 100 g	
	solution	H O
0	10 58	11 83
10	12 75	14 61
20	15 23	17 96
25	16 45	19 69
30	17 84	21 71
40	20 51	25 56
50	23 18	30 17
60	26 02	35 17
80	32 58	48 32
100	39 66	65 72

(Porlezza, Att Acc Inc 1914 (5) 23 II, 509)

Min *Cerbohite*

**Ammonium magnesium nickel sulphate,**  
 2(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, NiSO<sub>4</sub>+12H<sub>2</sub>O  
 Sol in H<sub>2</sub>O (Vohl, A 94 57)

**Ammonium magnesium potassium zinc sulphate, 2(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, 3MgSO<sub>4</sub>, 3K<sub>2</sub>SO<sub>4</sub>, 2ZnSO<sub>4</sub>+30H<sub>2</sub>O**  
 Sol in H<sub>2</sub>O (Schiff, A 107 64)  
 (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, 2MgSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+18H<sub>2</sub>O Sol in H<sub>2</sub>O (Schiff)  
 (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O Sol in H<sub>2</sub>O (Schiff)

**Ammonium magnesium zinc sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{MgSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)

**Ammonium manganous sulphate,**  $(\text{NH}_4)_2\text{SO}_4,$   
 $\text{MnSO}_4 + 6\text{H}_2\text{O}$

Deliquescent Easily sol in  $\text{H}_2\text{O}$  (Jahn)  
 1 l  $\text{H}_2\text{O}$  dissolves 372 g anhydrous salt  
 at  $25^\circ$  (Looke, Am Ch J 1902, 27 459)  
 $(\text{NH}_4)_2\text{SO}_4, 2\text{MnSO}_4$  Readily decomp by  
 $\text{H}_2\text{O}$  (Lepierre, C R 1895, 120 924)

**Ammonium manganic sulphate,**  $(\text{NH}_4)_2\text{SO}_4,$   
 $\text{Mn}_2(\text{SO}_4)_3$

Decomp by  $\text{H}_2\text{O}$  Insol in ether,  $\text{C}_6\text{H}_6$ , and  
 conc  $\text{H}_2\text{SO}_4$  Sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Le-  
 pierre, Bull Soc 1895, (3) 13 596)  
 $+24\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Mitscher-  
 lich)

**Ammonium manganous nickel sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{MnSO}_4, \text{NiSO}_4 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)

**Ammonium manganous zinc sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{MnSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Vohl)

**Ammonium mercuric sulphate,**  $(\text{NH}_4)_2\text{SO}_4,$   
 $3\text{Hg}_2\text{SO}_4 + 2\text{H}_2\text{O}$

(Hirzel, J B 1850 333)  
 $(\text{NH}_4)_2\text{SO}_4, \text{Hg}_2\text{SO}_4$  Difficultly sol in  
 $\text{H}_2\text{O}$  Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$

**Ammonium mercurous sulphate ammonia,**  
 $3\text{Hg}_2\text{O}, 2(\text{NH}_4)_2\text{HgSO}_4, 2\text{NH}_3$

Insol in hot or cold, dil or conc  $\text{H}_2\text{SO}_4$   
 and  $\text{HNO}_3$  Sol in  $\text{HCl}$  (Tarugi, Gazz  
 ch it 1903, 33 (1) 131)

**Ammonium nickel sulphate,**  $(\text{NH}_4)_2\text{SO}_4,$   
 $\text{NiSO}_4 + 6\text{H}_2\text{O}$

Sol in 4 pts cold  $\text{H}_2\text{O}$  (Link 1796)  
 100 pts  $\text{H}_2\text{O}$  dissolve at  
 $3^\circ 5^\circ 10^\circ 16^\circ 20^\circ 30^\circ$   
 18 3.2 5.8 5.9 8.3 pts anhydrous salt,  
 $40^\circ 50^\circ 59^\circ 68^\circ 85^\circ$   
 11.5 14.4 16.7 18.5 28.6 pts anhydrous salt  
 (Iobler, A 95 193)

100 pts sat solution contain at  $20^\circ$ , 9.4,  
 at  $40^\circ$ , 13.2, at  $60^\circ$ , 18.6, at  $80^\circ$ , 23.1 pts  
 anhydrous salt (v Huur, J pr 74 433)

1 l  $\text{H}_2\text{O}$  dissolves 75.7 g anhydrous salt  
 at  $25^\circ$  (Locke, Am Ch J 1902, 27 459)  
 Nearly insol in a weak acid solution of  
 $(\text{NH}_4)_2\text{SO}_4$  (Thompson, C C 1863 957)

**Ammonium nickel zinc sulphate,**  $2(\text{NH}_4)_2\text{SO}_4,$   
 $\text{NiSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)

**Ammonium nickel sulphate ammonia,**  
 $(\text{NH}_4)_2\text{SO}_4, \text{NiSO}_4, 6\text{NH}_3 + 3\text{H}_2\text{O}$   
 (André, C R 106 936)

**Ammonium platonic sulphate,**  $2(\text{NH}_4)_2\text{SO}_4,$   
 $\text{Pt}_2(\text{SO}_4)_3 + 25\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Prost, Bull Soc (2) 46 156)

**Ammonium potassium sulphate,**  $(\text{NH}_4)_2\text{SO}_4,$   
 $\text{K}_2\text{SO}_4 + 4\text{H}_2\text{O}$

Soluble in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  at  $16^\circ$  dis-  
 solve 13.68 pts salt (Thomson, 1831)  
 Min Taylorite

**Ammonium praseodymium sulphate,**  
 $(\text{NH}_4)_2\text{SO}_4, \text{Pr}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (von Scheele, Z anorg  
 1898, 18 359)

**Ammonium rhodium sulphate,**  
 $(\text{NH}_4)_2\text{SO}_4, \text{Rh}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$

Very sol  $\text{H}_2\text{O}$ , melts in crystal  $\text{H}_2\text{O}$  at  
 $102-103^\circ$  (Piccini, Z anorg 1901, 27 67)

**Ammonium samarium sulphate,**  $(\text{NH}_4)_2\text{SO}_4,$   
 $\text{Sm}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Cleve, Bull Soc (2) 43  
 166)

**Ammonium scandium sulphate,**  $(\text{NH}_4)_2\text{SO}_4,$   
 $\text{Sc}_2(\text{SO}_4)_3$

Sol in  $\text{H}_2\text{O}$  (Cleve)  
 Sol in  $\text{H}_2\text{O}$  and in dil  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$   
 (R J Meyer, Z anorg 1914, 86 279)

**Ammonium sodium sulphate,**  $\text{NH}_4\text{NaSO}_4 +$   
 $2\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve 46.6 pts of cryst salt  
 at  $15^\circ$ , and the solution has a sp gr of 1.1749  
 Sp gr of aqueous solution containing  
 $31.8 \quad 24.44 \quad 15.9\%$   $\text{NH}_4\text{NaSO}_4 + 2\text{H}_2\text{O}$ ,  
 1.1749 1.1380 1.0849

$12.72 \quad 6.36 \quad \%$   $\text{NH}_4\text{NaSO}_4 + 2\text{H}_2\text{O}$   
 1.0679 1.0337

(Schiiff, A 114 68)

**Ammonium strontium sulphate**

Insol in excess of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (Rose,  
 Pogg 110 296)

$(\text{NH}_4)_2\text{SO}_4, \text{SrSO}_4$  This double salt is  
 only stable in contact with nearly sat solu-  
 tions of  $(\text{NH}_4)_2\text{SO}_4$  (Barre, C R 1909, 149  
 293)

**Ammonium tellurium sulphate,**  
 $(\text{NH}_4)\text{HSO}_4, 2\text{TeO}_2, \text{SO}_3 + 2\text{H}_2\text{O}$

As K salt (Metzner, A ch 1898, (7)  
 15 203)

**Ammonium thallic sulphate,**  $\text{NH}_4\text{Ti}(\text{SO}_4)_2$

(Marshall, C C 1902, II 1089)  
 $+4\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  Easily sol  
 in dil acids (Fortini, Gazz ch it 1905, 35  
 (2) 450)



**Ammonium thorium sulphate**,  $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2$

Easily sol in  $\text{H}_2\text{O}$  and sat  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (Cleve)  
 $+2\text{H}_2\text{O}$  (Barre)  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$  (Barre, A ch 1911, (8) 24 240)  
 $3(\text{NH}_4)_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$  (B)

**Ammonium titanium sulphate**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{TiO}_3 \cdot \text{SO}_4 + \text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  with decomp  
 Insol in conc  $\text{H}_2\text{SO}_4$  (Rosenheim, Z anorg 1901, 26 252)  
 $(\text{NH}_4)_2\text{O} \cdot 2\text{TiO}_2 \cdot 2\text{SO}_3 + 3\text{H}_2\text{O}$  Slowly decomp by  $\text{H}_2\text{O}$  (Blondel, Bull Soc 1899, (3) 21 262)

**Ammonium titanium sesquisulphate**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot 3\text{Ti}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HCl}$   
 Insol in  $\text{H}_2\text{SO}_4$  Decomp by boiling with conc  $\text{H}_2\text{SO}_4$  (Stahler, B 1905, 38 2623)

**Ammonium uranous sulphate**,  $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{U}(\text{SO}_4)_2$

Easily sol in  $\text{H}_2\text{O}$  (Rammelsberg)  
 Sol in  $\text{H}_2\text{O}$  but solution rapidly decomp (Kohlschutter, B 1901, 34 3630)

**Ammonium uranyl sulphate**,  $(\text{NH}_4)_2\text{SO}_4 \cdot (\text{UO}_2)\text{SO}_4 + 2\text{H}_2\text{O}$

Quite difficultly sol in  $\text{H}_2\text{O}$  (Arfvedson)

**Ammonium vanadous sulphate**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{VSO}_4 + 6\text{H}_2\text{O}$

Decomp in the air  
 Sol in  $\text{H}_2\text{O}$  (Piccini, Z anorg 1899, 19 205)

Less sol in  $\text{H}_2\text{O}$  than  $\text{VSO}_4 + 7\text{H}_2\text{O}$  (Piccini and Marino, Z anorg 1902, 32 60)

**Ammonium vanadic sulphate**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{V}_2(\text{SO}_4)_3 + 12\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$   
 Insol in  $\text{H}_2\text{SO}_4$  Decomp by boiling with conc  $\text{H}_2\text{SO}_4$

Sol in  $\text{HCl}$  (Stahler, B 1905, 38 3980)  
 $+24\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$ , decomp in the air (Piccini, Z anorg 1896, 11 108)  
 100 pts  $\text{H}_2\text{O}$  dissolve 39.76 pts salt at  $10^\circ$   
 Sp gr of sat solution at  $4/20^\circ = 1.687$  (Piccini, Z anorg 1897, 13 446)

1 l  $\text{H}_2\text{O}$  dissolves 31.69 g anhydrous or 78.51 g hydrated salt at  $25^\circ$ , or 1.210 g mols anhydrous salt are sol in 1 l  $\text{H}_2\text{O}$  at  $25^\circ$   
 Mpt of crystals  $= 45^\circ$  (Locke, Am Ch J 1901, 26 175)

**Ammonium vanadyl sulphate**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{VO}(\text{SO}_4) + 3\frac{1}{2}\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  and in a mixture of a lcohol and conc  $\text{H}_2\text{SO}_4$ , but cannot be recryst therefrom (Koppel and Behrendt, Z anorg 1903, 35 176)

$(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{VOSO}_4 + \text{H}_2\text{O}$  Deliquescent  
 Slowly but abundantly sol in  $\text{H}_2\text{O}$ , but cannot be recryst from it except by addition of  $\text{H}_2\text{SO}_4$  (Koppel and Behrendt, Z anorg 1903, 35 172)

**Ammonium yttrium sulphate**,  $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{Y}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Cleve)

**Ammonium zinc sulphate**,  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{ZnSO}_4 + 6\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve pts  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{ZnSO}_4$  at

$0^\circ$	$10^\circ$	$13^\circ$	$15^\circ$	$20^\circ$
7 3	8 8	10 0	12 5	12 6 pts salt,
$30^\circ$	$45^\circ$	$60^\circ$	$75^\circ$	$85^\circ$
16 5	21 7	29 7	37 8	46 2 pts salt

(Tobler, A 95 193)

1 l  $\text{H}_2\text{O}$  dissolves 140.8 g anhydrous salt at  $25^\circ$  (Locke, Am Ch J 1902, 27 459)  
 $+7\text{H}_2\text{O}$  (André, C R 104 987)

**Ammonium zirconium sulphate**

Sol in cold or hot  $\text{H}_2\text{O}$  or in acids (Berzelius)

**Ammonium sulphate antimony fluoride**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{SbF}_3$

Very sol in  $\text{H}_2\text{O}$  (Mayer, B 1894, 27 R 922)

**Ammonium sulphate chromic chloride**,  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CrCl}_3 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Weinland, B 1907, 40 3768)

**Ammonium sulphate hydrogen peroxide**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{H}_2\text{O}_2$

Efflorescent in air  
 Easily sol in  $\text{H}_2\text{O}$  (Willstatter, B 1903, 36 1829)

**Antimony sulphate basic**,  $7\text{Sb}_2\text{O}_3 \cdot 2\text{SO}_3 + 3\text{H}_2\text{O}$

Insol in, and not decomp by hot or cold  $\text{H}_2\text{O}$  (Adie, Chem Soc 57 540)

$5\text{Sb}_2\text{O}_3 \cdot 2\text{SO}_3 + 7\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Hensgen, R t c 4 401)

$2\text{Sb}_2\text{O}_3 \cdot \text{SO}_3 + r\text{H}_2\text{O}$  Not decomp by cold  $\text{H}_2\text{O}$  (Adie)

$\text{Sb}_2\text{O}_3 \cdot \text{SO}_3 = (\text{SbO})_2\text{SO}_4$  Decomp by hot  $\text{H}_2\text{O}$  (Peligot, J B 1847 426)

$+ \text{H}_2\text{O}$  As above (Adie)  
 $\text{Sb}_2\text{O}_3 \cdot 2\text{SO}_3$ , and  $+ \text{H}_2\text{O}$ , and  $+ 2\text{H}_2\text{O}$   
 Scarcely decomp by cold, slowly by boiling  $\text{H}_2\text{O}$  Slowly sol in dil  $\text{HCl} + \text{Aq}$  (Adie)

**Antimony sulphate**,  $\text{Sb}_2(\text{SO}_4)_3$

Very deliquescent Combines with  $\text{H}_2\text{O}$  to a hard mass with evolution of heat, with more  $\text{H}_2\text{O}$  it becomes liquid, and by repeated treat-

ment with much boiling  $\text{H}_2\text{O}$  it is wholly decomp into  $\text{H}_2\text{SO}_4$  and  $\text{Sb}_2\text{O}_3$  (Hensgen, R t c 4 401)

**Antimony sulphate, acid,  $\text{Sb}_2\text{O}_3, 4\text{SO}_3$ ,**

Decomp by  $\text{H}_2\text{O}$  (Adie)  
 $\text{Sb}_2\text{O}_3 + 8$ , or  $9\text{SO}_3$  Decomp by  $\text{H}_2\text{O}$  (Adie)

**Antimony barium sulphate,**  
 $\text{Sb}_2(\text{SO}_4)_3, \text{BaSO}_4 + 6\text{H}_2\text{O}$

As Ca comp (Kuhl, Z anorg 1907, 54 257)

**Antimony caesium sulphate,  $\text{SbCs}(\text{SO}_4)_2$**

Slowly decomp by cold  $\text{H}_2\text{O}$  (Gutman, Arch Pharm 1908, 246 188)

**Antimony calcium sulphate,**  
 $\text{Sb}_2(\text{SO}_4)_3, \text{CaSO}_4 + 6\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Kuhl, Z anorg 1907, 54 257)

**Antimony lithium sulphate,  $\text{SbLi}(\text{SO}_4)_2$**

Decomp by  $\text{H}_2\text{O}$  (Gutman, Arch Pharm 1908, 246 187)

**Antimony potassium sulphate,  $\text{KSb}(\text{SO}_4)_2$**

Decomp by  $\text{H}_2\text{O}$  (Gutmann, Arch Pharm 1898, 236 478)

**Antimony rubidium sulphate,  $\text{SbRb}(\text{SO}_4)_2$**

Slowly decomp by cold  $\text{H}_2\text{O}$  (Gutman)

**Antimony silver sulphate,  $\text{SbAg}(\text{SO}_4)$**

Slowly decomp by  $\text{H}_2\text{O}$  (Kuhl, Z anorg 1907, 54 258)

Slowly decomp by cold  $\text{H}_2\text{O}$  (Gutman Arch Pharm 1908 246 189)

**Antimony sodium sulphate,  $\text{NaSb}(\text{SO}_4)_2$**

Slowly decomp by  $\text{H}_2\text{O}$  (Gutmann, Arch Pharm 1898 236 178)

**Antimony strontium sulphate,  $\text{Sb}(\text{SO}_4)_3$ ,  
 $\text{SrSO}_4 + 6\text{H}_2\text{O}$**

As Ca comp (Kuhl, Z anorg 1907, 54 257)

**Antimony thallium sulphate,  $\text{SbTl}(\text{SO}_4)_2$**

Slowly decomp by cold  $\text{H}_2\text{O}$  Decomp by conc  $\text{H}_2\text{SO}_4$  (Gutman Arch Pharm 1908, 246 189)

**Arsenic sulphate**

See Arsenic sulphur dioxide

**Barium sulphate,  $\text{BaSO}_4$**

Sol in 4,000 pt  $\text{H}_2\text{O}$  (Kierwan) in 200,000 pts  $\text{H}_2\text{O}$  (Marquardt, C k 38 08)  
 100 pts  $\text{H}_2\text{O}$  dissolves 0.002 pt  $\text{BaSO}_4$  (Ure's Dict)

$\text{BaCl}_2 + \text{Aq}$  containing 1 pt  $\text{BaO}$  to 71,000 pts  $\text{H}_2\text{O}$  when treated with  $\text{H}_2\text{SO}_4$  becomes turbid in  $\frac{1}{2}$  hour (Harting, J pr 22 52)

$\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  containing 1 pt  $\text{BaO}$  to 25,000 pts  $\text{H}_2\text{O}$  gives a distinct cloud with  $\text{H}_2\text{SO}_4$  or  $\text{Na}_2\text{SO}_4 + \text{Aq}$  with 50,000–100,000 pts  $\text{H}_2\text{O}$  a slight turbidity is produced with 200,000–400,000 pts  $\text{H}_2\text{O}$  the mixture becomes turbid in a few minutes while with 800,000 pts  $\text{H}_2\text{O}$  no action is visible (Lassaigne, J Chim Méd 8 526)

Sol in 800,000 pts  $\text{H}_2\text{O}$  (Calvert), in 400,000 pts cold or hot  $\text{H}_2\text{O}$  (Fresenius)

Calculated from the electrical conductivity of the solution,  $\text{BaSO}_4$  is sol in 429,700 pts  $\text{H}_2\text{O}$  at  $18.4^\circ$ , and 320,000 pts at  $37.7^\circ$  (Holleman, Z phys Ch 12 131)

1 l  $\text{H}_2\text{O}$  dissolves 1.72 mg at  $2^\circ$ , 1.97 mg at  $10^\circ$ , 2.29 mg at  $19.0^\circ$ , 2.60 mg at  $26^\circ$ , 2.91 mg at  $34^\circ$  (Kohlrausch and Rose, Z phys Ch 12 241)

Calculated from the electrical conductivity of the solution,  $\text{BaSO}_4$  is sol in 425,000 pts  $\text{H}_2\text{O}$  at  $18.3^\circ$  Results of Fresenius and Hintz (Z anal 1896, 35 170) are incorrect (Kuster, Z anorg 1896, 12 267)

Sat aq solution contains 2.29 mg  $\text{BaSO}_4$  per liter at  $25^\circ$  when particles of salt are not less than  $1.8\mu$  in diameter

Sat aq solution contains 4.15 mg  $\text{BaSO}_4$  per liter at  $25^\circ$  when particles of salt are  $0.1\mu$  in diameter ( $\mu = 0.0001 \text{ cm}$ ) (Hulett, Z phys Ch 1901, 37 398–9)

In general the influence of the size of the grain on the solubility of the substance is negligible when the solubility exceeds 2%. The increase of normal solubility by using finely divided solids, amounts to 80% in the case of  $\text{BaSO}_4$  (Hulett, Z phys Ch 1904, 47 366)

1 l  $\text{H}_2\text{O}$  dissolves 2.3 mg  $\text{BaSO}_4$  at  $18^\circ$  (Kohlrausch, Z phys Ch 1904, 50 356)

Calculated from electrical conductivity of  $\text{BaSO}_4 + \text{Aq}$

0.0190 milli-equivalents are sol in 1 liter  $\text{H}_2\text{O}$  at  $15^\circ$ , 0.0212 at  $25^\circ$ , 0.0255 at  $50^\circ$ , 0.0334 at  $100^\circ$

(McLeher, J Am Chem Soc 1910, 32 55)

Not attacked by cold  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  after several hours, and only in traces after several days. On boiling, traces of  $\text{BaSO}_4$  dissolve, and the liquid after cooling can be precipitated by  $\text{BaCl}_2$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but not by  $\text{H}_2\text{O}$  alone (Rose, Pogg 95 108)

By washing  $\text{BaSO}_4$  with  $\text{H}_2\text{O}$  or  $\text{HCl}$  or  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$  (Siegler), it can be precipitated by  $\text{H}_2\text{SO}_4$  or  $\text{BaCl}_2$  (Perrin, J B 1856 334)

1000 pts 3%  $\text{HCl} + \text{Aq}$  dissolve 0.06 pt  $\text{BaSO}_4$  in the cold, and still more on boiling

230 cc  $\text{HCl} + \text{Aq}$  of 1.02 sp gr dissolve 0.048 g  $\text{BaSO}_4$  from 0.679 g  $\text{BaSO}_4$  when boiled  $\frac{1}{4}$  hour

165 cc  $\text{HCl} + \text{Aq}$  of 1.03 sp gr dissolve 0.0075 g  $\text{BaSO}_4$  from 0.577 g  $\text{BaSO}_4$  when boiled 5 minutes (Siegler, J pr 69 142)

Solubility of  $\text{BaSO}_4$  in  $\text{HCl} + \text{Aq}$ 

No cc $\text{HCl} + \text{Aq}$ containing 1 mg equiv $\text{HCl}$	Mg $\text{BaSO}_4$ per 1 mg equiv of $\text{HCl}$	g per 100 cc solution	
		$\text{HCl}$	$\text{BaSO}_4$
2 0	0 133	1 82	0 0067
1 0	0 089	3 65	0 0089
0 5	0 056	7 29	0 0101
0 2	0 017	18 23	0 0086

(Banthusch, J pr 1884, 29 54)

100,000 pts  $\text{H}_2\text{O}$  dissolve 0 124 pt  $\text{BaSO}_4$ ,  
1000 pts  $\text{HNO}_3 + \text{Aq}$  of 1 167 sp gr dissolve  
2 pts  $\text{BaSO}_4$ , 1000 pts  $\text{HNO}_3 + \text{Aq}$  of 1 032  
sp gr dissolve 0 062 pt  $\text{BaSO}_4$  (Calvert,  
Chem Gaz 1856 55)

When 0 4 g  $\text{BaSO}_4$  is heated  $\frac{1}{4}$  hour with  
150 ccm  $\text{HNO}_3 + \text{Aq}$  of 1 02 sp gr, 0 165 g  
is dissolved (Siegle, J pr 69 142)

Solubility of  $\text{BaSO}_4$  in  $\text{HNO}_3 + \text{Aq}$ 

No cc $\text{HNO}_3 + \text{Aq}$ containing 1 mg equiv $\text{HNO}_3$	Mg $\text{BaSO}_4$ per 1 mg equiv of $\text{BaSO}_4$	G per 100 cc solution	
		$\text{HNO}_3$	$\text{BaSO}_4$
2 0	0 140	3 15	0 0070
1 0	0 107	6 31	0 0107
0 5	0 085	12 61	0 0170
0 2	0 048	31 52	0 0241

1884, 29 54)

ac acid has less solvent power than  
the acids 80 ccm  $\text{HCl} + \text{H}_2\text{O} + \text{Aq}$  of 1 02  
sp gr boiled with 0 4 g  $\text{BaSO}_4$   $\frac{1}{4}$  hour dis-  
solve 0 002 g (Siegle, J pr 69 142)

Sol in boiling conc  $\text{H}_2\text{SO}_4$  (See  
 $\text{BaH}_2(\text{SO}_4)_2$ )

Sol in fuming  $\text{H}_2\text{SO}_4$  (See  $\text{BaS}_2\text{O}_7$ )

Sol in 2500 pts boiling 40%  $\text{HBr} + \text{Aq}$ , in  
6000 pts boiling 40%  $\text{HI} + \text{Aq}$  (Haslam,  
C N 53 87)

Sol in considerable amount in metaphos-  
phoric acid +  $\text{Aq}$  (Scheerer and Drechsel,  
J pr (2) 7 68)

Not attacked by boiling conc  $\text{KOH} + \text{Aq}$  if  
 $\text{CO}_2$  is not present (Rose, Pogg 95 104)

Very sl decomp by standing a long time  
with cold conc alkali carbonates +  $\text{Aq}$

Decomp by boiling  $\text{Na}_2\text{CO}_3$  or  $\text{K}_2\text{CO}_3 +$   
 $\text{Aq}$ , not by  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (See Storer's  
Dict for analytical data)

Very sl sol in  $\text{NH}_4\text{Cl} + \text{Aq}$ , 1 pt dissolv-  
ing in 230,000 pts sat  $\text{NH}_4\text{Cl} + \text{Aq}$

500 ccm sat  $\text{NH}_4\text{NO}_3 + \text{Aq}$  with 50 ccm  
sat  $\text{NH}_4\text{Cl} + \text{Aq}$  dissolve 2 g  $\text{BaSO}_4$ , 100  
ccm sat  $\text{NH}_4\text{NO}_3 + \text{Aq}$  with 100 ccm sat  
 $\text{NH}_4\text{Cl} + \text{Aq}$  dissolve only 0 08 g  $\text{BaSO}_4$ ,  
therefore above solubility is due to free  
chlorine (Mittentzwey, J pr 75 214)

$\text{BaSO}_4$  cannot be precipitated from solu-  
tions containing free  $\text{Cl}_2$  (Erdmann, J pr  
75 215)

Pptn is retarded sl by tartaric and racemic  
acids (Spiller)

$\text{Na}$  metaphosphate prevents pptn of  $\text{BaSO}_4$ ,  
but not ortho- or pyrophosphate (Scheerer,  
J pr 75 114)

Not precipitated in presence of alkali ci-  
trates (Spiller)

Much less sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  than in  
 $\text{NH}_4\text{NO}_3 + \text{Aq}$  Insol in warm conc  $\text{Na}_2\text{S}_2\text{O}_3$   
+  $\text{Aq}$  (Diehl, J pr 79 431)

Not appreciably sol in  $\text{H}_2\text{O}$  containing  
ammonium or sodium chloride (Brett, Witt-  
stein, Wackenroder)

Not appreciably sol in  $\text{H}_2\text{O}$  at  $250^\circ$ , or in  
 $\text{H}_2\text{O}$  containing  $\text{Na}_2\text{S}$  (Senarmont)

Solubility is increased by alkali nitrates,  
but not appreciably by  $\text{NaCl}$ ,  $\text{KClO}_3$ , or  
 $\text{Ba}(\text{NO}_3)_2$  (Fresenius, Z anal 9 52)  
Scarcely sol in boiling conc  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$   
(Fresenius)

Solubility in  $\text{H}_2\text{O}$  increased by presence of  
 $\text{MgCl}_2$  (Fresenius), cerium salts (Marignac)

Sol in  $\text{Fe}_2\text{Cl}_6 + \text{Aq}$  (Lunge, Z anal 19  
141)

Solubility in various salts +  $\text{Aq}$  at  $20-25^\circ$ 

g salt per l	Mg $\text{BaSO}_4$ dissolved per l in		
	$\text{FeCl}_3$	$\text{AlCl}_3$	$\text{MgCl}_2$
1	58	33	30
2 5	72	43	30
5	115	60	33
10	123	64	33
25	150	116	50
50	160	170	50
100	170	175	50

(Fraps, Am Ch J 1902 27 290)

Solubility in sat solution of various salts +  
 $\text{Aq}$ 

Salt	C $\text{BaSO}_4$ sol in 1 l of the solvent
$\text{NaNO}_3$	0 2940
$\text{NaCl}$	0 00753
$\text{NH}_4\text{Cl}$	0 00827

(Ehlert, Z Elektrochem 1912 18 725)

Conc  $\text{CrCl}_3 + \text{Aq}$  dissolves 40-120 times  
as much  $\text{BaSO}_4$  as  $\text{H}_2\text{O}$ , when boiled there-  
with for 5 days, conc  $\text{CrCl}_3 + \text{Aq}$  acidified  
with  $\text{HCl}$  450 times as much in 10 days  
(Kuster, Z anorg 1905, 43 345)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch  
J 1898, 20 827)

Sol in  $\text{H}_2\text{O}_2 + \text{Aq}$  (Grawalowski, C C  
1906, II 7)

100 cc 95% formic acid dissolve 0 01 g  
 $\text{BaSO}_4$  at  $18.5^\circ$  (Aschun Ch Ztg 1913 37  
1117)

Insol in methyl acetate (Naumann, B  
1909, 42 3790), in ethyl acetate (Naumann,  
B 1904, 37 3601)

Min Barite

**Barium hydrogen sulphate,  $\text{BaH}_2(\text{SO}_4)_2$** 

100 pts  $\text{H}_2\text{SO}_4$  dissolve 222 pts  $\text{BaSO}_4$  (Lies-Bodart and Jacquemin, C R 46 1206), 569 pts  $\text{BaSO}_4$  (Struve, Z anal 9 31)

Boiling  $\text{H}_2\text{SO}_4$  dissolves 10–12% freshly precipitated  $\text{BaSO}_4$  without separating crystals on cooling  $\text{H}_2\text{SO}_4$  at  $100^\circ$  dissolves more than boiling  $\text{H}_2\text{SO}_4$ , and becomes cloudy if heated to boiling (Schultz, Pogg 133 146)

1 g  $\text{BaSO}_4$  pptd from  $\text{BaCl}_2$  is sol in 3153 g 91%  $\text{H}_2\text{SO}_4$ , from  $\text{Ba}(\text{NO}_3)_2$  is sol in 1519 g 91%  $\text{H}_2\text{SO}_4$  (Varenne and Pauleau, C R 93 1016)

100 pts hot conc  $\text{H}_2\text{SO}_4$  dissolve approx 6 pts  $\text{BaSO}_4$  (Rohland, Z anorg 1910, 66 206)

10 ccm of sat  $\text{BaSO}_4$ +absolute  $\text{H}_2\text{SO}_4$  contain approx 2851 g  $\text{BaSO}_4$  (Bergius, Z phys Ch 1910, 72 355)

**Equilibrium in the system  $\text{BaSO}_4 + \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$  at  $25^\circ$**

Composition of the solution

% $\text{H}_2\text{SO}_4$	g $\text{BaSO}_4$ per l	Solid phase
73.83	0.030	$\text{BaSO}_4$
78.04	0.135	"
80.54	0.285	"
83.10	0.800	"
85.78	3.215	$\text{BaSO}_4, 2\text{H}_2\text{SO}_4$
88.08	12.200	"
93.17	49.665	$\text{BaSO}_4, \text{H}_2\text{SO}_4$

Volkhonski, C C 1910, I 1954, C A 1911 617)

Decomp by  $\text{H}_2\text{O}$ , alcohol, or ether

+2 $\text{H}_2\text{O}$  (Schultz)

$\text{BaSO}_4, 2\text{H}_2\text{SO}_4 + \text{H}_2\text{O}$  (Volkhonski)

**Barium pyrosulphate,  $\text{Ba}_2\text{S}_2\text{O}_7$** 

100 pts fuming  $\text{H}_2\text{SO}_4$  dissolve 1589 pts  $\text{Ba}_2\text{S}_2\text{O}_7$  (Struve, Z anal 9 34)

Very deliquescent

Decomp with  $\text{H}_2\text{O}$  with hissing (Schultz-Hack, B 4 111)

**Barium calcium sulphate,  $3\text{BaSO}_4, \text{CaSO}_4$** 

Min *Draculite*

**Barium platonic sulphate (?)**

Insol in  $\text{H}_2\text{O}$ , boiling  $\text{HCl}$  or  $\text{HNO}_3$  (Al) Sol in conc  $\text{H}_2\text{SO}_4$  (Jacquemin, D Davy)

**Barium tin (stannic) sulphate,  $\text{Ba}_2\text{SnO}_4, \text{Sn}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  Insol in  $\text{HCl}$  (Weinland and Kuhl, Z anorg 1907, 54 249)

**Barium titanium sulphate,  $2\text{BaSO}_4, 3\text{Ti}(\text{SO}_4)_2$** 

Ppt Decomp by  $\text{H}_2\text{O}$ , giving titanic acid (Weinland, Z anorg 1907, 54 255)

**Barium sulphate potassium chloride,  $3\text{BaSO}_4, \text{KCl}$** 

Ppt (Silberberger, M 1904, 25 233)

**Bismuth sulphate, basic,  $(\text{BiO})_2\text{SO}_4$** 

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$

+2 $\text{H}_2\text{O}$  (Heintz, Pogg 63 55)

4 $\text{Bi}_2\text{O}_3, 3\text{SO}_3 + 15\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Leist)

$(\text{BiO})\text{HSO}_4 + \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$

+2 $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  with separation of  $(\text{BiO})_2\text{SO}_4 + 2\text{H}_2\text{O}$  (Heintz)

3 $\text{Bi}_2\text{O}_3, 2\text{SO}_3 + 2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Athanasesco, C R 103 271)

5 $\text{Bi}_2\text{O}_3, 11\text{SO}_3 + 17\text{H}_2\text{O}$  This sulphate crystallizes out from sulphuric acid of any strength between  $\text{H}_2\text{SO}_4, 6\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4, 12\text{H}_2\text{O}$  (Adie, Proc Chem Soc 1899, 15 226)

$\text{Bi}_2\text{O}_3, 2\text{SO}_3, 2\frac{1}{2}\text{H}_2\text{O}$  is in equilibrium at  $50^\circ$  with 54–51.4%  $\text{H}_2\text{SO}_4 + \text{Aq}$

$\text{Bi}_2\text{O}_3, \text{SO}_3$  is in equilibrium at  $50^\circ$  with acid solutions weaker than 5.4%  $\text{H}_2\text{SO}_4$

(Allan, Am Ch J 1902, 27 287)

**Bismuth sulphate,  $\text{Bi}_2(\text{SO}_4)_3$** 

Very hygroscopic Takes up  $\text{H}_2\text{O}$  with strong evolution of heat to form  $2\text{Bi}_2(\text{SO}_4)_3 + 7\text{H}_2\text{O}$ , which becomes  $\text{Bi}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$  at  $100^\circ$  Decomp by boiling  $\text{H}_2\text{O}$  into  $\text{Bi}_2\text{O}_3, \text{SO}_3 + \text{H}_2\text{O}$  (Hensgen, J B 1885 552)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

**Bismuth sulphate, acid,  $\text{Bi}_2\text{O}_3, 4\text{SO}_3$** 

$\text{Bi}_2\text{O}_3, 4\text{SO}_3$  is in equilibrium at  $50^\circ$  with 51.4–90%  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Allan, Am Ch J 1902, 27 287)

+ $\text{H}_2\text{O}$  Crystallizes out from sulphuric acid at temp above  $170^\circ$  (Adie, Proc Chem Soc 1899, 15 226)

+3 $\text{H}_2\text{O}$  Crystallizes from sulphuric acid of any strength between  $\text{H}_2\text{SO}_4, \text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4, 2\text{H}_2\text{O}$  (Adie)

+7, or 9 $\text{H}_2\text{O} = \text{BiH}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Easily sol in acids, especially  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$  (Leist A 160 29)

+7 $\text{H}_2\text{O}$  Crystallizes out from sulphuric acid of any strength between  $\text{H}_2\text{SO}_4, 3\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4, 5\text{H}_2\text{O}$

+10 $\text{H}_2\text{O}$  Crystallizes out from sulphuric acid at temp below  $170^\circ$  (Adie)

**Bismuth potassium sulphate,  $\text{Bi}(\text{SO}_4)_3, 3\text{K}_2\text{SO}_4$  (?)**

Decomp by  $\text{H}_2\text{O}$ , insol in sat  $\text{K}_2\text{SO}_4 + \text{Aq}$  (Heintz)

$\text{Bi}_2(\text{SO}_4)_3, 2\text{K}_2\text{SO}_4$

$\text{BiK}(\text{SO}_4)_2 = \text{Bi}_2(\text{SO}_4)_3, \text{K}_2\text{SO}_4$  Insol in cold  $\text{H}_2\text{O}$ , decomp by boiling (Brighun, Am Ch J 14 170)

**Bismuth sodium sulphate**,  $\text{Bi}_4\text{Na}_6(\text{SO}_4)_9$   
(Ludecke, A 140 277)

**Boron sulphate**

See Borosulphuric acid

**Bromomolybdenum sulphate**

See under Bromomolybdenum compounds

**Cadmium sulphate, basic**,  $2\text{CdO}$ ,  $\text{SO}_3$ , and  $+\text{H}_2\text{O}$

Difficultly sol in  $\text{H}_2\text{O}$  (Stromeyer) SI  
sol in hot  $\text{H}_2\text{O}$  (Habermann, M 5 432)  
 $4\text{CdO}$ ,  $\text{SO}_3$  (Pickering, Chem Soc 1907,  
91 1987)

**Cadmium sulphate**,  $\text{CdSO}_4$

Sat  $\text{CdSO}_4 + \text{Aq}$  contains at

0°	10°	24°	30°	65°
35.9	37.5	41.5	42.0	49.7% $\text{CdSO}_4$
86°	94°	130°	165°	188° 200°
43.5	91.6	27.7	14.7	7.1 2.3% $\text{CdSO}_4$

$\text{CdSO}_4$  easily forms supersat solutions  
(Etard, A ch 1894, (7) 2 552)

Solubility in  $\text{H}_2\text{O}$

t°	Per cent $\text{CdSO}_4$ in sat solution	Solid phase
-18	43.35	Ice
-10	43.27	
0	43.01	
+10	43.18	
15	43.20	$\text{CdSO}_4 \cdot \frac{8}{3}\text{H}_2\text{O}$
20	43.37	
30	43.75	
40	43.99	
60	44.99	
62	45.06	
72	46.2	
73.5	46.6	
74.5	46.7	
75	46.5	$\text{CdSO}_4 \cdot \text{H}_2\text{O}$
77	42.2	
78.5	41.5	
85	39.6	
90	38.7	
95	38.1	
100	37.8	

(Mylius and Funk, B 1897, 30 825)

See also under  $\text{CdSO}_4 + 2\frac{2}{3}\text{H}_2\text{O}$ , and  $7\text{H}_2\text{O}$

Sp gr at  $0^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing  
14.0 g  $\text{CdSO}_4$  in 1000 g  $\text{H}_2\text{O} = 1.0122$

Sp gr at  $12^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing  
14.0 g  $\text{CdSO}_4$  in 100 g  $\text{H}_2\text{O} = 1.0121$

Sp gr at  $12^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing  
57.2 g  $\text{CdSO}_4$  in 1000 g  $\text{H}_2\text{O} = 1.0514$

Sp gr at  $0^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing  
183.1 g  $\text{CdSO}_4$  in 1000 g  $\text{H}_2\text{O} = 1.1552$

Sp gr at  $13^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing  
183.1 g  $\text{CdSO}_4$  in 1000 g  $\text{H}_2\text{O} = 1.1529$

(Fouqué, Ann Observ 1868, 9 172)

Sp gr of  $\text{CdSO}_4 + \text{Aq}$  at  $18^\circ$

% $\text{CdSO}_4$	1	5	10	15
Sp gr	1.0084	1.0486	1.1026	1.1607
% $\text{CdSO}_4$	20	25	30	35
Sp gr	1.2245	1.295	1.3725	1.4575
% $\text{CdSO}_4$	36			
Sp gr	1.4743			

(Grottrian, W Ann 1883, 18 193)

Sp gr of  $\text{CdSO}_4 + \text{Aq}$  at room temp containing

7.14	14.66	22.011% $\text{CdSO}_4$
1.0681	1.1591	1.2681

(Wagner, W Ann 1883, 18 268)

Sp gr of  $\text{CdSO}_4 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{CdSO}_4 + \text{Aq}$	Sp gr
1-normal	1.0973
$\frac{1}{2}$ -"	1.0487
$\frac{1}{4}$ -"	1.0244
$\frac{1}{8}$ -"	1.0120

(Wagner, Z phys Ch 1890, 5 36)

Sp gr of  $\text{CdSO}_4 + \text{Aq}$

% $\text{CdSO}_4$	t°	Sp gr at t°	Sp gr at 18
0.0289	17.29	0.99905	0.99893
	23.65	0.99776	
0.0498	18.00		0.99915
0.0999	18.00		0.99961
0.495	18.00		1.0034
0.981	18.00		1.0084

(Wershofen, Z phys Ch 1890, 5 194)

Sp gr at  $16^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing  
29.4654%  $\text{CdSO}_4 = 1.36280$ , containing  
21.3671%  $\text{CdSO}_4 = 1.24211$  (Schonrock, Z  
phys Ch 1893, 11 781)

Sp gr of  $\text{CdSO}_4 + \text{Aq}$  at  $18^\circ/4^\circ$

% $\text{CdSO}_4$	25.121	18.172
Sp gr	1.297	1.200

% $\text{CdSO}_4$	9.952	5.639
Sp gr	1.101	1.055

(de Muynck, W Ann 1894, 53 561)

$\text{CdSO}_4 + \text{Aq}$  containing 13.40%  $\text{CdSO}_4$  has  
sp gr  $20^\circ/20^\circ = 1.1429$

$\text{CdSO}_4 + \text{Aq}$  containing 16.79%  $\text{CdSO}_4$  has  
sp gr  $20^\circ/20^\circ = 1.1847$

(Le Blanc and Rohland, Z phys Ch 1896,  
19 282)

Sp gr of  $\text{CdSO}_4$  at  $18^\circ$ , when  $p$ =per cent strength of solution,  $d$ =observed density,  $w$ =volume conc in grams per cc ( $\frac{pd}{100} = w$ )

p	d	w
39 86	1 5639	0 6231
31 53	1 4080	0 4439
26 85	1 3310	0 3574
24 17	1 2901	0 3118
18 35	1 2084	0 2217
13 27	1 1437	0 1518
9 97	1 1045	0 1102
7 46	1 0764	0 0803
6 12	0 0619	0 0650
2 52	0 0242	0 0259
1 45	0 0132	0 0147
0 464	0 0033	0 0046

(Barnes, J phys Ch 1898, 2 543)

Sp gr of  $\text{CdSO}_4$ +Aq sat at  $25^\circ$  and 1 atm = 1 617 (Sinnige, Z phys Ch 1909, 67 518)

See also under  $\text{CdSO}_4+2\frac{2}{3}\text{H}_2\text{O}$ , and  $+4\text{H}_2\text{O}$

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch 1898, 20 827)

Insol in acetone (Naumann, B 1904, 37 329), methyl acetate (Naumann, B 1909, 2 3790), ethyl acetate (Naumann, B 1910, 43 314)

+ $\text{H}_2\text{O}$  See Mylius and Funk, under  $\text{CdSO}_4$

+ $1\frac{1}{2}\text{H}_2\text{O}$  (Worobieff, Bull Soc 1896, 3) 16 1754)

+ $2\text{H}_2\text{O}$  1 pt  $\text{H}_2\text{O}$  dissolves 0 59 pt anhydrous salt at  $23^\circ$ , and not much more on heating. Sat solution boils at  $102^\circ$ . Precipitated by alcohol (v Hauer)

100 g  $\text{H}_2\text{O}$  dissolve g  $\text{CdSO}_4$  at t

t	C $\text{CdSO}_4$
0	75 52
3	75 65
7	65 73
9	75 85
11	75 91
12	76 01
13	76 11
16	76 16
17	76 15
18	76 11
19	76 18
20	76 79

(v Hauer and Cohen, W Ann 1898 65 352)

100 pts  $\text{H}_2\text{O}$  dissolves at  
 $13^\circ$  7°  $14^\circ$  98°  $15^\circ$  0°  $16^\circ$  0°  
 76 06 76 09 76 14 76 18 pts anhydrous salt,  
 $16^\circ$  96°  $18^\circ$  0°  $19^\circ$  0°  $25^\circ$  0°  
 76 26 76 32 76 39 76 81 pts anhydrous salt  
 (Steinwehr, W Ann 1902, (4) 9 1050)

100 g  $\text{H}_2\text{O}$  dissolve 76 02 g  $\text{CdSO}_4$  at  $25^\circ$   
 (Stortenbecker, Z phys Ch 1900, 34 109)

Solubility of  $\text{CdSO}_4+2\frac{2}{3}\text{H}_2\text{O}$  at  $25^\circ$  and varying pressures

Pressure in atmospheres	G $\text{CdSO}_4$ in 100 g $\text{H}_2\text{O}$
1	76 80
500	77 85
500	78 08
1000	78 77
1000	78 68

Det by another method

Pressure in atmospheres	G $\text{CdSO}_4$ in 100 g $\text{H}_2\text{O}$
250	77 53
500	78 02
750	78 60
1000	78 96

(Cohen and Sinnige Trans Farad Soc 1910, 5 269)

Sp gr at  $21\frac{6}{10}^\circ$  of  $\text{CdSO}_4$ +Aq containing 11 47%  $\text{CdSO}_4+\frac{2}{3}\text{H}_2\text{O}=1 0944$  (Kannnikoff, J pr 1885, (2) 31 346)

100 g  $\text{H}_2\text{O}$  dissolve 57 61 g  $\text{CdSO}_4$ +  
 10 63 g  $\text{CdSO}_4$  at  $25^\circ$  (Stortenbecker, Z phys Ch 1900, 34 109)

+ $4\text{H}_2\text{O}$  (Lescour, A ch 1895, (7) 4 222)

Sp gr at  $15^\circ$  of  $\text{CdSO}_4$ +Aq containing 10 g  $\text{CdSO}_4+4\text{H}_2\text{O}$  in 100 cc of solution = 1 0790, containing 20 g  $\text{CdSO}_4+4\text{H}_2\text{O}$  in 100 cc of solution = 1 1522 (Lutten, J pr 1885, (2) 31 207)

Could not be obtained (Mylius and Funk)

+ $7\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$

t	C $\text{CdSO}_4$
17	11 15
16	11 5
12	15 3
10	16 1
7	17 5
5	18 5
1 5	18 7

(Mylius and Funk B 1897 30 828)

Cadmium caesium sulphate,  $\text{CdSO}_4$ ,  $\text{Cs}_2\text{SO}_4$ +  
 $6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Lutton, Chem Soc 63 337)  
 1 l  $\text{H}_2\text{O}$  dissolves 1399 g anhydrous salt at  $25^\circ$  (Locke, Am Ch J 1902, 27 459)

**Bismuth sodium sulphate**,  $\text{Bi}_4\text{Na}_8(\text{SO}_4)_3$   
(Ludecke, A 140 277)

**Boron sulphate**

See Borosulphuric acid

**Bromomolybdenum sulphate**

See under Bromomolybdenum compounds

**Cadmium sulphate, basic**,  $2\text{CdO}$ ,  $\text{SO}_3$ , and  $+\text{H}_2\text{O}$

Difficultly sol in  $\text{H}_2\text{O}$  (Stromeyer) SI  
sol in hot  $\text{H}_2\text{O}$  (Habermann, M 5 432)  
 $4\text{CdO}$ ,  $\text{SO}_3$  (Pickering, Chem Soc 1907,  
91 1987)

**Cadmium sulphate**,  $\text{CdSO}_4$

Sat  $\text{CdSO}_4 + \text{Aq}$  contains at

0°	10°	24°	30°	65°
35.9	37.5	41.5	42.0	49.7% $\text{CdSO}_4$
86°	94°	130°	165°	188° 200°
43.5	91.6	27.7	14.7	7.1 2.3% $\text{CdSO}_4$

$\text{CdSO}_4$  easily forms supersat solutions  
(Étard, A ch 1894, (7) 2 552)

Solubility in  $\text{H}_2\text{O}$

t°	Per cent $\text{CdSO}_4$ in sat solution	Solid phase
-18	43.35	Ice
-10	43.27	
0	43.01	
+10	43.18	
15	43.20	$\text{CdSO}_4 \cdot \frac{8}{3}\text{H}_2\text{O}$
20	43.37	
30	43.75	
40	43.99	
60	44.99	"
62	45.06	
72	46.2	
73.5	46.6	
74.5	46.7	$\text{CdSO}_4 \cdot \text{H}_2\text{O}$
75	46.5	
77	42.2	
78.5	41.5	
85	39.6	"
90	38.7	
95	38.1	
100	37.8	

(Mylus and Funk, B 1897, 30 825)

See also under  $\text{CdSO}_4 + 2 \frac{1}{3}\text{H}_2\text{O}$ , and  $7\text{H}_2\text{O}$

Sp gr at  $0^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing  
14.0 g  $\text{CdSO}_4$  in 1000 g  $\text{H}_2\text{O} = 1.0122$

Sp gr at  $12^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing  
14.0 g  $\text{CdSO}_4$  in 100 g  $\text{H}_2\text{O} = 1.0121$

Sp gr at  $12^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing  
57.2 g  $\text{CdSO}_4$  in 1000 g  $\text{H}_2\text{O} = 1.0514$

Sp gr at  $0^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing  
183.1 g  $\text{CdSO}_4$  in 1000 g  $\text{H}_2\text{O} = 1.1552$

Sp gr at  $13^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing  
183.1 g  $\text{CdSO}_4$  in 1000 g  $\text{H}_2\text{O} = 1.1529$

(Fouqué, Ann Observ 1868, 9 172)

Sp gr of  $\text{CdSO}_4 + \text{Aq}$  at  $18^\circ$

% $\text{CdSO}_4$	1	5	10	15
Sp gr	1.0084	1.0486	1.1026	1.1607

% $\text{CdSO}_4$	20	25	30	35
Sp gr	1.2245	1.295	1.3725	1.4575

% $\text{CdSO}_4$	36
Sp gr	1.4743

(Grotian, W Ann 1883, 18 193)

Sp gr of  $\text{CdSO}_4 + \text{Aq}$  at room temp containing

7.14	14.66	22.011% $\text{CdSO}_4$
1.0681	1.1591	1.2681

(Wagner, W Ann 1883, 18 268)

Sp gr of  $\text{CdSO}_4 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{CdSO}_4$ +Aq	Sp gr
1-normal	1.0973
$\frac{1}{2}$ " "	1.0487
$\frac{1}{4}$ " "	1.0244
$\frac{1}{8}$ " "	1.0120

(Wagner, Z phys Ch 1890, 5 36)

Sp gr of  $\text{CdSO}_4 + \text{Aq}$

% $\text{CdSO}_4$	t°	Sp gr at t°	Sp gr at $18^\circ$
0.0289	17.29	0.99908	0.99893
	23.65	0.99776	
0.0498	18.00		0.99915
0.0999	18.00		0.99961
0.495	18.00		1.0034
0.981	18.00		1.0084

(Wershofen, Z phys Ch 1890, 5 494)

Sp gr at  $16^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing  
29.4654%  $\text{CdSO}_4 = 1.30289$ , containing  
21.3671%  $\text{CdSO}_4 = 1.24211$  (Schonrock, Z  
phys Ch 1893, 11 781)

Sp gr of  $\text{CdSO}_4 + \text{Aq}$  at  $18^\circ/4^\circ$

% $\text{CdSO}_4$	25.121	18.172
Sp gr	1.297	1.200

% $\text{CdSO}_4$	9.952	5.639
Sp gr	1.101	1.055

(de Muynck, W Ann 1894, 53 561)

$\text{CdSO}_4 + \text{Aq}$  containing 13.40%  $\text{CdSO}_4$  has  
sp gr  $20^\circ/20^\circ = 1.1429$

$\text{CdSO}_4 + \text{Aq}$  containing 16.79%  $\text{CdSO}_4$  has  
sp gr  $20^\circ/20^\circ = 1.1847$

(Le Blanc and Rohland, Z phys Ch 1896,  
19 282)

Sp gr of  $\text{CdSO}_4$  at 18  $^{\circ}$ , when p = per cent strength of solution, d = observed density, w = volume conc in grams per cc ( $\frac{pd}{100} = w$ )

p	d	w
39 86	1 5639	0 6231
31 53	1 4080	0 4439
26 85	1 3310	0 3574
24 17	1 2901	0 3118
18 35	1 2084	0 2217
13 27	1 1437	0 1518
9 97	1 1045	0 1102
7 46	1 0764	0 0803
6 12	0 0619	0 0650
2 52	0 0242	0 0259
1 45	0 0132	0 0147
0 464	0 0033	0 0046

(Barnes, J phys Ch 1898, 2 543)

Sp gr of  $\text{CdSO}_4 + \text{Aq}$  sat at 25 $^{\circ}$  and 1 atm = 317 (Sinnige, Z phys Ch 1909, 67 518)

See also under  $\text{CdSO}_4 + 2\frac{1}{3}\text{H}_2\text{O}$ , and  $\text{I}_2\text{O}$

sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 98, 20 827)

sol in acetone (Naumann, B 1904, 37 432), methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1911, 43 314)

$\text{H}_2\text{O}$  See Mylius and Funk, under  $\text{Cd}$

$1\frac{1}{3}\text{H}_2\text{O}$  (Worobieff, Bull Soc 1896, (3) 6 1754)

$2\frac{2}{3}\text{H}_2\text{O}$  1 pt  $\text{H}_2\text{O}$  dissolves 0.59 pt anhydrous salt at 23 $^{\circ}$ , and not much more on heating. Sat solution boils at 102 $^{\circ}$ . Prepared by alcohol (v Hauer)

100 g  $\text{H}_2\text{O}$  dissolve g  $\text{CdSO}_4$  at t $^{\circ}$

t $^{\circ}$	C $\text{CdSO}_4$
0	75 52
5	75 65
7	65 73
9	75 85
11 5	75 94
13	76 04
15	76 11
16	76 16
17	76 13
18	76 14
19	76 18
25	76 79

(Königsmann and Cohen, W Ann 1898, 65 352)

100 pts  $\text{H}_2\text{O}$  dissolves at  
13 7 $^{\circ}$  14 98 $^{\circ}$  15 0 $^{\circ}$  16 0 $^{\circ}$   
76 06 76 09 76 14 76 18 pts anhydrous salt,  
16 96 $^{\circ}$  18 0 $^{\circ}$  19 0 $^{\circ}$  25 0 $^{\circ}$   
76 26 76 32 76 39 76 81 pts anhydrous salt  
(Steinwehr, W Ann 1902, (4) 9 1050)

100 g  $\text{H}_2\text{O}$  dissolve 76 02 g  $\text{CdSO}_4$  at 25 $^{\circ}$  (Stortenbecker, Z phys Ch 1900, 34 109)

Solubility of  $\text{CdSO}_4 + 2\frac{1}{3}\text{H}_2\text{O}$  at 25 $^{\circ}$  and varying pressures

Pressure in atmospheres	G $\text{CdSO}_4$ in 100 g $\text{H}_2\text{O}$
1	76 80
500	77 85
500	78 08
1000	78 77
1000	78 68

Det by another method

Pressure in atmospheres	G $\text{CdSO}_4$ in 100 g $\text{H}_2\text{O}$
250	77 53
500	78 02
750	78 60
1000	78 96

(Cohen and Sinnige Trans Farad Soc 1910, 5 269)

Sp gr at 21 6 $^{\circ}$  0 $^{\circ}$  of  $\text{CdSO}_4 + \text{Aq}$  containing 11 47%  $\text{CdSO}_4 + \frac{8}{3}\text{H}_2\text{O} = 1.0944$  (Kannnikoff, J pr 1885, (2) 31 346)

100 g  $\text{H}_2\text{O}$  dissolve 57 61 g  $\text{CdSO}_4 + 10.63$  g  $\text{FeSO}_4$  at 25 $^{\circ}$  (Stortenbecker, Z phys Ch 1900, 34 109)

$+4\text{H}_2\text{O}$  (Lescœur, A ch 1895, (7) 4 222)

Sp gr at 15 $^{\circ}$  of  $\text{CdSO}_4 + \text{Aq}$  containing 10 g  $\text{CdSO}_4 + 4\text{H}_2\text{O}$  in 100 cc of solution = 1.0790, containing 20 g  $\text{CdSO}_4 + 4\text{H}_2\text{O}$  in 100 cc of solution = 1.1522 (Traube, J pr 1885, (2) 31 207)

Could not be obtained (Mylius and Funk)

$+7\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$

t $^{\circ}$	% $\text{CdSO}_4$
-17	44 15
-16	44 5
-12	45 3
-10	46 1
-7	47 5
-5	48 5
-4 5	48 7

(Mylius and Funk, B 1897, 30 828)

Cadmium cæsium sulphate,  $\text{CdSO}_4, \text{Cs}_2\text{SO}_4 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Tutton, Chem Soc 63 337)  
1 l  $\text{H}_2\text{O}$  dissolves 1399 g anhydrous salt at 25 $^{\circ}$  (Locke, Am Ch J 1902, 27 459)



**Cadmium calcium potassium sulphate**,  
 $\text{Ca}_2\text{CdK}_2(\text{SO}_4)_4 + 2\text{H}_2\text{O}$   
 (D'Ans, B 1908, 41 1778)

**Cadmium cerium sulphate**,  $\text{CdSO}_4, \text{Ce}_2(\text{SO}_4)_3 + 6\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Wyruboff)

**Cadmium hydrazine sulphate**,  
 $\text{CdH}_2(\text{SO}_4)_2, 2\text{N}_2\text{H}_4$   
 1 pt is sol in 202.5 pts  $\text{H}_2\text{O}$  at  $12^\circ$   
 Not attacked by dil acids Easily sol in  
 $\text{NH}_4\text{OH} + \text{Aq}$  (Curtius, J pr 1894, (2) 50  
 331)

**Cadmium magnesium sulphate**,  $\text{CdSO}_4, \text{MgSO}_4 + 14\text{H}_2\text{O}$   
 Very efflorescent Sol in  $\text{H}_2\text{O}$  (Schiff, A  
 104 325)

**Cadmium potassium sulphate**,  $\text{K}_2\text{SO}_4, \text{CdSO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (v Hauer, Pogg 133 176)  
 100 pts  $\text{H}_2\text{O}$  dissolve 42.50 pts anhydrous  
 salt at  $26^\circ$   
 100 pts  $\text{H}_2\text{O}$  dissolves 42.80 pts anhydrous  
 salt at  $31^\circ$   
 100 pts  $\text{H}_2\text{O}$  dissolve 43.45 pts anhydrous  
 salt at  $40^\circ$   
 100 pts  $\text{H}_2\text{O}$  dissolve 44.90 pts anhydrous  
 (Wyruboff, Bull Soc Min

00 pts  $\text{H}_2\text{O}$  dissolve 42.89 pts  
 us salt at  $16^\circ$ , 46.82 pts at  $31^\circ$ ,  
 47.40 pts at  $40^\circ$  (Wyruboff)  
 $+4\text{H}_2\text{O}$  Efflorescent (Wyruboff, Bull  
 Soc Min 1891, 14 235)  
 $+6\text{H}_2\text{O}$  Very efflorescent, and easily  
 decomp (Schiff)  
 Does not exist (Wyruboff)

**Cadmium rubidium sulphate**,  $\text{CdSO}_4, \text{Rb}_2\text{SO}_4 + 6\text{H}_2\text{O}$   
 Efflorescent Sol in  $\text{H}_2\text{O}$  (Tutton)  
 1 l  $\text{H}_2\text{O}$  dissolves 767 g anhydrous salt  
 at  $25^\circ$  (Locke, Am Ch J 1902, 27 459)

**Cadmium sodium sulphate**,  $\text{CdSO}_4, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (v Hauer)  
 Solubility of  $\text{CdNa}_2(\text{SO}_4)_2 + 2\text{H}_2\text{O}$  in 100 g  
 $\text{H}_2\text{O}$  at  $t^\circ$

t	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$
24	35.49	24.04
25	35.88	24.46
30	36.28	24.605
35	36.69	24.99
40	37.24	25.455

(Koppel, Z phys Ch 1905, 52 413)  
 Decomp by  $\text{H}_2\text{O}$  below  $20.5^\circ$

Solubility of  $\text{CdNa}_2(\text{SO}_4)_2, 2\text{H}_2\text{O} + \text{CdSO}_4$ ,  
 $\frac{8}{3}\text{H}_2\text{O}$  in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$	$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$
0	73.54	8.80	15	73.76	9.425
5	73.38	8.67	20	73.81	9.450
10	72.78	8.55	25	73.71	10.48
			40	75.385	13.75

(Koppel)

Solubility of  $\text{CdNa}_2(\text{SO}_4)_2, 2\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ ,  
 $10\text{H}_2\text{O}$  in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$
-14.8	72.68	8.32
0	66.325	11.625
5	61.78	12.97
10	55.34	14.785
12	51.615	15.95
15	46.60	17.99
19.8	36.13	22.16
20	36.25	23.52
24	27.82	29.17
25	25.59	31.06
30	14.62	44.145

(Koppel)

Solubility of  $\text{CdNa}_2(\text{SO}_4)_2, 2\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$   
 (anhydrous) in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$
35	13.26	47.06
40	16.25	46.27

(Koppel)

**Cadmium sulphate ammonia**,  $\text{CdSO}_4, 6\text{NH}_3$   
 Sol in  $\text{H}_2\text{O}$  with separation of  $\text{CdO}$  (Rose,  
 Pogg 20 152)  
 $\text{CdSO}_4, 4\text{NH}_3 + 4\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$   
 (Malaguti and Sarzeau, A ch (3) 9 431)  
 $+2\text{H}_2\text{O}$  Ppt (Andre, C R 104 987)  
 $+2\frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with separation of  
 basic sulphate (Muller, A 149 70)  
 $\text{CdSO}_4, 3\text{NH}_3$  (Isambert, C R 1870, 70  
 457)

**Cadmium sulphate cupric oxide**,  $\text{CdSO}_4, 3\text{CuO} + x\text{H}_2\text{O}$   
 (Recoura, C R 1901, 132 1415)  
 $2\text{CdSO}_4, 3\text{CuO} + 8\text{H}_2\text{O}$  (Mailhe, A ch  
 1902, (7) 27 383)  
 $+12\text{H}_2\text{O}$  (Mailhe)  
 $6\text{CdSO}_4, 20\text{CuO} + x\text{H}_2\text{O}$  (Recoura, C R  
 1901, 132 1415)

**Cadmium sulphate hydrazine**,  $\text{CdSO}_4, 2\text{N}_2\text{H}_4$

Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  but cannot be  
 cryst therefrom (Franzen, Z anorg 1908,  
 60 282)

**Cadmium sulphate hydrogen chloride,**  
 $3\text{CdSO}_4, 4\text{HCl} + 4\text{H}_2\text{O}$ 

Very deliquescent (Baskerville and Harris,  
J Am Chem Soc 1901, **23** 896)  
 $3\text{CdSO}_4, 8\text{HCl}$  Very deliquescent (Bas-  
kerville and Harris)

**Cæsium sulphate,  $\text{Cs}_2\text{SO}_4$** 

Not deliquescent  
100 pts  $\text{H}_2\text{O}$  dissolve 158.7 pts  $\text{Cs}_2\text{SO}_4$  at  
—2°  
100 cc  $\text{H}_2\text{O}$  at 17–18° dissolve 163.5 g  
 $\text{Cs}_2\text{SO}_4$  (Tutton, Chem Soc 1894, **65**  
632)

Solubility in  $\text{H}_2\text{O}$ 

$t^\circ$	G $\text{Cs}_2\text{SO}_4$ per 100 g		G mols $\text{Cs}_2\text{SO}_4$ per l	$t^\circ$	G $\text{Cs}_2\text{SO}_4$ per 100 g		G mols $\text{Cs}_2\text{SO}_4$ per l
	Solu- tion	$\text{H}_2\text{O}$			Solu- tion	$\text{H}_2\text{O}$	
0	62.6	167.1	3.42	60	66.7	199.9	3.78
10	63.4	173.1	3.49	70	67.2	205.0	3.83
20	64.1	178.7	3.56	80	67.8	210.3	3.88
30	64.8	184.1	3.62	90	68.3	214.9	3.92
40	65.5	189.9	3.68	100	68.8	220.3	3.97
50	66.1	194.9	3.73	108.6	69.2	224.5	4.00

(Berkeley, Trans Roy Soc 1904, **203** A  
210)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$ 

Sat solution contains 54.7%  $\text{Cs}_2\text{SO}_4 +$   
11.45%  $\text{Na}_2\text{SO}_4$  at 25° (Foote, J Am  
Chem Soc 1911, **33** 467)

Insol in alcohol (Bunsen)

Insol in methyl acetate (Naumann, B  
1909, **42** 3790)

Insol in acetone (Naumann, B 1904, **37**  
4329; (Eidmann, C C 1899, II 1014)

Solubility in glycol at ord temp = 3.0–  
3.2% (de Coninck, Belg Acad Bull  
1905 359)

**Cæsium hydrogen sulphate,  $\text{CsHSO}_4$** 

Sol in  $\text{H}_2\text{O}$

**Cæsium pyrosulphate,  $\text{Cs}_2\text{S}_2\text{O}_7$** 

Decomp by  $\text{H}_2\text{O}$

**Cæsium osulphate,  $\text{Cs}_2\text{S}_8\text{O}_{25}$** 

Decomp by  $\text{H}_2\text{O}$  (Weber, B 17 2497)

**Cæsium calcium sulphate,  $\text{Ca}_2\text{Cs}_2(\text{SO}_4)_2$** 

Very stable, (D'Ans, B 1908, **41** 1776)

**Cæsium chromium sulphate,  $\text{Cs}_2\text{Cr}_2(\text{SO}_4)_4$   
+  $24\text{H}_2\text{O}$** 

Melts in crystal  $\text{H}_2\text{O}$  at 116° (Locke)

Solubility in  $\text{H}_2\text{O}$ 

Temp	G per litre	G mols anhydrous salt per l
25°	5.7	0.015
30°	9.6	0.025
35°	12.06	0.032
40°	15.3	0.0405

(Locke, Am Ch J 1901, **26** 180)

**Cæsium cobaltous sulphate,  $\text{Cs}_2\text{SO}_4, \text{CoSO}_4 +$   
 $6\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Tutton, Chem Soc **63**  
337)

1 l  $\text{H}_2\text{O}$  dissolves 418.8 g anhydrous  
salt at 25° (Locke, Am Ch J 1902, **27**  
459)

**Cæsium cobaltic sulphate,  $\text{Cs}_2\text{Co}_2(\text{SO}_4)_4 +$   
 $24\text{H}_2\text{O}$** 

Melts in crystal  $\text{H}_2\text{O}$  at 116° (Locke,  
Am Ch J 1901, **26** 183)

**Cæsium copper sulphate,  $\text{Cs}_2\text{SO}_4, \text{CuSO}_4 +$   
 $6\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Tutton)  
1 l  $\text{H}_2\text{O}$  dissolves 460 g anhydrous salt  
at 25° (Locke, Am Ch J 1902, **27** 459)

**Cæsium gallium sulphate,  $\text{Cs}_2\text{Ga}_2(\text{SO}_4)_4 +$   
 $24\text{H}_2\text{O}$** 

(Soret, Arch sc phys nat 1888, (3) **20**  
531)

**Cæsium indium sulphate,  $\text{Cs}_2\text{In}_2(\text{SO}_4)_4 +$   
 $24\text{H}_2\text{O}$** 

75.7 g anhydrous (117.39 hydrated) salt  
or 0.172 g mols of anhydrous salt are sol  
in 1 l  $\text{H}_2\text{O}$  at 25° (Locke, Am Ch J 1901,  
**26** 175)

100 pts  $\text{H}_2\text{O}$  dissolve 3.04 pts at 16.5°  
(Chabrie and Rengade, C R 1900, **131** 1301)

**Cæsium iridium sulphate,  $\text{Cs}_2\text{SO}_4,$   
 $\text{Ir}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$** 

Mpt 109–110°

Very sl sol in cold More easily sol in  
hot  $\text{H}_2\text{O}$  (Marino, Z anorg 1904, **42** 218)

**Cæsium iron (ferrous) sulphate,  $\text{Cs}_2\text{SO}_4,$   
 $\text{FeSO}_4 + 6\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Tutton)

1 l  $\text{H}_2\text{O}$  dissolves 1011 g anhydrous salt  
at 25° (Locke, Am Ch J 1902, **27** 459)

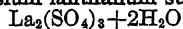
**Cæsium iron (ferric) sulphate,  $\text{Cs}_2\text{Fe}_2(\text{SO}_4)_4$   
+  $24\text{H}_2\text{O}$** 

Melts in crystal  $\text{H}_2\text{O}$  at 71° (Locke)

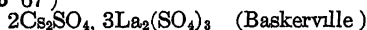
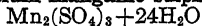
Solubility in H<sub>2</sub>O

t°	G per litre	G mols anhydrous salt per litre
25	17 1	0 045
30	25 2	0 066
35	37 5	0 099
40	60 4	0 156

(Locke, Am Ch J 1901, 26 180)

**Cæsium lanthanum sulphate**, Cs<sub>2</sub>SO<sub>4</sub>,

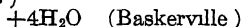
(Baskerville, J Am Chem Soc 1904, 26 67)

**Cæsium magnesium sulphate**, Cs<sub>2</sub>SO<sub>4</sub>,  
MgSO<sub>4</sub>+6H<sub>2</sub>OSol in H<sub>2</sub>O (Tutton)1 l H<sub>2</sub>O dissolves 533 g anhydrous salt at 25° (Locke, Am Ch J 1902, 27 459)**Cæsium manganous sulphate**, Cs<sub>2</sub>SO<sub>4</sub>,  
MnSO<sub>4</sub>+8H<sub>2</sub>OSol in H<sub>2</sub>O (Tutton)Sol in H<sub>2</sub>O and acids with decomp (Piccini, Z anorg 1899, 20 14)1 l H<sub>2</sub>O dissolves 804 g anhydrous salt at 25° (Locke, Am Ch J 1902, 27 45)**Cæsium manganic sulphate**, Cs<sub>2</sub>SO<sub>4</sub>,Decomp by H<sub>2</sub>O and dil acids with separation of MnO<sub>2</sub> Sol in 1 3 H<sub>2</sub>SO<sub>4</sub>+Aq and in conc HNO<sub>3</sub> Insol in acetic acid Sol in oxalic acid+Aq (Christensen, Z anorg 1901, 27 332)**Cæsium neodymium sulphate**, Cs<sub>2</sub>SO<sub>4</sub>,  
Nd<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+3H<sub>2</sub>O

(Baskerville, J Am Chem Soc 1904, 26 74)

**Cæsium nickel sulphate**, Cs<sub>2</sub>SO<sub>4</sub>, NiSO<sub>4</sub>+  
6H<sub>2</sub>OSol in H<sub>2</sub>O (Tutton)1 l H<sub>2</sub>O dissolves 255 8 g anhydrous salt at 25° (Locke, Am Ch J 1902, 27 459)**Cæsium praseodymium sulphate**, Cs<sub>2</sub>SO<sub>4</sub>,  
Pr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+2H<sub>2</sub>O

(Baskerville, J Am Chem Soc 1904, 26 73)

**Cæsium rhodium sulphate**, Cs<sub>2</sub>SO<sub>4</sub>, Rh<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+  
24H<sub>2</sub>OSl sol in cold, sol in warm H<sub>2</sub>O, mpt 110–111° (Piccini, Z anorg 1901, 27 64)**Cæsium thallic sulphate**, CsTi(SO<sub>4</sub>)<sub>4</sub>+  
1½H<sub>2</sub>O

Hygroscopic (Locke, Am Ch J 1902, 27 283)

+3H<sub>2</sub>O Very sl sol in cold, easily sol in hot H<sub>2</sub>O Can be recryst from H<sub>2</sub>SO<sub>4</sub>+Aq The recryst salt is at once decomp by H<sub>2</sub>O or 95% alcohol (Locke)**Cæsium thorium sulphate**, Cs<sub>2</sub>SO<sub>4</sub>, Th(SO<sub>4</sub>)<sub>2</sub>+  
2H<sub>2</sub>OSl sol in H<sub>2</sub>O (Manuelli, Gazz ch it 1903, 32 (2) 523)**Cæsium titanium sulphate**, Cs<sub>2</sub>SO<sub>4</sub>, Ti<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+  
24H<sub>2</sub>O

Deliquesces in the air and is decomp

Sl sol in cold H<sub>2</sub>O, decomp by hot H<sub>2</sub>O (Piccini, Gazz ch it 1895, 25 542)Sl sol in cold H<sub>2</sub>O, more sol in hot H<sub>2</sub>O acidified with H<sub>2</sub>SO<sub>4</sub>

Decomp in neutral aq solution (Piccini, Z anorg 1898, 17 356)

**Cæsium uranyl sulphate**, Cs<sub>2</sub>(UO<sub>2</sub>)(SO<sub>4</sub>)<sub>2</sub>+  
2H<sub>2</sub>O

As Na salt (de Coninck, C C 1905, I 1306)

**Cæsium vanadium sulphate**, Cs<sub>2</sub>V<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+  
24H<sub>2</sub>O771 g anhydrous (13 1 g hydrated) salt, or 0 0204 gr mols of the anhydrous salt are sol in 1 l H<sub>2</sub>O at 25° (Locke, Am Ch J 1901, 26 175)Sl sol in cold, easily sol in hot H<sub>2</sub>O (Piccini, Z anorg 1896, 11 114)100 pts H<sub>2</sub>O dissolve 0 464 pts of the salt at 10° and sp gr of the solution at 4°/20° = 2 033 More sol in hot H<sub>2</sub>O than in cold (Piccini, Z anorg 1897, 13 446)**Cæsium zinc sulphate**, Cs<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+  
6H<sub>2</sub>OSol in H<sub>2</sub>O (Bunsen and Kopp, Pogg 113 337)1 l H<sub>2</sub>O dissolves 386 3 g anhydrous salt at 25° (Locke, Am Ch J 1902, 27 459)**Cæsium zirconium sulphate**, Zr O<sub>3</sub>.(Cs<sub>2</sub>SO<sub>4</sub>)<sub>2</sub>+  
11H<sub>2</sub>O

Ppt (Rosenheim, B 1905, 38 515)

**Calsium sulphate**, CaSO<sub>4</sub>, and +2H<sub>2</sub>OThe older determinations of the solubility of CaSO<sub>4</sub> in H<sub>2</sub>O have little, but historic value, as the solutions were usually either non-saturated or supersaturated They may be tabulated as follows

A = pts  $\text{H}_2\text{O}$  required for dissolving 1 pt  $\text{CaSO}_4$ , and B for 1 pt  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	A	B	Authority
Hot or cold	500		Fourcroy
Cold	500		Bergmann
Boiling	450		"
All temp	322		Lassaigne
(?)	438		Anthou
(?)	250-300		Dumas
Hot or cold	578.5	461.5	Bucholz
Cold	480	380	Giese
Hot	491	388	"
15-20°	492	388	Tipp
12 5°	503	397	Lecoq

100 pts  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve pts  $\text{CaSO}_4$

$t^\circ$	Pts $\text{CaSO}_4$	$t^\circ$	Pts $\text{CaSO}_4$	$t^\circ$	Pts $\text{CaSO}_4$
0	0 205	35	0 254	70	0 244
5	0 219	40	0 252	80	0 239
12	0 233	50	0 251	90	0 231
20	0 241	60	0 248	100	0 217
30	0 249				

(Poggiale, A ch (3) 8 469)

Poggiale worked with supersat solutions (Droeze, B 10 330)

$\text{H}_2\text{O}$  dissolves  $\text{CaSO}_4$  most abundantly at 35° (Poggiale), at 32-41° (Marignac)

1 pt $\text{CaSO}_4 + 2\text{H}_2\text{O}$ dissolves at					
0°	18°	24°	32°	38°	
in 415	386	378	371	368	pts $\text{H}_2\text{O}$ ,
41°	53°	72°	86°	99°	
in 370	375	391	417	451	pts $\text{H}_2\text{O}$ ,

or (by calculation) 1 pt anhydrous  $\text{CaSO}_4$  dissolves at

0°	18°	24°	32°	38°	
in 525	488	479	470	466	pts $\text{H}_2\text{O}$ ,
41°	53°	72°	86°	99°	
in 468	474	495	528	571	pts $\text{H}_2\text{O}$

The above nonsat solutions are obtained by using a large excess of  $\text{CaSO}_4 + 2\text{H}_2\text{O}$ . The undissolved part retains its water of crystallisation ( $\text{CaSO}_4$ , dehydrated at 130-140°, forms a supersaturated solution with  $\text{H}_2\text{O}$  in 10 minutes, containing 1 pt  $\text{CaSO}_4$  to 110 pts  $\text{H}_2\text{O}$ , which soon deposits crystals. The undissolved part takes up its water of crystallisation. Ignited  $\text{CaSO}_4$  dissolves very slowly in  $\text{H}_2\text{O}$ , so that in 24 hours the solution contains  $1/13$  to  $1/18$  anhydrous  $\text{CaSO}_4$ . By longer contact solution continues with formation of supersaturated solutions, which contain after 10-30 days  $1/37$  to  $1/33$   $\text{CaSO}_4$ , but these become normal as the water of crystallisation takes up its water of crystallisation. The mineral anhydrite behaves similarly water taking up  $1/582$   $\text{CaSO}_4$  in 1 day,  $1/861$  in 40 days, and  $1/467$  in 8 months.

Supersaturated solutions are also obtained

by evaporation of a saturated solution. By evaporation with heat, solutions are obtained containing  $1/306$   $\text{CaSO}_4$ , and in the cold with  $1/112$   $\text{CaSO}_4$ , in the solution over the separated  $\text{CaSO}_4 + 2\text{H}_2\text{O}$ . Neutralising dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  with  $\text{CaCO}_3$  gives a solution containing  $1/114$   $\text{CaSO}_4$ , which crystallises out partly in 24 hours, leaving  $1/313$   $\text{CaSO}_4$  dissolved.

Supersaturated solutions containing  $1/110$  to  $1/180$   $\text{CaSO}_4$  deposit crystals rapidly, those under  $1/350$  do not crystallise spontaneously. A solution containing  $1/283$  shows crystals in 14 days, and contains  $1/312$  in 1 month,  $1/414$  in 2 months,  $1/446$  in 3 months, in spite of repeated shaking.

Boiling diminishes the supersaturation without however removing it entirely (Marignac, A ch (5) 1 274).

1 pt  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  is sol in 443 pts  $\text{H}_2\text{O}$  at 13 7°, in 447 pts  $\text{H}_2\text{O}$  at 14 2°, in 421 pts  $\text{H}_2\text{O}$  at 20 2°, in 419 pts  $\text{H}_2\text{O}$  at 21 2°, and in 445 pts  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat at 18 7° (Church, J B 1867 192).

Church's solutions were not sat (Droeze, B 10 330).

1000 pts  $\text{H}_2\text{O}$  dissolve 2 19 pts  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at 16 5°, 2 352 pts  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at 22° (Cossa, Gazz ch it 1873 135).

Cossa's solutions were not saturated (Droeze).

$\text{CaSO}_4 + 2\text{H}_2\text{O}$  is sol in 415 pts  $\text{H}_2\text{O}$  at 0°, in 412 pts  $\text{H}_2\text{O}$  at 5°, in 407 pts  $\text{H}_2\text{O}$  at 10°, in 398 pts  $\text{H}_2\text{O}$  at 15°, in 371 pts  $\text{H}_2\text{O}$  at 20°, in 365 pts  $\text{H}_2\text{O}$  at 25°, in 361 pts  $\text{H}_2\text{O}$  at 30°, in 359 pts  $\text{H}_2\text{O}$  at 35° (Droeze, B 10 330).

Sol in 500 pts  $\text{H}_2\text{O}$  at 12 5° (From Marignac's and his own results, de Boisbaudran, A ch (5) 3 477).

$\text{CaSO}_4$  is sol in 564.5 pts  $\text{H}_2\text{O}$  at 0.8°, 506.27 pts at 14°, 472.3 pts at 32.5-38.8°, 498.73 pts at 64°, 533.92 pts at 79.6° (Raupenstrauch, M 6 563).

According to Goldammer (C C 1888 708)  $\text{H}_2\text{O}$  is fully saturated with  $\text{CaSO}_4$  by shaking the finely-powdered substance 5 minutes therewith.

The following results were obtained. Figures denote pts  $\text{H}_2\text{O}$  in which 1 pt  $\text{CaSO}_4$  was dissolved at  $t^\circ$  (a) from pptd  $\text{CaSO}_4$  "ipse fact," (b) from pptd  $\text{CaSO}_4$  "gehe," (c) from "glacies mariae pulv," (d) from "glacies Mariae pulv," containing less than  $2\text{H}_2\text{O}$ .

t	a	b	c	t	d
0	561.5	558	557.5	0	476.5
7.5	526	526	520		
15	497.5	497.5	493	20	436
22.5	481	481.5	479		
30	475	475	470		
37.5	463	469	465.5	40	450
45	473.5	474.5	470.5		
60	484	486.5	482	60	476
75	507.5	508	503	80	502.5
90	533.5	530	534		
100	556	557	534.5	100	547

Burnt gypsum easily forms supersat solutions containing nearly 1%  $\text{CaSO}_4$ . It forms supersat solutions more readily at  $0^\circ$ , and that tendency decreases with increase of temp, hence figures in (d) which contained burnt gypsum (Goldammer, C C 1888 708)

Calculated from electrical conductivity of  $\text{CaSO}_4 + \text{Aq}$ , 1 l  $\text{H}_2\text{O}$  dissolves 2.07 g  $\text{CaSO}_4$  at  $18^\circ$  (Kohlrausch and Rose, Z phys Ch 12 241)

The anhydrous salt varies in solubility. Solubility depends (1) upon temp and time of drying, (2) upon the relative amount of salt, (3) upon time of shaking. Possibly  $\alpha$  and  $\beta$  modifications (Potilzin, C C 1894, II 515)

2.04 gr are dissolved in 1 liter of sat solution at  $20^\circ$  (Böttger, Z phys Ch 1903, 46 603)

At  $15^\circ$  and after 5 minutes shaking, the highest degree of supersaturation which can be obtained with pure sol calcium sulphate = 9.47 g of the anhydrous salt or 11.976 g  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  in 1 l of  $\text{H}_2\text{O}$  (Cavazzi, C C 1905, I 1694)

Solubility of  $\text{CaSO}_4$  in 100 pts  $\text{H}_2\text{O}$  at high temp

$t^\circ$	Pts 100	$t^\circ$	Pts $\text{CaSO}_4$	$t^\circ$	Pts $\text{CaSO}_4$
0	0.78	175-185	0.027	250	0.016
0	0.056	240	0.018		

Landen and Shenstone, Phil Trans 1884 31)

Pptn of  $\text{CaSO}_4$  which has been started by heating solution to  $140-150^\circ$  continues even after solution has cooled (Storer)

$\text{CaSO}_4$  is completely insol in sea water or pure  $\text{H}_2\text{O}$  at temperatures between  $140^\circ$  and  $150^\circ$  (Cousté)

Solubility of  $\text{CaSO}_4$  in sea water at temperatures over  $100^\circ$   $t^\circ = \text{temp}$ ,  $P = \text{pressure}$  in atmospheres, % = per cent  $\text{CaSO}_4$  in sat solution

$t^\circ$	P	%	t	P	%
103	1	0.500	118.5	1.50	0.226
103.8	1	0.477	121.2	1.5	0.183
105.15	1	0.432	124	2	0.140
108.6	1.25	0.395	127.9	2	0.097
111	1.25	0.355	130	2.5	0.060
113.2	1.25	0.310	133.3	2.5	0.023
115.8	1.50	0.267			

(Cousté, Ann Min (5) 5 80)

Solubility of  $\text{CaSO}_4$  in  $\text{H}_2\text{O}$  at various pressures

100 g sat  $\text{CaSO}_4 + \text{Aq}$  at 1 atmos pressure and  $15^\circ$  contain 0.206 g  $\text{CaSO}_4$ , at 20 atmos pressure and  $15^\circ$  contain 0.227 g  $\text{CaSO}_4$ , at 1 atmos pressure and  $16.2^\circ$  contain 0.213 g  $\text{CaSO}_4$  (Moller, Pogg 117 386)

### Soluble anhydrite

1 l  $\text{H}_2\text{O}$  dissolves 22.8 milliequivalents at  $100^\circ$

1 l  $\text{H}_2\text{O}$  dissolves 6.4 milliequivalents at  $156^\circ$

### Anhydrite

1 l  $\text{H}_2\text{O}$  dissolves 9.2 milliequivalents at  $100^\circ$

1 l  $\text{H}_2\text{O}$  dissolves 2.7 milliequivalents at  $156^\circ$

1 l  $\text{H}_2\text{O}$  dissolves 0.7 milliequivalents at  $218^\circ$

(Melcher, J Am Chem Soc 1910, 32 63)

See also under gypsum, p 953

Maximum solubility is at  $37.5^\circ$  (Cameron, J phys Chem 1901, 5 572)

Sp gr of sat  $\text{CaSO}_4 + \text{Aq}$  at  $15^\circ = 1.0022$  (Stolba, J pr 97 503)

Sp gr of sat  $\text{CaSO}_4 + \text{Aq}$  at  $31^\circ = 1.0031$

1 pt  $\text{CaSO}_4$  is sol in 218 pts  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  (Beyer, Arch Pharm (2) 150 193)

Sl sol in cold  $\text{HCl} + \text{Aq}$ , completely sol in boiling dil  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  (Rose, Pogg 95 108)

### Solubility of $\text{CaSO}_4$ in $\text{HCl} + \text{Aq}$

$t^\circ$	% HCl	100 ccm dissolve g of $\text{CaSO}_4$	$t^\circ$	% HCl	100 ccm dissolve g of $\text{CaSO}_4$
25	0.77	0.6405	25	6.12	1.6539
25	1.56	0.8821	101	0.77	1.1209
25	3.06	1.2639	102	3.06	3.1780
25	4.70	1.5342	103	6.12	4.6902

(Lunge, J Soc Chem Ind 4 31)

### Solubility in $\text{HNO}_3 + \text{Aq}$ at $25^\circ$

g $\text{HNO}_3$ per 100 cc	g $\text{CaSO}_4$ per 100 cc solution	g $\text{HNO}_3$ per 100 cc	g $\text{CaSO}_4$ per 100 cc solution
0	0.208	6	1.48
1	0.56	8	1.70
2	0.82	10	1.84
3	1.02	12	1.98
4	1.20		

(Banthisch, J pr 1884, 29 52)

For solubility in  $\text{H}_2\text{SO}_4$  see  $\text{CaH}_2(\text{SO}_4)_2$

### Solubility in $\text{H}_3\text{PO}_4 + \text{Aq}$ at $25^\circ$

G $\text{P}_2\text{O}_5$ per l	G $\text{CaSO}_4$ per l	Sp gr $25^\circ/25^\circ$
0.0	2.126	
5.0	3.138	1.002
10.5	3.734	1.007
21.4	4.456	1.016
46.3	5.760	1.035
105.3	7.318	1.075
145.1	7.920	1.106
204.9	8.383	1.145
312.0	7.965	1.221
395.7	6.848	1.230
494.6	5.573	1.344

(Taber, J phys Chem 1906, 10 628)

Solubility in formic acid at  $25^\circ$

100 cc of solution of acid containing 4%

dissolve 0.24 g  $\text{CaSO}_4$  (Banthusch, J pr 1884, 29 52)

Solubility of  $\text{CaSO}_4$  in chloroacetic acid at 25° 100 cc of solution of acid containing 4% dissolve 0.22 g  $\text{CaSO}_4$ , 10%, 0.25 g (Banthusch, J pr 1884, 29 52)

Solubility in  $\text{H}_2\text{O}$  is increased by presence of  $\text{NH}_4\text{Cl}$  (Vogel, J pr 1 196), ammonium succinate (Wittstein, Report 57 18),  $(\text{NH}_4)_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{B}_4\text{O}_7$  (Popp, A Suppl 8 11), also  $\text{KNO}_3$  (Vogel, Jun.),  $\text{Na}_2\text{SO}_4$  (Henry, J Pharm 12 31),  $\text{NaCl}$  (Trommsdorf, N J Pharm 18, 1 234)

Decomp by alkali carbonates + Aq (See Storer's Dict)

1 g  $\text{CaSO}_4$  is sol in 162 ccm sat  $\text{KCl}$  + Aq at 8°, in 147 ccm sat  $\text{NaCl}$  + Aq at 8.5°, in 93 ccm sat  $\text{NH}_4\text{Cl}$  + Aq at 12.5°, in 94 ccm sat  $\text{KNO}_3$  + Aq, in 92 ccm sat  $\text{NaNO}_3$  + Aq, in 320 ccm sat  $\text{NH}_4\text{NO}_3$  + Aq, in 54 ccm  $\frac{1}{2}$  sat  $\text{NH}_4\text{NO}_3$  + Aq, in about 2000 ccm sat  $\text{K}_2\text{SO}_4$  + Aq (Droeze)

More sol in  $\text{Fe}_2\text{Cl}_6$ ,  $\text{Cr}_2\text{Cl}_6$ ,  $\text{CuCl}_2$ ,  $\text{ZnCl}_2$  + Aq than in  $\text{H}_2\text{O}$ , but not more sol in  $\text{CaCl}_2$  + Aq (Gladstone)

$\text{NH}_4\text{Cl}$  + Aq

1 g  $\text{CaSO}_4$  is sol in 92 ccm sat  $\text{NH}_4\text{Cl}$  + Aq at 13.5°, in 94 ccm  $\frac{1}{2}$  sat  $\text{NH}_4\text{Cl}$  + Aq at 13.5–15.5°, in 200 ccm  $\frac{1}{8}$  sat  $\text{NH}_4\text{Cl}$  + Aq at 13.5°, in 183 ccm  $\frac{1}{8}$  sat  $\text{NH}_4\text{Cl}$  + Aq at 100° (Fassbender, B 9 1360)

Solubility of  $\text{CaSO}_4$  in 25%  $\text{NH}_4\text{Cl}$  + Aq

t°	% $\text{CaSO}_4$	t°	% $\text{CaSO}_4$
8	1 030	60	1 333
9	1 023	80	1 026
25	1 096	120	1 000
39	1 126		

(Tilden and Shenstone, Roy Soc Proc 38 335)

Solubility in  $\text{NH}_4\text{Cl}$  + Aq increases with percentage of  $\text{NH}_4\text{Cl}$ , but if solution contains more than 60 g  $\text{NH}_4\text{Cl}$  per l more  $\text{CaO}$  dissolves than  $\text{SO}_3$ . With 333 g  $\text{NH}_4\text{Cl}$  per l, the solution contains 4.9 g  $\text{SO}_3$  and 4.4 g  $\text{CaO}$ , while the  $\text{SO}_3$  content requires only 3.4 g  $\text{CaO}$  (Ditte, C R 1898, 126 694)

Solubility of  $\text{CaSO}_4$  in  $\text{NH}_4\text{Cl}$  + Aq at 25°

Grams $\text{NH}_4\text{Cl}$ per liter	Grams $\text{CaSO}_4$ per liter
10 8	3 90
24 4	5 38
46 7	7 07
94 5	8 80
149 7	10 30
198 6	10 85
210 0	10 88
275 0	10 60
325 0	9 40
375 3 (saturated)	7 38

(Cameron and Brown, J phys Chem 1905, 9 211)

$\text{CaCl}_2$  + Aq

Solubility of  $\text{CaSO}_4$  in  $\text{CaCl}_2$  + Aq at t°

t°	% $\text{CaCl}_2$	100 ccm dissolve g of $\text{CaSO}_4$	t°	% $\text{CaCl}_2$	100 ccm dissolve g of $\text{CaSO}_4$
23	3 54	0 1225	25	16 91	0 0702
24	6 94	0 0963	101 0	3 54	0 1370
25	10 36	0 0886	102 5	10 36	0 1426
25	15 90	0 0734	103 5	16 91	0 1301

(Lunge, l c)

Solubility of  $\text{CaSO}_4$  in  $\text{H}_2\text{O}$  containing various amts of  $\text{CaCl}_2$  at 20° 100 pts  $\text{H}_2\text{O}$  containing pts  $\text{CaCl}_2$  dissolve pts  $\text{CaSO}_4$

Pts $\text{CaCl}_2$	Pts $\text{CaSO}_4$	Pts $\text{CaCl}_2$	Pts $\text{CaSO}_4$
0 00	0 225	19 80	0 041
11 50	0 078	51 00	0 000
14 39	0 063	67 05	0 000

(Tilden and Shenstone)

Solubility of  $\text{CaSO}_4$  in  $\text{CaCl}_2$  + Aq at t°

t	% $\text{CaCl}_2$	% $\text{CaSO}_4$	t	% $\text{CaCl}_2$	% $\text{CaSO}_4$
15	15 00	0 063	94	15 16	0 110
21	14 70	0 068	138	14 70	0 071
39	15 00	0 091	170	14 82	0 031
72	14 90	0 100	195	14 70	0 022

(Tilden and Shenstone, l c)

Solubility in  $\text{CaCl}_2$  + Aq at 25°

g per l of solution		g per l of solution	
$\text{CaCl}_2$	$\text{CaSO}_4$	$\text{CaCl}_2$	$\text{CaSO}_4$
0 00	2 06	51 53	1 02
7 49	1 24	97 02	0 84
11 96	1 18	192 71	0 47
25 77	1 10	280 30	0 20
32 05	1 08	367 85	0 03

(Cameron and Seidell, J phys Ch 1901, 5 643)

1000 pts of 1%  $\text{CaCl}_2$  + Aq dissolve 1 1414 pts  $\text{CaSO}_4$ , 40%  $\text{CaCl}_2$ , 0 2130 pts  $\text{CaSO}_4$  (Orloff, Chem Soc 1903, 84, (2) 211)

Solubility in  $\text{CaO}_2\text{H}_2 + \text{Aq}$  at  $25^\circ$ 

G $\text{CaSO}_4$ per l	G $\text{CaO}$ per l	Solid phase
0 0	1 166	$\text{Ca}(\text{OH})_2$
0 391	1 141	"
0 666	1 150	"
0 955	1 215	"
1 214	1 242	"
1 588	1 222	$\text{Ca}(\text{OH})_2$ and $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
1 634	0 939	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
1 722	0 611	"
1 853	0 349	"
1 918	0 176	"
2 030	0 062	"
2 126	0 0	"

(Cameron and Bell, J Am Chem Soc 1906,  
28 1221)

Solubility of  $\text{CaSO}_4$  in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $25^\circ$ 

G $\text{NH}_4\text{NO}_3$ per l	G $\text{CaSO}_4$ per l
10	3 18
25	3 93
55	5 80
100	7 65
150	8 88
200	9 85
300	10 80
400	11 40
550	12 02
750	12 20
1000	11 81
1200	11 10
1400	10 02
saturated	7 55

(Cameron and Brown, J phys Chem 1905,  
9 213)

 $\text{MgCl}_2 + \text{Aq}$ 

Sol in 324 pts  $\text{MgCl}_2 + \text{Aq}$  (34 1%  $\text{MgCl}_2$ )  
at  $19^\circ$  (Karsten)  
1 g  $\text{CaSO}_4$  is sol in 146 ccm  $\frac{1}{2}$  sat  $\text{MgCl}_2$   
+ Aq at  $13.5^\circ$  (Fassbender)  
1 l  $\frac{1}{2}$  sat  $\text{MgCl}_2 + \text{Aq}$  dissolves 6 83 g  
 $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $13.5^\circ$  (Droeze)

Solubility of  $\text{CaSO}_4$  in  $\text{MgCl}_2 + \text{Aq}$ 

t	% $\text{MgCl}_2$	% $\text{CaSO}_4$
9	19 7	0 765
39	11 1	2 744
80	9 99	1 038

(Tilden and Shenstone, l c)

Solubility in  $\text{MgCl}_2 + \text{Aq}$  at  $26^\circ$ 

g per l of solution			g per l of solution		
$\text{MgCl}_2$	$\text{CaSO}_4$	$\text{H}_2\text{O}$	$\text{MgCl}_2$	$\text{CaSO}_4$	$\text{H}_2\text{O}$
0 0	2 08	997 9	121 38	8 62	972 2
8 50	4 26	996 5	206 98	6 57	949 9
19 18	5 69	994 5	337 0	2 77	908 7
46 64	7 59	989 1	441 0	1 39	878 6

(Cameron and Seidell, J phys Ch 1901,  
5 645)

1 l sat  $\text{MgCl}_2 + \text{Aq}$  at  $25^\circ$  containing 476 5  
g  $\text{MgCl}_2$  dissolves 1 09 g  $\text{CaSO}_4$  (Cameron  
and Brown, J phys Ch 1905, 9 214)

$\text{NH}_4\text{NO}_3 + \text{Aq}$   
1 g  $\text{CaSO}_4$  is sol in 320 ccm sat  $\text{NH}_4\text{NO}_3$   
+ Aq at  $8-9^\circ$ , in 54 ccm  $\frac{2}{3}$  sat  $\text{NH}_4\text{NO}_3$  +  
Aq at  $13.5^\circ$ , in 103 ccm  $\frac{2}{27}$  sat  $\text{NH}_4\text{NO}_3$  + Aq  
at  $13.5^\circ$  (Fassbender)

 $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$ 

Solubility of  $\text{CaSO}_4$  in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$

Weight of 1000 cc of solution	G $\text{Ca}(\text{NO}_3)_2$ per l	G $\text{CaSO}_4$ per l
998 1	0	2 084
1013 8	25	1 238
1031 7	50	1 196
1067 3	100	1 134
1136 9	200	0 929
1203 5	300	0 759
1265 6	400	0 569
1328 1	500	0 403
1352 0	544	0 346

(Seidell and Smith, J phys Chem 1904, 8  
498)

 $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$ 

Solubility of  $\text{CaSO}_4$  in  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$

Weight of 1000 cc of solution grams	G $\text{Mg}(\text{NO}_3)_2$ per l	G $\text{CaSO}_4$ per l
998 1	0	2 084
1020 5	25	5 772
1039 8	50	7 884
1078 6	100	9 920
1149 8	200	1 340
1219 0	300	14 000
1282 1	400	14 683
1355 3	514	15 040

(Seidell and Smith, J phys Chem 1904 8  
497)

1 l sat  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$  containing  
615 1 g  $\text{Mg}(\text{NO}_3)_2$  dissolves 15 26 g  $\text{CaSO}_4$   
(Cameron and Brown, J phys Ch 1905, 9  
214)

**KNO<sub>3</sub>+Aq**  
 1 g CaSO<sub>4</sub> is sol in 94 ccm sat KNO<sub>3</sub>+Aq at 13 5°, in 82 ccm sat KNO<sub>3</sub>+Aq at 15 5°, in 68 ccm nearly sat KNO<sub>3</sub>+Aq at 20° (Fassbender)

Solubility in KNO<sub>3</sub>+Aq at 25°

Wt of 1000 ccm of solution grams	G KNO <sub>3</sub> per l	G CaSO <sub>4</sub> per l
998 1	0 0	2 084
1008 1	12 5	3 284
1015 4	25 0	4 080
1032 1	50 0	5 255
1062 5	100 0	6 855
1092 4	150 0	7 907
1122 4	200 0	8 688
1153 9	260 0	a { 6 278 12 112

<sup>a</sup> Probably due to formation of double salt of calcium and potassium sulphates, CaK<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+H<sub>2</sub>O

(Seidell and Smith, J phys Chem 1908 8 496)

**NaNO<sub>3</sub>+Aq**  
 1 g CaSO<sub>4</sub> is sol in 92 ccm sat NaNO<sub>3</sub>+Aq at 8 5°, in 318 ccm 1/3 sat NaNO<sub>3</sub>+Aq at 13 5° (Fassbender)  
 100 ccm sat NaNO<sub>3</sub>+Aq dissolve 1 086 g CaSO<sub>4</sub>+2H<sub>2</sub>O, 100 ccm 1/3 sat NaNO<sub>3</sub>+Aq dissolve 0 314 g CaSO<sub>4</sub>+2H<sub>2</sub>O (Droeze, B 10 338)

Solubility in NaNO<sub>3</sub>+Aq at 25°

Wt of 1000 ccm of solution grams	G NaNO <sub>3</sub> per l	G CaSO <sub>4</sub> per l
998 1	0	2 084
1016 3	25	4 252
1034 0	50	5 500
1058 4	100	7 100
1133 6	200	8 790
1191 6	300	9 282
1363 9	600	7 886
1390 4	655	7 238

(Seidell and Smith, J phys Chem 1904, 8 495)

1 l sat NaNO<sub>3</sub>+Aq at 25°, containing 668 4 g NaNO<sub>3</sub>, dissolves 5 52 g CaSO<sub>4</sub> (Cameron and Brown, J phys Ch 1905, 9 214)

## Solubility in KBr+Aq at 21°

G KBr per l	G CaSO <sub>4</sub> per l	G KBr per l	G CaSO <sub>4</sub> per l
0	2 05	100	6 3
10	3 1	125	6 7
20	3 6	150	7 0
40	4 5	200	7 3
60	5 2	250	Double salt
80	5 9		

(Ditte, A ch 1898, (7) 14 294)

**KCl+Aq**  
 1 g CaSO<sub>4</sub> is sol in 162 ccm sat KCl+Aq at 8°, in 295 ccm 1/3 sat KCl+Aq at 9°

## Solubility in KCl+Aq at 21°

g per l		g per l	
KCl	CaSO <sub>4</sub>	KCl	CaSO <sub>4</sub>
0	2 05	60	6 6
10	3 6	80	7 2
20	4 5	100	7 5
40	5 8	125	Double Salt

(Ditte, A ch 1898, (7) 14 294)

## Solubility in KI+Aq at 21°

G KI per l	G CaSO <sub>4</sub> per l	G KI per l	G CaSO <sub>4</sub> per l
0	2 05	100	5 1
10	2 8	125	5 45
20	3 2	150	5 8
40	3 9	200	5 95
60	4 5	250	6 00
80	4 85	300	Double salt

(Ditte, l c)

**NaCl+Aq**

Sol in 122 pts sat NaCl+Aq (Anthon)  
 Insol in sat NaCl+Aq, but more sol in dil NaCl+Aq than in H<sub>2</sub>O Maximum solubility in NaCl+Aq is when the sp gr is 1 033

1 g CaSO<sub>4</sub> is sol in 147 ccm of sat NaCl+Aq at 8 5°, in 150 ccm of sat NaCl+Aq at 13 5°, in 149 ccm of 1/3 sat NaCl+Aq at 13 5°, in 244 ccm of 1/5 sat NaCl+Aq at 13 5° (Fassbender)

100 ccm sat NaCl+Aq dissolve 0 6785 g CaSO<sub>4</sub>+2H<sub>2</sub>O at 8 5°, 0 6665 g CaSO<sub>4</sub>+2H<sub>2</sub>O at 13 5° 100 ccm 1/3 sat NaCl+Aq dissolve 0 671 g CaSO<sub>4</sub>+2H<sub>2</sub>O at 13 5°, 1/5 sat NaCl+Aq dissolve 0 4085 g CaSO<sub>4</sub>+2H<sub>2</sub>O at 13 5° (Droeze)

Solubility of CaSO<sub>4</sub> in NaCl+Aq at t°

t	NaCl	CaSO <sub>4</sub>	t	NaCl	CaSO <sub>4</sub>
20	19 90	0 825	130	19 92	0 392
44	19 93	0 850	165	20 04	0 250
67	19 95	0 832	169	20 05	0 244
85	19 90	0 825	179	20 10	0 229
101	20 08	0 682	225	21 00	0 178

(Tilden and Shenstone, Roy Soc Proc 38 331)



Solubility of  $\text{CaSO}_4$  in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	% $\text{NaCl}$	100 cem dissolve g of $\text{CaSO}_4$	$t^\circ$	% $\text{NaCl}$	100 cem dissolve g of $\text{CaSO}_4$
21 5	3 53	0 5115	17 5	17 46	0 7369
19 5	7 35	0 6429	101 0	3 53	0 4891
21	11 12	0 7215	102 5	14 18	0 6248
18	14 18	0 7340	103	17 46	0 6299

(Lunge, J Soc Chem Ind 4 31)

100 pts  $\text{H}_2\text{O}$  containing pts  $\text{NaCl}$  dissolve pts  $\text{CaSO}_4$  at  $20^\circ$ 

Pts $\text{NaCl}$	Pts $\text{CaSO}_4$	Pts $\text{NaCl}$	Pts $\text{CaSO}_4$	Pts $\text{NaCl}$	Pts $\text{CaSO}_4$
0 00	0 225	5 05	6 34	24 40	0 820
0 52	0 301	10 00	7 38	35 10	0 734
2 03	0 441	20 00	0 823	35 86	0 709
5 02	6 15				

(Tilden and Shenstone)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $26^\circ$ 

g per l		wt of 1 cc solution	g per l		wt of 1 cc solution
$\text{NaCl}$	$\text{CaSO}_4$		$\text{NaCl}$	$\text{CaSO}_4$	
0 00	2 12	0 9998	176 50	7 12	1 1196
9 11	6 66	1 0644	228 76	6 79	1 1488
143 99	7 18	1 0981	264 17	6 50	1 1707
148 34	7 16	1 012	320 49	5 72	1 2034

(Cameron, J phys Ch 1901, 5 556)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $15^\circ$ 

G $\text{CaSO}_4$ per l		G $\text{NaCl}$ per l	
2 3		0 6	
2 5		1 1	
3 1		5 1	
3 7		10 6	
4 8		31 1	
5 6		51 4	
7 4		139 9	

(Cameron, J phys Ch 1901, 5 559)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $26^\circ$ 

$\text{NaCl}$ in 100 g $\text{H}_2\text{O}$	$\text{CaSO}_4$ in 100 g $\text{H}_2\text{O}$
0 0000	0 2126
9 4307	0 6886
15 2056	0 7581
15 6859	0 7575
18 8570	0 7605
25 0478	0 7439
29 3509	0 7219
36 5343	0 6515

(Cameron, J phys Ch 1901, 5 564)

Solubility in  $\text{NaCl} + \text{Aq}$ 

30°		52°		70°		82°	
G $\text{NaCl}$ per l	G $\text{CaSO}_4$ per l	G $\text{NaCl}$ per l	G $\text{CaSO}_4$ per l	G $\text{NaCl}$ per l	G $\text{CaSO}_4$ per l	G $\text{NaCl}$ per l	G $\text{CaSO}_4$ per l
0 5	2 5	0 5	2 3	0 5	2 2	0 0	2 07
10 3	3 6	1 1	2 4	10 0	3 4	1 0	2 18
30 3	5 0	5 0	2 9	29 6	4 9	5 0	2 65
47 3	6 1	10 1	3 5	48 8	5 8	10 1	3 30
73 4	6 9	29 6	5 0	132 7	7 4	29 5	4 68
126 9	7 3	48 3	5 8	195 0	7 6	48 8	5 54
192 4	7 7	75 7	6 6			74 9	6 23
		131 6	7 1			128 7	7 00
		195 9	7 4			195 1	7 15

(Cameron, J phys Ch 1901, 5 562)

1 l sat  $\text{NaCl} + \text{Aq}$  at  $25^\circ$  containing 318 3 g  $\text{NaCl}$  dissolves 5 52 g  $\text{CaSO}_4$  (Cameron and Brown, J phys Ch 1905, 9 214)Solubility in  $\text{NaCl} + \text{Aq}$ 

G $\text{NaCl}$ per l of $\text{NaCl} + \text{Aq}$	G anhydrous $\text{CaSO}_4$ dissolved per litre	
	at $14^\circ$	at $20^\circ$
0 0	1 70	2 10
2 925	2 32	2 70
5 850	2 79	3 15
11 70	3 41	3 75
14 62	3 68	4 00
29 25	4 40	4 70
58 50	5 72	6 00
87 75	6 58	6 85
102 3	6 90	7 15
117 0	7 10	7 30
131 6	7 20	7 30
146 2	7 10	7 13
160 8	7 00	7 05
175 6	6 80	6 50
204 7	6 30	6 30
234 0	5 90	5 90
263 2	5 50	5 52
292 6	5 30	5 30

(d'Anselme, Bull Soc 1903, (3) 29 373)

Solubility in  $\text{NaCl} + \text{Aq}$ 

G $\text{NaCl}$ in 100 cc solution	G $\text{CaSO}_4 + 2\text{H}_2\text{O}$
0 00	0 200 g
2 44 g	0 635 g
4 77 g	0 826 g
9 50 g	1 056 g
14 22 g	1 193 g
23 15 g	1 275 g
31 30 g	1 583 g

(Cloe, Bull Soc 1903, (3) 29 167)

## Solubility in NaCl+Aq at t°

When a sat solution of NaCl is shaken with a mixture of solid NaCl and CaSO<sub>4</sub>·2H<sub>2</sub>O, the calcium sulphate dissolved, calculated from the amount of CaO in solution, is always greater than that calculated from the sulphuric acid in solution. Similar results are obtained when solid calcium sulphate alone is shaken with a sat solution of NaCl.

t°	In 100 g of the solution		
	Cl	CaSO <sub>4</sub> calc from CaO	CaSO <sub>4</sub> calc from SO <sub>3</sub>
0	15 253	0 4464	0 4334
10	15 920	0 4477	0 4426
25	15 967	0 4609	0 4542
40	16 123	0 4938	0 4730
50	16 270	0 5093	0 4832
60	16 324	0 5305	0 5047
62 5	16 361	0 5091	0 5091
65	16 459	0 5435	0 3749
71	16 486	0 5578	0 3631
75	16 524	0 5603	0 3587
85	16 670	0 5399	0 3519
99	17 128	0 4066	0 3414

(Arth, Bull Soc 1906, (3) 35 780)

Within a temp range from 25°–80° CaSO<sub>4</sub> forms no double salt in solutions of NaCl. At any concentration with respect to the latter maximum solubility occurs with 155 g NaCl per l and amounts to 7.3 g CaSO<sub>4</sub> at 80° (Cameron, J phys Chem 1907, 11 496).

See also under Gypsum, p 653

Solubility of CaSO<sub>4</sub> in NaCl+Aq in contact with solid Ca(HCO<sub>3</sub>)<sub>2</sub>

CaSO <sub>4</sub> per l	Ca(HCO <sub>3</sub> ) <sub>2</sub> per l	G NaCl per l
1 9298	0 0603	0 000
2 7200	0 0724	3 628
3 4460	0 0845	11 490
5 1560	0 1006	39 620
6 1240	0 0603	79 520
5 2720	0 0563	121 900
4 7860	0 0482	193 800
4 1620	0 0402	267 600

(Cameron and Suddell, J phys Chem 1901, 5 653)

(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq

Sol in 287 pts (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq (1.4) (Freeman, Z anal 30 593)

1 lb CaSO<sub>4</sub> is sol in 327 cm (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq at 9° in 369 cm 1/7 sat (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq at 13.5° (Kassbender)

Solubility in sat (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, or Na<sub>2</sub>SO<sub>4</sub> is the same as in H<sub>2</sub>O (Droeze, B 10 330)

Solubility in (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq at 25°

g per l solution			g per l		
(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	CaSO <sub>4</sub>	wt of 100 cc solution	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	CaSO <sub>4</sub>	wt of 100 cc solution
0 00	0 208	99 91	6 575	0 144	100 36
0 129	0 204	99 91	13 15	0 146	100 82
0 258	0 199	99 92	26 30	0 162	101 76
0 821	0 181	99 95	84 9	0 233	105 34
1 643	0 166	99 99	169 8	0 333	110 32
3 287	0 154	100 10	339 6	0 450	119 15

(Sullivan, J Am Chem Soc 1905, 27 529)

Solubility in (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq at 50°

Sp gr	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> per l	CaSO <sub>4</sub> per l	Solid phase
	0	2 168	CaSO <sub>4</sub> +2H <sub>2</sub> O
1 0026	15 65	1 609	
1 0113	30 67	1 750	
1 0440	91 6	2 542	
1 0819	160 4	3 402	
1 1108	221 6	4 068	
1 1385	280 6	4 690	
1 1653	340 6	5 084	
1 1972	415 6	5 336	
1 1964	416 5	5 354	
1 2043	428 4	4 632	CaSO <sub>4</sub> (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> +2H <sub>2</sub> O
1 2187	479 4	3 524	
1 2437	530 8	2 152	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>
1 2480	558 0	1 986	
1 2502	564 7	1 98	
1 2508	566 0	1 08	
1 2510	566 7	0	

(Bell and Taber, J phys Chem 1906, 10 120)

Solubility of CaSO<sub>4</sub> in (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq at t°

Excess of (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>			Excess of CaSO <sub>4</sub>		
t°	CaSO <sub>4</sub>	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	t	CaSO <sub>4</sub>	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>
6	0 1529	41 82	3	0 3782	36 62
40 5	0 1569	44 55	31	0 4070	35 50
58	0 1662	46 07	60	0 5083	34 97
78	0 1968	47 51	75	0 5898	34 86
100	0 2546	49 45	80	0 6108	34 88
			84	0 5725	32 40
			100	0 4895	25 97

(Barre, C R 1909, 148 1605)

The solubility of CaSO<sub>4</sub> in H<sub>2</sub>O is considerably increased by the presence of (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>.

but decreased by the presence of  $K_2SO_4$   
(Barre, C R 1909, 148 1606)

### $CuSO_4 + Aq$

Solubility in  $CuSO_4 + Aq$  at  $25^\circ$

Sp gr of the solution $25^\circ/25$	g $CuSO_4$ per l	g $CaSO_4$ per l
1 002	1 144	2 068
1 005	3 564	1 986
1 007	6 048	1 944
1 009	7 279	1 858
1 016	14 814	1 760
1 021	19 729	1 736
1 030	29 543	1 688
1 041	39 407	1 718
1 051	49 382	1 744
1 061	58 880	1 782
1 098	97 950	1 931
1 146	146 725	2 048
1 192	196 021	2 076
1 218	224 916	2 088

(Bell and Taber, J phys Ch 1907, 11 637)

### $MgSO_4 + Aq$

Insol in sat  $MgSO_4 + Aq$

1 g  $CaSO_4$  is sol in 1162 ccm  $1/10$  sat  $MgSO_4 + Aq$  at  $13.5^\circ$  (Fassbender, B 9 1360)

\* Sol in 635 pts sat  $MgSO_4 + Aq$  at  $19^\circ$  (Karsten)

Absolutely insol in sat  $MgSO_4 + Aq$ , and pptd from aqueous solution by the addition of  $MgSO_4$  (Droeze, B 10 340)

1 l  $1/10$  sat  $MgSO_4 + Aq$  dissolves 0.86 g  $CaSO_4 + 2H_2O$  (Droeze)

Solubility in  $MgSO_4 + Aq$  at  $25^\circ$

g per l		Sp gr at $25^\circ/25^\circ$	g per l		Sp gr at $25^\circ/25^\circ$
$MgSO_4$	$CaSO_4$		$MgSO_4$	$CaSO_4$	
0 0	2 046	1 0032	149 67	1 597	1 1377
3 20	1 620	1 0055	165 7	1 549	1 1479
6 39	1 507	1 0090	171 2	1 474	1 1537
10 64	1 471	1 0118	198 8	1 422	1 1813
21 36	1 478	1 0226	232 1	1 254	1 2095
42 68	1 558	1 0419	265 6	1 070	1 2382
64 14	1 608	1 0626	298 0	1 860	1 2624
85 67	1 617	1 0833	330 6	0 647	1 2877
128 28	1 627	1 1190	355 0	0 501	1 3023

(Cameron and Bell, J phys Ch 1906, 10 210)

### $K_2SO_4 + Aq$

1 g  $CaSO_4$  is sol in 2325 ccm sat  $K_2SO_4 + Aq$  at  $13.5^\circ$ , in 664 ccm  $1/5$  sat  $K_2SO_4 + Aq$  at  $13.5^\circ$

Solubility in  $K_2SO_4 + Aq$  at  $25^\circ$

g per l		wt of 1 cc of solution
$K_2SO_4$	$CaSO_4$	
0 0	2 08	0 9981
4 88	1 60	1 0036
5 09	1 56	1 0038
9 85	1 45	1 0075
19 57	1 49	0 151
28 35	1 55	1 0229
30 66	1 57	1 0236
32 47*	1 58	

\*Solid phase syngenite  
(Cameron and Breazeale, J phys Ch 1904, 8 335)

Solubility in  $K_2SO_4 + Aq$  at  $25^\circ$

In 1000 g of the solution

mole  $K_2SO_4$  mole  $CaSO_4$

3 223 0 223

(D'Ans, Z anorg 1909, 62 151)

Solubility of  $CaSO_4$  in  $K_2SO_4 + Aq$  at  $t^\circ$

Excess of $K_2SO_4$			Excess of $CaSO_4$	
$t^\circ$	% $CaSO_4$	% $K_2SO_4$	% $CaSO_4$	% $K_2SO_4$
0	0 1296	2 00	0 0229	6 99
18	0 1531	2 79	0 0271	9 81
51	0 1754	4 21	0 0300	14 18
80	0 1922	5 00	0 0349	17 55
99	0 1980	5 39	0 0371	19 70

(Barre, C R 1909, 148 1606)

### $Ag_2SO_4 + Aq$

1 l of the solution contains 2.31 g  $CaSO_4$  + 7.23 g  $Ag_2SO_4$  = 9.54 g mixed salts at  $17^\circ$   
Sp gr = 1.0083

1 l of the solution contains 2.61 g  $CaSO_4$  + 8.11 g  $Ag_2SO_4$  = 10.72 g mixed salts at  $25^\circ$   
Sp gr = 1.010 (Euler, Z phys Ch 1904, 49 313)

### $Na_2SO_4 + Aq$

1 g  $CaSO_4$  is sol in 398 ccm sat  $Na_2SO_4 + Aq$  at  $10.5^\circ$

Solubility of  $CaSO_4$  in  $Na_2SO_4 + Aq$  at  $22^\circ$

G $CaSO_4$ per l	C $Na_2SO_4$ per l
2 084	0 000
1 583	2 771
1 433	13 520
1 408	16 360
1 569	39 510
1 841	77 520
2 185	133 00
2 414	193 800
*2 578	*222 580

\*Both  $CaSO_4$  and  $Na_2SO_4$  as solid phases in contact with the solution  
(Cameron and Seidell, J phys Chcm 1901, 5 650)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

wt of 1000 ccm of solution grams	g $\text{Na}_2\text{SO}_4$ per l	g $\text{CaSO}_4$ per l
1001 26	2 390	1 650
1007 59	9 535	1 457
1011 45	14 132	1 388
1020 46	24 369	1 471
1031 48	36 979	1 563
1039 12	46 150	1 650
1079 47	94 220	1 980
1096 47	115 084	2 096
1142 66	146 612	2 234
1176 47	205 105	2 503
1212 00	257 100	2 650

(Cameron and Breazeale, J phys Chem 1904, 8 340)

1 l sat  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$  containing 254.09,  $\text{Na}_2\text{SO}_4$  dissolves 2.58 g  $\text{CaSO}_4$  (Cameron and Brown, J phys Ch 1905, 9 214)

Hydration is retarded by dil solutions and accelerated by conc solution of sodium, potassium, ammonium and magnesium sulphates (Rohland, Z Elektrochem 1908, 14 422)

More than 10 times as much  $\text{CaSO}_4$  dissolves in sat  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  as in  $\text{H}_2\text{O}$  (Diehl Insol in alcohol of 0.905 sp gr or less (Anthon, J pr 14 125))

Solubility in 10% alcohol = 0.0970 g  $\text{CaSO}_4$  per 100 g solution (Magnanini, Gazz Ch it 1901, 31 (2) 544)

Sol in dil alcoholic solutions of  $\text{NH}_4\text{NO}_3$ ,  $\text{KNO}_3$ ,  $\text{NaNO}_3$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{KCl}$ , and  $\text{NaCl}$  (Margueritte, C R 38 308)

Sol to considerable extent in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ , especially if freshly pptd. More sol in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  than in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Weppen, J pr 11 182)

More sol in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  than in other  $\text{NH}_4$  salts (Cohn, J pr (2) 35 43)

More sol in  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$  or  $\text{KCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Mulder)

Solubility in N/200 potassium hydrogen tartrate +  $\text{Aq}$  = 0.2323 g  $\text{CaSO}_4$  per 100 g solution (Magnanini, Gazz ch it 1901, 31 (2) 544)

72.61 millimols per l of  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  are sol at  $25^\circ$  in ammonium citrate +  $\text{Aq}$  (concentration = 0.5 millimols per l)

36.39 millimols per l of  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  are sol at  $25^\circ$  in sodium citrate +  $\text{Aq}$  (Concentration = 0.25 millimols per l (Randell, Z phys Ch 1910, 70 452))

100 pts glycerine dissolve 0.957 pt  $\text{CaSO}_4 + 2\text{H}_2\text{O}$ , and solubility increases with the temp (Asselin, C R 76 884)

100 g glycerine (sp gr 1.256) dissolve 5.17 g  $\text{CuSO}_4$  at  $15-16^\circ$  (Ossendowski, Pharm J 1907, 79 575)

Solubility in 10% alcoholic N/200  $\text{KHC}_2\text{H}_4\text{O}_6 + \text{Aq}$  = 0.0866 g  $\text{CaSO}_4$  per 100 g solution

Solubility in N/200  $\text{KHC}_2\text{H}_4\text{O}_6 + \text{Aq}$  + 5% tartaric acid = 0.2556 g  $\text{CaSO}_4$  per 100 g solution

Solubility in 10% alcoholic N/400  $\text{KHC}_2\text{H}_4\text{O}_6 + 5\%$  tartaric acid = 0.1086 g  $\text{CaSO}_4$  in 100 g solution (Magnanini)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethylacetate (Naumann, B 1910, 43 314)

Solubility in sugar +  $\text{Aq}$  at  $t^\circ$ 

% sugar	G $\text{CaSO}_4$ dissolved in 1 l sugar solutions					
	$30^\circ$	$40^\circ$	$50^\circ$	$60^\circ$	$70^\circ$	$80^\circ$
0		2 157	1 730	1 730	1 652	1 710
10	2 041	1 730	1 730	1 574	1 574	1 613
20	1 808	1 652	1 419	1 380	1 419	1 263
27	1 550	1 438	1 361	1 283	1 283	0 972
35	1 263	1 050	1 088	1 108	0 914	
42	1 030		0 777	0 816	0 855	0 729
49		0 564	0 739	0 564	0 603	0 486
55		0 486	0 505	0 486	0 369	0 330

(Stolle, Z Ver Zuckerind, 1900, 50 331)

## Min Anhydrite

+  $2\text{H}_2\text{O}$  Min Gypsum

Gypsum A sat aq solution of gypsum of particles not less than  $2\mu$  contains 2.085 g  $\text{CaSO}_4$  per litre at  $25^\circ$

A sat aq solution of gypsum of particles not smaller than  $0.3\mu$  contains 2.476 g  $\text{CaSO}_4$  per liter at  $25^\circ$  ( $\mu = 0.0001 \text{ cm}$ ) (Hulett and Allen, Z phys Ch 1901, 37 391 and 393)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	g $\text{CaSO}_4$ in 100 ccm of the solution	Densitv of the solution at t
0	0 17590	1 001970
10	0 19255	1 001727
18	0 20160	1 000590
25	0 20805	0 999109
30	0 20935	0 997891
35	0 20960	0 996122
40	0 20970	0 994390
45	0 20835	0 992370
55	0 20095	0 987960
65	0 19320	0 982560
75	0 18475	0 977724
100	0 16195	

(Hulett and Allen, J Am Chem Soc 1902, 24 674)

1 l  $\text{H}_2\text{O}$  dissolves 2.13 g  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $25^\circ$  (Fulcr, Z phys Ch 1904, 49 314)

2023 mg ue dissolved in 1 l of sat solution at  $18^\circ$  (Kohh usch, Z phys Ch 1908, 64 168)

1 l  $\text{H}_2\text{O}$  dissolves 2.267 g  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $0^\circ$ , 2.684 g at  $35^\circ$ , 2.662 g at  $50^\circ$ , and 2.155 g at  $100^\circ$  (Cavazzi, C C 1905, I 1693)

1 l H<sub>2</sub>O dissolves 29.5 milliequivalents at 18°, 30 at 50°, 23.3 at 100° (Melcher, J Am Chem Soc 1910, 32 63)

See also under CaSO<sub>4</sub>

Solubility of pulverized gypsum in NaCl + Aq at 23°

Grams gypsum	G NaCl per l	G CaSO <sub>4</sub> per l
2 99	0 99	2 37
3 82	4 95	3 02
4 48	10 40	3 54
6 31	30 19	4 97
7 51	49 17	5 94
8 53	75 58	6 74
9 42	129 50	7 50
9 17	197 20	7 25
8 88	229 70	7 03
7 19	306 40	5 68
6 79	315 55	5 37

(Cameron, J phys Chem 1901, 5 559)

See also under CaSO<sub>4</sub>

+ 1/2 H<sub>2</sub>O Plaster of Paris contains 1/2 H<sub>2</sub>O according to Chatelier (C C 1889, 1 203)

#### Calcium hydrogen sulphate, CaH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>

100 pts H<sub>2</sub>SO<sub>4</sub> of 1.82 sp gr dissolve about 2 pts CaSO<sub>4</sub>, 100 pts fuming H<sub>2</sub>SO<sub>4</sub> dissolve 10.17 pts CaSO<sub>4</sub> (Struve, Z anal 9 34), 100 pts H<sub>2</sub>SO<sub>4</sub> dissolve 2.5 pts CaSO<sub>4</sub> (Lies-Bodart and Jacquemin, C R 46 1206), CaSO<sub>4</sub> is precipitated by H<sub>2</sub>O from H<sub>2</sub>SO<sub>4</sub> solution

100 pts boiling H<sub>2</sub>SO<sub>4</sub> dissolve 10 pts CaSO<sub>4</sub> (Schultz, Pogg 133 137)

Solubility of CaSO<sub>4</sub> in H<sub>2</sub>SO<sub>4</sub> + Aq

wt of 1000 ccm of solution at 25°	g H <sub>2</sub> SO <sub>4</sub> per l	g CaSO <sub>4</sub> per l at		
		25°	35°	43
999 1067	0 00	2 126		2 145
1002 493	0 48	2 128	2 209	2 236
1002 553	4 87	2 144	2 451	2 456
1005 091	8 11	2 203		2 760
1009 787	16 22	2 382		3 116
1030 151	48 67	2 727	3 397	3 843
1043 470	75 00	2 841		4 146
1075 613	97 35	2 779	3 606	
	146 01	2 571	3 150	4 139
1113 392	194 70	2 313		3 551
1141 755	243 35	1 901		2 959
1168 143	292 02	1 541		2 481

(Cameron and Breazeale, J phys Chem 1903, 7 574)

100 pts hot conc H<sub>2</sub>SO<sub>4</sub> dissolve approx 10 pts CaSO<sub>4</sub> (Rohland, Z anorg 1910, 66 206)

Decomp by H<sub>2</sub>O

Calcium hexahydrogen sulphate, CaH<sub>6</sub>(SO<sub>4</sub>)<sub>4</sub>  
Decomp by H<sub>2</sub>O (Schultz, Pogg 133 137)

Calcium cupric potassium sulphate,  
Ca<sub>2</sub>K<sub>2</sub>Cu(SO<sub>4</sub>)<sub>4</sub> + 2H<sub>2</sub>O  
(D'Ans, B 1908, 41 1778)

Calcium magnesium potassium sulphate,  
2CaSO<sub>4</sub>, MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> + 2H<sub>2</sub>O  
Min *Polyhalite* Sol in H<sub>2</sub>O with residue of CaSO<sub>4</sub>  
4CaSO<sub>4</sub>, MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> + 2H<sub>2</sub>O Min *Krugite* Decomp by H<sub>2</sub>O

Calcium potassium sulphate, CaK<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> + H<sub>2</sub>O

Min *Syngenite* Sol in 400 pts H<sub>2</sub>O (Zepharovitch) Less sol than K<sub>2</sub>SO<sub>4</sub>  
Decomp by heating with separation of CaSO<sub>4</sub>  
Decomp by H<sub>2</sub>O until 25 g K<sub>2</sub>SO<sub>4</sub> are dissolved in a litre, after which there is no decomposition (Ditte, C R 84 86)

Easily sol in dil acids (Phillips)

Solubility of syngenite, CaK<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> + H<sub>2</sub>O in K<sub>2</sub>SO<sub>4</sub> + Aq at 25°

Wt of 1000 ccm of solution grams	g K <sub>2</sub> SO <sub>4</sub> per l	g CaSO <sub>4</sub> per l
1013 08	16 31	*1 495
1015 78	19 87	1 529
1020 01	25 01	1 537
1024 54	30 83	1 565
1036 82	46 99	0 810
1058 10	75 45	0 451
1085 91	112 87	0 330

\*In first four determinations syngenite completely decomposed  
(Cameron and Breazeale, J phys Chem 1904, 8 339)

This double salt is stable between 0° and 99° in the presence of an excess of either CaSO<sub>4</sub> or K<sub>2</sub>SO<sub>4</sub>. In this temp interval the double sulphate, 2CaSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, 3H<sub>2</sub>O described by Ditte (C R 84 867) does not exist (Barre, C R 1909, 148 1607)

Ca<sub>2</sub>K<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> + 3H<sub>2</sub>O Decomp by cold H<sub>2</sub>O (Ditte, C R 84 867)

5CaSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> + H<sub>2</sub>O Slowly decomp by H<sub>2</sub>O (van't Hoff and Geiger, B A B 1904 935)

Calcium potassium zinc sulphate,  
Ca<sub>2</sub>K<sub>2</sub>Zn(SO<sub>4</sub>)<sub>4</sub> + 2H<sub>2</sub>O  
(D'Ans, B 1908, 41 1778)

Calcium rubidium sulphate, Ca<sub>2</sub>Rb<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>

(D'Ans, B 1907, 40 4913)

+ 3H<sub>2</sub>O Decomp by H<sub>2</sub>O (Ditte, C R 84 86)

CaRb<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> + H<sub>2</sub>O (D'Ans)

**Calcium sodium sulphate,  $\text{CaNa}_2(\text{SO}_4)_2$** 

Min *Glauberite* Gradually sol in  $\text{H}_2\text{O}$ , but crystals of  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  soon separate out (Fritzsche)

Insol in alcohol, and conc  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , decomp by  $\text{H}_2\text{O}$  (Folkhard, C N 43 6)

$\text{CaNa}_4(\text{SO}_4)_2 + 2\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Fritzsche)

**Calcium titanium sulphate,  $\text{CaSO}_4, \text{Ti}(\text{SO}_4)_2$** 

Ppt, decomp by  $\text{H}_2\text{O}$  giving titanic acid (Wenland, Z anorg 1907, 54 254)

**Calcium uranium sulphate**

Min *Uranochalcite*

Min *Medysite* Easily sol in dil  $\text{HCl} + \text{Aq}$

**Cerous sulphate,  $\text{Ce}_2(\text{SO}_4)_3$** 

Anhydrous cerous sulphate is much more sol in  $\text{H}_2\text{O}$  than the hydrated salt

Easily sol in cold  $\text{H}_2\text{O}$  if added thereto in small amounts. If large amount of  $\text{Ce}_2(\text{SO}_4)_3$  is treated with a little  $\text{H}_2\text{O}$  it hardens with evolution of heat, and becomes very difficultly soluble. 100 pts  $\text{H}_2\text{O}$  dissolve 161 pts  $\text{Ce}_2(\text{SO}_4)_3$  at  $0^\circ$  and 17 86 pts at  $19^\circ$

$\text{Ce}_2(\text{SO}_4)_3 + \text{Aq}$  sat in cold deposits  $\text{Ce}_2(\text{SO}_4)_3$  at  $75^\circ$ , and only 2 25 pts remain in solution at  $100^\circ$  (Jolin, Bull Soc (2) 21 536)

100 pts  $\text{H}_2\text{O}$  dissolve 8 31 pts  $\text{Ce}_2(\text{SO}_4)_3$  at  $20^\circ$ , 8 08 pts at  $45^\circ$ , 4 95 pts at  $60^\circ$ , 0 504 pt at  $100^\circ$  (Buhrig, J pr (2) 12 240)

60 pts anhydrous salt dissolve quickly at  $0-3^\circ$  in 100 pts  $\text{H}_2\text{O}$

At  $15^\circ$  the solution solidifies, and the mother liquor contains only 27 88%  $\text{Ce}_2(\text{SO}_4)_3$ . At  $15^\circ$  the maximum attainable strength is 31 62%  $\text{Ce}_2(\text{SO}_4)_3$  (Brauner, Chem Soc 53 357)

100 pts  $\text{H}_2\text{O}$  dissolve 10 747 pts  $\text{Ce}_2(\text{SO}_4)_3$  at  $16^\circ$ , 9 648 pts at  $19^\circ$ , 6 949 pts at  $33^\circ$

The solubility of  $\text{Ce}_2(\text{SO}_4)_3$  in  $\text{H}_2\text{O}$  is diminished by the addition of  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$  or  $\text{Na}_2\text{SO}_4$  (Barre, C R 1910, 151 872)

Sp gr of  $\text{Ce}_2(\text{SO}_4)_3 + \text{Aq}$  was found to be constant whether  $\text{Ce}_2(\text{SO}_4)_3$  or  $\text{Ce}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  was used. The following results were obtained at  $15^\circ$

Pts $\text{Ce}_2(\text{SO}_4)_3$ to 100 pts $\text{H}_2\text{O}$	Sp gr	Pts $\text{Ce}_2(\text{SO}_4)_3$ to 100 pts $\text{H}_2\text{O}$	Sp gr
3 17	1 03005	12 66	1 11917
6 11	1 05812	14 56	1 13665
8 35	1 07910	15 64	1 14623
9 61	1 09085	21 19	1 19640
10 55	1 09939	31 62	1 28778
11 66	1 10987		

(Brauner, Chem Soc 53 357)

4 5 pts  $\text{Ce}_2(\text{SO}_4)_3$  dissolve in 100 pts  $\text{H}_2\text{SO}_4$  (Wyruboff, Bull Soc (3) 2 745)

**Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $16^\circ$** 

Per 100 pts  $\text{H}_2\text{O}$

$(\text{NH}_4)_2\text{SO}_4$	$\text{Ce}_2(\text{SO}_4)_3$
0 00	10 747
3 464	1 026
9 323	0 782
19 240	0 748
29 552	0 701
45 616	0 497
55 083	0 194
63 920	0 090
72 838	0 035

(Barre, A ch 1911, (8) 24 252)

**Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $19^\circ-20^\circ$** 

Per 100 pts  $\text{H}_2\text{O}$

$\text{Na}_2\text{SO}_4$	$\text{Ce}_2(\text{SO}_4)_3$
0 00	9 64
0 328	0 637
0 684	0 259
1 091	0 0937
1 392	0 057
1 699	0 0303
2 640	0 012
3 589	0 0065
5 660	0 0046
7 710	0 0037

(Barre, A ch 1911, (8) 24 251)

**Solubility in  $\text{K}_2\text{SO}_4 + \text{Aq}$  at  $16^\circ$** 

Per 100 pts  $\text{H}_2\text{O}$

$\text{K}_2\text{SO}_4$	$\text{Ce}_2(\text{SO}_4)_3$
0 00	10 747
0 178	0 956
0 510	0 432
0 726	0 250
1 290	0 0419

(Barre, A ch 1911, (8) 24 248)

$+4\text{H}_2\text{O}$  100 g  $\text{H}_2\text{O}$  dissolve at

$35^\circ$   $40^\circ$   $50^\circ$   $57^\circ$   
8 5 6 04 3 43 2 34 g  $\text{Ce}_2(\text{SO}_4)_3$

$65^\circ$   $70^\circ$   $82^\circ$  100 5° bpt of sat solution  
1 883 1 38 1 01 0 43 g  $\text{Ce}_2(\text{SO}_4)_3$

(Koppel, Z anorg 1904, 41 399)

+5H <sub>2</sub> O	
100 pts H <sub>2</sub> O dissolve pts Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> at t°	
t°	Pts Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
100	0 775
80	1 70
60	3 45
50	5 56
40	8 20

(Muthmann and Rolig, Z anorg 1898, **16** 456)

100 g H <sub>2</sub> O dissolve at		
45°	60°	70°
8 833	3 247	1 929 g Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
80°	90°	100 5° bpt of sat solution
1 207	0 8355	0 469 g Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>

Muthmann and Rolig's determinations are inaccurate (Koppel)

+8H<sub>2</sub>O 100 pts H<sub>2</sub>O dissolve 14 92 pts Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> at 20° from Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O<sub>3</sub> (Jolin)

100 pts H <sub>2</sub> O dissolve pts Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> at t°			
t°	Pts Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	t°	Pts Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
0	19 10	50	12 48
18	17 32	60	9 40
30	16 13	70	4 24

(Muthmann and Rolig)

100 g H <sub>2</sub> O dissolve at		
0°	15°	20 4°
10 09	11 06	9 525 g Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
30°	40°	50° 60°
7 388	5 947	4 785 4 064 g Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>

Previous determinations are inaccurate (Koppel, Z anorg 1904, **41** 395)

100 g sat solution at 25° contain 7 60 g anhydrous salt (Wirth, Z anorg **76** 174)

Solubility in H<sub>2</sub>SO<sub>4</sub>+Aq at 25° Solid phase Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O

Normality H <sub>2</sub> SO <sub>4</sub>	In 100 g of the liquid are dissolved	
	g Ce O <sub>3</sub>	g Ce (SO <sub>4</sub> ) <sub>3</sub>
0	4 604	7 60
0 1	4 615	7 618
1 1	3 64	6 00
2 16	3 04	5 018
4 32	2 0	3 301
6 685	0 9115	1 505
9 68	0 4339	0 733
15 15	0 145	0 239

(Wirth, Z anorg 1912, **76** 191)

+9H<sub>2</sub>O 100 pts H<sub>2</sub>O dissolve 17 52 pts Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> from Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+9H<sub>2</sub>O (Brauner

100 g H <sub>2</sub> O dissolve at				
0°	15°	21°	30°	31 2°
20 98	11 87	9 725	7 353	7 185 g Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
31 6°	45°	50°	60°	65°
7 164	5 13	4 673	3 88	3 595 g Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>

(Koppel)

+12H <sub>2</sub> O	
100 pts H <sub>2</sub> O dissolve pts Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> at t°	
t°	Pts Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
0	21 40
18	18 44
25	16 22

(Muthmann and Rolig, Z anorg 1898, **16** 457)

100 g H <sub>2</sub> O dissolve at		
0°	18 8°	19 2°
16 56	17 52	17 70 g Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>

Previous determinations are inaccurate (Koppel)

**Ceroceric sulphate**, Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2Ce(SO<sub>4</sub>)<sub>2</sub>+24H<sub>2</sub>O

Decomp by H<sub>2</sub>O Sol in HCl+Aq with decomp (Mendelejeff, A **168** 45)

Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3Ce(SO<sub>4</sub>)<sub>2</sub>+31H<sub>2</sub>O (Jolin)

**Ceric sulphate, basic**, CeO<sub>2</sub>, SO<sub>3</sub>+2H<sub>2</sub>O

Very sl sol in H<sub>2</sub>O

Sol in 2500 pts H<sub>2</sub>O (Mosander)

Boiling H<sub>2</sub>O gradually dissolves out H<sub>2</sub>SO<sub>4</sub> (Erk)

Sol in acids

8CeO<sub>2</sub>, 7SO<sub>3</sub>+12H<sub>2</sub>O, 8CeO<sub>2</sub>, 7SO<sub>3</sub>+15H<sub>2</sub>O, 6CeO<sub>2</sub>, 5SO<sub>3</sub>+5H<sub>2</sub>O, 4CeO<sub>2</sub>, 3SO<sub>3</sub>+7H<sub>2</sub>O, and 3Ce(SO<sub>4</sub>)<sub>2</sub>, 5Ce(OH)<sub>4</sub> All are insol ppts

**Ceric sulphate**, Ce(SO<sub>4</sub>)<sub>2</sub>

*Anhydrous* Very slowly sol in cold, more rapidly in hot H<sub>2</sub>O When solution has once begun, almost unlimited quantities may be dissolved Insol in conc H<sub>2</sub>SO<sub>4</sub> (Meyer, B 1904, **37** 144)

+4H<sub>2</sub>O Sol in H<sub>2</sub>O with immediate decomp (Rammelsberg)

Decomp by H<sub>2</sub>O (Muthmann, B 1900, **33** 1764)

**Cerous hydrogen sulphate**, Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3H<sub>2</sub>SO<sub>4</sub>

Decomp by H<sub>2</sub>O (Wyrouboff, Bull Soc (3) **2** 745, Brauner, Z anorg 1904, **38** 329)

**Ceroceric hydrogen sulphate**, Ce<sub>2</sub>H(SO<sub>4</sub>)<sub>4</sub>+13H<sub>2</sub>O

Sol in H<sub>2</sub>O Forms very supersat solutions

Solubility in H<sub>2</sub>SO<sub>4</sub> decreases with increase in concentration of the acid (Meyer, B 1904, **37** 146)

**Cerous potassium sulphate**,  $\text{Ce}_2(\text{SO}_4)_3$ ,  $\text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$ , insol in sat  $\text{K}_2\text{SO}_4 + \text{Aq}$  (Czudnowicz, J pr 80 26)

$2\text{Ce}_2(\text{SO}_4)_3$ ,  $3\text{K}_2\text{SO}_4$  As above (Hermann, J pr 30 188)

$+8\text{H}_2\text{O}$  (Barre, A ch 1911, (8) 24 249)  
 $\text{Ce}_2(\text{SO}_4)_3$ ,  $2\text{K}_2\text{SO}_4 + 3\text{H}_2\text{O}$  As above (Jolin)

$\text{Ce}_2(\text{SO}_4)_3$ ,  $3\text{K}_2\text{SO}_4$  Sol in about 56 pts  $\text{H}_2\text{O}$  at  $9-20^\circ$  Easily sol in acidified  $\text{H}_2\text{O}$

Nearly insol in sat  $\text{K}_2\text{SO}_4 + \text{Aq}$  (Jolin)  
 $\text{Ce}_2(\text{SO}_4)_3$ ,  $5\text{K}_2\text{SO}_4$  Insol in  $\text{K}_2\text{SO}_4 + \text{Aq}$  (Barre, l c)

**Ceric potassium sulphate**,  $\text{Ce}(\text{SO}_4)_2$ ,  $2\text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  with decomp Insol in sat  $\text{K}_2\text{SO}_4 + \text{Aq}$

**Ceric silver sulphate**,  $10\text{Ce}(\text{SO}_4)_2$ ,  $6\text{Ag}_2\text{SO}_4$

Only sl sol in cold  $\text{H}_2\text{O}$ , decomp by hot  $\text{H}_2\text{O}$  in which it is readily sol (Pozzi-Escot, C R 1913, 156 1074)

**Cerous sodium sulphate**,  $\text{Ce}_2(\text{SO}_4)_3$ ,  $\text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$ , and still less in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  100 ccm sat  $\text{Na}_2\text{SO}_4 + \text{Aq}$  dissolve an amount corresponding to 62 mg  $\text{Ce}_2\text{O}_3$  (Jolin)

Sl sol in  $\text{HCl} + \text{Aq}$  (Czudnowicz)

**Cerous thallous sulphate**,  $\text{Ce}_2(\text{SO}_4)_3$ ,  $3\text{Tl}_2\text{SO}_4$   
Ppt

$\text{Ce}_2(\text{SO}_4)_3$ ,  $\text{Tl}_2\text{SO}_4 + 2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Zschiesche, J pr 107 98)

$+4\text{H}_2\text{O}$  Very sl sol in cold, somewhat more in warm  $\text{H}_2\text{O}$  (Wyruboff, Bull Soc Min 14 83)

**Cerous tin (stannic) hydrogen sulphate**,  $\text{CeHSn}(\text{SO}_4)_4$

Decomp by  $\text{H}_2\text{O}$  Sol in very dil  $\text{HCl}$  (Weinland, Z anorg 1907, 54 251)

**Chromous sulphate**,  $\text{CrSO}_4 + 7\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve 12 35 pts  $\text{CrSO}_4 + 7\text{H}_2\text{O}$  Aqueous solution can be boiled without decomp Sl sol in alcohol

$+ \text{H}_2\text{O}$  (Moissan, Bull Soc 37 296)

**Chromic sulphate, basic**,  $3\text{Cr}_2\text{O}_3$ ,  $2\text{SO}_3 + 12\text{H}_2\text{O} = 2\text{Cr}_2(\text{SO}_4)(\text{OH})_4$ ,  $\text{Cr}_2(\text{OH})_6 + 5\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in acids Slowly decomp by  $\text{KOH} + \text{Aq}$  or  $\text{K}_2\text{CO}_3 + \text{Aq}$

$5\text{Cr}_2\text{O}_3$ ,  $3\text{SO}_3$  Sol in  $\text{H}_2\text{O}$  (Recoura, C R 112 1439)

$\text{Cr}_2\text{O}_3$ ,  $\text{SO}_3 = \text{Cr}_2\text{O}_2(\text{SO}_4)$  Ppt (Schiff, A 124 167)

$+10\text{H}_2\text{O}$  or  $[\text{Cr}(\text{OH})_2(\text{OH})_4]_2\text{SO}_4$  Nearly insol in  $\text{H}_2\text{O}$  (Werner, B 1908, 41 3451)

$5\text{Cr}_2\text{O}_3$ ,  $8\text{SO}_3$  (?) (Siewert, A 126 97)

$\text{Cr}_2\text{O}_3$ ,  $2\text{SO}_3 = \text{Cr}_2\text{O}(\text{SO}_4)_2$  Easily sol in a little  $\text{H}_2\text{O}$ , but a precipitate is thrown down

by further addition of  $\text{H}_2\text{O}$ , which redissolves on evaporation

$5\text{Cr}_2\text{O}_3$ ,  $12\text{SO}_3$  (?) (Siewert)

$2\text{Cr}_2\text{O}_3$ ,  $5\text{SO}_3 + 15\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  insol in alcohol and acetone by which it is ppt from aqueous solution (Nicolardot, C R 1907, 145 1338)

**Chromic sulphate**,  $\text{Cr}_2(\text{SO}_4)_3$

*Anhydrous* Insol in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , aqua regia, and  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp by boiling caustic alkalis, and slowly by alkali carbonates  $+ \text{Aq}$  (Schrotter) According to Traube (A 71 92) and Siewert (A 126 94), Schrotter's salt is an acid sulphate,  $\text{Cr}_4(\text{SO}_4)_5(\text{OSO}_3\text{OH})_2 = 2\text{Cr}_2(\text{SO}_4)_3$ ,  $\text{H}_2\text{SO}_4$  According to Etard (Bull Soc (2) 31 200) both salts exist, and formula of above salt is  $\text{Cr}_2(\text{SO}_4)_3\text{Cr}_2$  Formula is  $2[(\text{Cr}_2\text{O}_3)_2, (\text{SO}_3)_3]$ ,  $17\text{H}_2\text{SO}_4$  (?) (Cross and Higgins, Chem Soc 41 113)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

$+6\text{H}_2\text{O}$  (?) *Green modification* Readily sol in  $\text{H}_2\text{O}$  or alcohol Sol in conc  $\text{H}_2\text{SO}_4$   $\text{H}_2\text{O}$  solution is converted into the violet modification by standing 3-4 weeks (Schrotter)  
 $+11\text{H}_2\text{O}$  (?) Extremely deliquescent, becomes liquid in moist air in 2 minutes Not pptd by  $\text{BaCl}_2 + \text{Aq}$  (Recoura, C R 113 857)

$+18\text{H}_2\text{O}$  *Violet modification* Sol in 0 833 pt  $\text{H}_2\text{O}$  at  $20^\circ$  When the  $\text{H}_2\text{O}$  solution is heated to  $65-70^\circ$  it begins to be converted into the green modification This conversion is also brought about by cold  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{PCl}_3$  (Etard, C R 84 1090)

Sp gr of aqueous solution of violet modification of  $\text{Cr}_2(\text{SO}_4)_3$  containing

5	10	20%	$\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1 0275	1 0560	1 1150	
30	40	50%	$\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1 1785	1 2480	1 3250	

Sp gr of aqueous solution of green modification of  $\text{Cr}_2(\text{SO}_4)_3$  containing

10	20	30%	$\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1 0510	1 1070	1 1680	
40	50	60%	$\text{Cr}(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1 2340	1 3055	1 3825	

70 80%  $\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$   
1 4650 1 5535

(Gerlach, Z anal 28 494)

See also **Chromosulphuric acid**

**Chromic hydrogen sulphate**,  $\text{Cr}_2(\text{SO}_4)_3$ ,  $\text{H}_2\text{SO}_4 + 16\text{H}_2\text{O}$

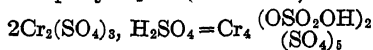
*Two modifications*

a *Violet* Decomp by  $\text{H}_2\text{O}$

b *Green* Obtained from violet modification on heating Sol in  $\text{H}_2\text{O}$  (Weinland, Z anorg 1906, 49 157)



+24H<sub>2</sub>O Decomp by alcohol, giving the normal sulphate (Weinland)  
 Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2H<sub>2</sub>SO<sub>4</sub>+18H<sub>2</sub>O Hygroscopic  
 Decomp by H<sub>2</sub>O (Weinland)

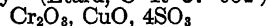


Correct composition of Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> (Traube), which see

See also Chromosulphuric acid

**Chromic cupric sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2CuSO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>

Insol in H<sub>2</sub>O, but gradually decomp thereby (Étard, C R 87 602)



Insol in H<sub>2</sub>O (Recoura, C R 1893, 117 39)

**Chromous hydrazine sulphate**, CrSO<sub>4</sub>, 2N<sub>2</sub>H<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>

Only sl sol in H<sub>2</sub>O Sol in acids (Traube B 1913, 46 1507)

**Chromic hydroxylamine sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, (NH<sub>2</sub>OH)<sub>2</sub>SO<sub>4</sub>+24H<sub>2</sub>O

Sol in H<sub>2</sub>O (Meyerinhg)

**Chromic iron (ferrous) sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2FeSO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>+2H<sub>2</sub>O

As above (Étard, l c)

**Chromic iron (ferric) sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>

Insol in H<sub>2</sub>O (Étard, C R 86 1399)

Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub> Insol in H<sub>2</sub>O (Étard)

**Chromic lithium sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3Li<sub>2</sub>SO<sub>4</sub>

Resembles the corresponding K salt (Wernicke)

**Chromic manganous sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3MnSO<sub>4</sub>

(Étard, C R 86 1402)

**Chromic manganic sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>

Insol in H<sub>2</sub>O (Étard, C R 86 1399)

Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2H<sub>2</sub>SO<sub>4</sub> Sl deliquescent Sol in H<sub>2</sub>O with decomp (Étard)

**Chromic nickel sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, NiSO<sub>4</sub>, 2H<sub>2</sub>SO<sub>4</sub>+3H<sub>2</sub>O

Insol in H<sub>2</sub>O, but gradually decomp thereby (Étard, C R 87 602)

**Chromous potassium sulphate**, CrSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O

Sol in H<sub>2</sub>O, less sol in alcohol (Peligot, A ch (3) 12 546)

**Chromic potassium sulphate**, K<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>

Anhydrous α Sol in H<sub>2</sub>O when not heated over 350°

β Insol in cold H<sub>2</sub>O and cold acids When ignited is insol in hot H<sub>2</sub>O and acids, except slightly in boiling conc H<sub>2</sub>SO<sub>4</sub> (Fischer)

+2H<sub>2</sub>O (?) Insol in cold H<sub>2</sub>O or dil acids Sol by long boiling with H<sub>2</sub>O, and more quickly when HCl is added (Hertwig)

+4H<sub>2</sub>O Is potassium chromosulphate, which see

+24H<sub>2</sub>O *Chrome-alum* Violet modification Efflorescent at 29° Sol in 6-7 pts cold H<sub>2</sub>O When the H<sub>2</sub>O solution is heated to 60-70° it is partially decomp into a green modification, which is more sol in H<sub>2</sub>O The green modification on standing in H<sub>2</sub>O solution is very slowly converted back into violet modification The green modification may also be formed by heating dry salt to 100°, at which temp it melts in its crystal H<sub>2</sub>O When all crystal H<sub>2</sub>O has been expelled at 300-350°, it still dissolves in hot H<sub>2</sub>O, but when heated above 350° it becomes insol in H<sub>2</sub>O (Lowell, A ch (3) 44 313)

125 l g anhydrous, or 243.9 g hydrated salt, or 0.441 g mols anhydrous salt are sol in 1 l H<sub>2</sub>O at 25° (Locke, Am Ch J 1901, 26 175)

Melts in crystal H<sub>2</sub>O at 89° (Tilden, Chem Soc 45 409)

Sp gr of aqueous solution of violet modification at 15° containing

5	10	15%
102725	105500	108350

Sp gr of sat solution at 15° = 1.0985

Sp gr of aqueous solution of green modification at 15° containing

10	20	30%
1050	1103	1161

40	50	60%
1225	1295	1371

70	80	90%
1453	1541	1635

(Gerlach, Z anal 28 497)

Sp gr of chrome-alum solutions at 15° containing

5	10	15	20	25	% salt,
10174	10342	10524	10746	11004	

30	35	40	45	50	% salt,
11274	11572	11896	12352	12894	

55	60	65	70	% salt
13704	14566	15462	16362	

(Franz, J pr (2) 5 298)

Insol in alcohol

3K<sub>2</sub>SO<sub>4</sub>, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> Insol in H<sub>2</sub>O, acids, or dil alkalies Decomp by boiling with conc KOH+Aq (Wernicke, Pogg 159 576)

**Chromic rubidium sulphate**, Rb<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O

Sol in H<sub>2</sub>O (Petersson)

Solubility in H<sub>2</sub>O

Temp	G anhydrous salt per l	G mols of anhy drous salt per l
25°	25 7	0 079
30°	31 7	0 096
35°	41 1	0 128
40°	59 7	0 181

Melts in crystal H<sub>2</sub>O at 107°

(Locke, Am Ch J 1901, 26 180)

**Chromic sodium sulphate, Na<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+10H<sub>2</sub>O**

Is sodium chromosulphate, which see +24H<sub>2</sub>O More efflorescent than K or NH<sub>4</sub> salt Sol in H<sub>2</sub>O, and properties resemble the corresponding K salt

Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3Na<sub>2</sub>SO<sub>4</sub> Resembles the corresponding K salt

**Chromic thalious sulphate, Tl<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O**

0 212 mols of anhydrous salt are sol in 1 l H<sub>2</sub>O at 25° 1 l H<sub>2</sub>O dissolves 104 8 g of anhydrous or 163 8 g hydrated salt at 25° Melts in crystal H<sub>2</sub>O at 92° (Locke, Am Ch J 1901, 26 175)

**Chromic sulphate chloride, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>Cl<sub>2</sub>+2H<sub>2</sub>O**

Slightly hygroscopic Sol in H<sub>2</sub>O (Schiff, A 124 176)

[CrSO<sub>4</sub>, 5H<sub>2</sub>O, Cl Sol in H<sub>2</sub>O (Weinland, Z anorg 1908, 58 176)

**Chromyl sulphate, (CrO<sub>2</sub>)SO<sub>4</sub>**

Decomp by H<sub>2</sub>O (Pictet and Karl, Bull Soc 1908, (4) 3 1114)

**Cobaltous sulphate, basic**

Ppt Insol in H<sub>2</sub>O (Berzelius) 6CoO, SO<sub>3</sub>+10H<sub>2</sub>O (Athanasesco, C R 103 271)

5CoO, SO<sub>3</sub>+4H<sub>2</sub>O Ppt Very sl sol in H<sub>2</sub>O (Habermann, M Ch 5 432)

**Cobaltous sulphate, CoSO<sub>4</sub>**

100 pts H<sub>2</sub>O dissolve at

3° 10° 20° 24° 29°  
26 2 30 5 36 4 38 9 40 pts anhydrous salt,

35° 44° 50° 60° 70°

46 3 50 4 55 2 60 4 65 7 pts anhydrous salt

(Tobler, A 95 193)

100 pts H<sub>2</sub>O at 11–14° dissolve 23 88 pts anhydrous salt (v Hauer, J pr 103 114)

Solubility in 100 pts H<sub>2</sub>O at t°, using CoSO<sub>4</sub>+7H<sub>2</sub>O

t°	Pts CoSO <sub>4</sub>	t°	Pts CoSO <sub>4</sub>	t°	Pts CoSO <sub>4</sub>
0	24 6	36	43 5	72	65 0
1	25 0	37	44 0	73	65 6
2	25 5	38	44 6	74	66 2
3	26 0	39	45 2	75	66 8
4	26 5	40	45 8	76	67 4
5	27 0	41	46 4	77	68 0
6	27 5	42	47 0	78	68 6
7	28 0	43	47 6	79	69 2
8	28 5	44	48 2	80	69 8
9	29 0	45	48 8	81	70 4
10	29 5	46	49 4	82	71 0
11	30 0	47	50 0	83	71 6
12	30 5	48	50 6	84	72 2
13	31 0	49	51 2	85	72 8
14	31 5	50	51 8	86	73 4
15	32 0	51	52 4	87	74 0
16	32 5	52	53 0	88	74 6
17	33 0	53	53 6	89	75 2
18	33 5	54	54 2	90	75 9
19	34 0	55	54 8	91	76 6
20	34 5	56	55 4	92	77 2
21	35 1	57	56 0	93	77 9
22	35 6	58	56 6	94	78 6
23	36 2	59	57 2	95	79 2
24	36 8	60	57 8	96	79 9
25	37 4	61	58 4	97	80 6
26	38 0	62	59 0	98	81 3
27	38 5	63	59 6	99	81 9
28	39 1	64	60 2	100	82 6
29	39 6	65	60 8	101	83 3
30	40 2	66	61 4	102	83 9
31	40 7	67	62 0	103	84 6
32	41 3	68	62 6	104	85 3
33	41 8	69	63 2	105	86 0
34	42 4	70	63 8	106	86 7
35	42 9	71	64 4	106 4	86 9

(Mulder, calculated from his own and Tobler's determinations, Scheik Verhandel 1864 68)

100 g H<sub>2</sub>O dissolve 37 8 g CoSO<sub>4</sub> at 25° (Wagner, Z phys Ch 1910, 71 430)

See also +7H<sub>2</sub>O

Sp gr of CoSO<sub>4</sub>+Aq at t° S=pts CoSO<sub>4</sub> in 100 pts solution, S<sub>1</sub>=mols CoSO<sub>4</sub> in 100 mols of solution

S	S <sub>1</sub>	Sp gr
6 8910	0 852	1 0765
5 8140	0 711	1 0641
4 7095	0 570	1 0517
3 5792	0 429	1 0392
2 4273	0 288	1 0263
1 2099	0 141	1 0131

(Charpy, A ch (6) 29 26)

Sp gr of  $\text{CoSO}_4 + \text{Aq}$  at room temp containing

7 239	14 156	21 167%	$\text{CoSO}_4$
1 0860	1 1591	1 2398	
(Wagner, W Ann 1883, 18 269)			

Sp gr of  $\text{CoSO}_4 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{CoSO}_4 + \text{Aq}$	Sp gr
1-normal	1 0750
$\frac{1}{2}$ -"	1 0883
$\frac{1}{4}$ -"	1 0193
$\frac{1}{8}$ -"	1 0110

(Wagner, Z phys Ch 1890, 5 37)

100 pts sat solution of  $\text{CoSO}_4$  and  $\text{CuSO}_4$  contain 22.70 pts of the two salts

Solubility of  $\text{CoSO}_4 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ , 10  $\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$  100 g  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$

$t^\circ$	grams $\text{CoSO}_4$	grams $\text{Na}_2\text{SO}_4$
0	21 855	10 07
5	23 94	13 155
10	25 41	16 665

(Koppel, Z phys Ch 1905, 52 396)

See also under  $\text{CoNa}_2(\text{SO}_4)_2 + 4\text{H}_2\text{O}$

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 827)

$\text{HC}_2\text{H}_3\text{O}_2$  pptts it completely from  $\text{CoSO}_4 + \text{Aq}$  (Persoz)

100 pts absolute methyl alcohol dissolve 1.04 pts  $\text{CoSO}_4$  at  $18^\circ$  (de Bruyn, Z phys Ch 10 784)

100 pts absolute methyl alcohol dissolve 54.5 pts  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at  $18^\circ$ , 100 pts absolute methyl alcohol dissolve 42.8 pts  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at  $3^\circ$ , 100 pts 93.5% methyl alcohol dissolve 13.3 pts  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at  $3^\circ$ , 100 pts 50% methyl alcohol dissolve 1.8 pts  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at  $3^\circ$

100 pts absolute ethyl alcohol dissolve 2.5 pts  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at  $3^\circ$  (de Bruyn, Z phys Ch 10 786)

100 g solution in glycol contain 2.5 g  $\text{CoSO}_4$  (de Conneek, Bull Ac Belg 1905 359)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

Insol in ethyl acetate (Naumann, B 1904, 37 3602)

$+\text{H}_2\text{O}$  Sl sol in cold, and only very slowly sol in hot  $\text{H}_2\text{O}$  (Vortmann, B 15 1888)

$+4\text{H}_2\text{O}$  (Frohde, Arch Pharm (2) 127 92)

$+6\text{H}_2\text{O}$  (Marignac)

$+7\text{H}_2\text{O}$  Sol in 24 pts cold  $\text{H}_2\text{O}$  Insol in alcohol (Persoz)

Solubility of  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$  100 g  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$

$t^\circ$	g $\text{CoSO}_4$	$t^\circ$	g $\text{CoSO}_4$	$t^\circ$	g $\text{CoSO}_4$
0	25 53	15	33 045	30	42 26
5	28 05	20	36 21	35	45 80
10	30 55	25	39 35	40	48 85

(Koppel, Z phys Ch 1905, 52 395)

M-pt of  $\text{CoSO}_4 + 7\text{H}_2\text{O} = 96-98^\circ$  (Tilden, Chem Soc 45 409)

**Cobaltocobaltic sulphate**,  $\text{Co}_2\text{O}_3$ ,  $6\text{CoO}$ ,  $\text{SO}_3 + 15\text{H}_2\text{O}$

Precipitate Insol in boiling  $\text{CoSO}_4 + \text{Aq}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  (Gentile, J pr 69 130)

**Cobaltic sulphate**,  $\text{Co}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with immediate decomp and liberation of O Sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  without immediate decomp Sol in conc  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Marshall, Chem Soc 59 760)

**Cobaltous cupric sulphate**,  $2\text{CoSO}_4$ ,  $\text{CuSO}_4 + 21\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (v Hauer, Pogg 125 637)

$+36\text{H}_2\text{O}$  (Liebig)

$2\text{CoSO}_4$ ,  $2\text{CuSO}_4$ ,  $\text{H}_2\text{SO}_4$  (Etard)

**Cobaltous cupric magnesium potassium zinc sulphate**,  $\text{CoSO}_4$ ,  $\text{CuSO}_4$ ,  $\text{MgSO}_4$ ,  $4\text{K}_2\text{SO}_4$ ,  $\text{ZnSO}_4 + 24\text{H}_2\text{O}$  (?)

Sol in  $\text{H}_2\text{O}$  (Vohl)

**Cobaltous cupric potassium sulphate**,  $\text{CoSO}_4$ ,  $\text{CuSO}_4$ ,  $2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$  (?)

Sol in  $\text{H}_2\text{O}$  (Vohl)

Does not exist (Aston and Pickering, Chem Soc 49 123)

**Cobaltous hydrazine sulphate**,  $\text{CoH}(\text{SO}_4)_2$ ,  $2\text{N}_2\text{H}_4$

1 pt is sol in 305.16 pts  $\text{H}_2\text{O}$  at  $12^\circ$  Sol in  $\text{HNO}_3$  with decomp Insol in  $\text{HCl}$  (Curtius, J pr 1894, (2) 50 331)

**Cobaltous iron (ferrous) potassium sulphate**,  $\text{CoSO}_4$ ,  $\text{Fe}_2\text{SO}_4$ ,  $2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)

$2\text{CoSO}_4$ ,  $2\text{FeSO}_4$ ,  $\text{H}_2\text{SO}_4$  (Etard)

**Cobaltous magnesium sulphate**,  $3\text{CoSO}_4$ ,  $\text{MgSO}_4 + 28\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Winkelblech)

**Cobaltous magnesium potassium sulphate**,  
 $\text{CoSO}_4, \text{MgSO}_4, \text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)  
 Does not exist (Aston and Pickering,  
 Chem Soc 49 123)

**Cobaltous manganous potassium sulphate**,  
 $\text{CoSO}_4, \text{MnSO}_4, 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)

**Cobaltous nickel potassium sulphate**,  $\text{CoSO}_4,$   
 $\text{NiSO}_4, 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)  
 Does not exist (Thomson, Rep Brit  
 Assn Adv Sci 1877 209)

**Cobaltous potassium sulphate**,  $\text{CoSO}_4, \text{K}_2\text{SO}_4$   
 $+ 6\text{H}_2\text{O}$   
 Less sol in  $\text{H}_2\text{O}$  than  $\text{CoSO}_4$   
 100 pts  $\text{H}_2\text{O}$  dissolve at  
 0° 12° 15° 20° 25°  
 19 1 30 32 5 39 4 45 3 pts anhydrous salt,

30° 35° 40° 49°  
 51 9 55 4 64 6 81 3 pts anhydrous salt  
 (Tobler, A 96 126)

100 pts saturated solution contain at  
 20° 40° 60° 80°  
 14 19 5 24 4 31 8 pts anhydrous salt  
 (v Hauer, J pr 74 433)

1 l  $\text{H}_2\text{O}$  dissolves 128 8 g anhydrous  
 salt at 25° (Locke, Am Ch J 1902, 27 459)

**Cobaltic potassium sulphate**,  $\text{K}_2\text{Co}_2(\text{SO}_4)_4 +$   
 $24\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  with decomp (Marshall,  
 Chem Soc 59 760)

**Cobaltous potassium zinc sulphate**,  $\text{CoSO}_4,$   
 $2\text{K}_2\text{SO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)

**Cobaltous rubidium sulphate**,  $\text{CoSO}_4, \text{Rb}_2\text{SO}_4$   
 $+ 6\text{H}_2\text{O}$   
 Sol in  $\text{H}_2\text{O}$  (Lutton)  
 1 l  $\text{H}_2\text{O}$  dissolves 92 8 g anhydrous salt  
 at 25° (Locke, Am Ch J 1902, 27 459)

**Cobaltic rubidium sulphate**,  $\text{Rb}_2\text{Co}_2(\text{SO}_4)_4 +$   
 $24\text{H}_2\text{O}$   
 Decomp by  $\text{H}_2\text{O}$  Sol in dil  $\text{HCl}$  and  
 $\text{H}_2\text{SO}_4$  Decomp by conc  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$   
 (Howe and O'Neal, J Am Chem Soc 1898,  
 20 762)  
 Melts in crystal  $\text{H}_2\text{O}$  at 47° (Locke, Am  
 Ch J 1901, 26 183)

**Cobaltous sodium sulphate**,  $\text{CoNa}_2(\text{SO}_4)_2 +$   
 $4\text{H}_2\text{O}$

Solubility of  $\text{CoNa}_2(\text{SO}_4)_2, 4\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°  
 100 g  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$  and  
 grams  $\text{Na}_2\text{SO}_4$

t°	g $\text{CoSO}_4$	g $\text{Na}_2\text{SO}_4$
20	26 65	24 91
25	25 365	23 325
30	23 13	21 61
35	22 55	20 85
40	20 975	20 055

(Koppel, Z phys Ch 1905, 52 397)

Solubility of  $\text{CoNa}_2(\text{SO}_4)_2, 4\text{H}_2\text{O} + \text{CoSO}_4,$   
 $7\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t° 100 g  $\text{H}_2\text{O}$  dissolve  
 grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$

t°	g $\text{CoSO}_4$	g $\text{Na}_2\text{SO}_4$	t°	g $\text{CoSO}_4$	g $\text{Na}_2\text{SO}_4$
18 5	28 61	23 82	30	32 695	18 17
20	29 42	23 015	35	34 065	15 61
25	30 73	20 575	40	35 01	13 715

(Koppel, Z phys Ch 1905, 52 397)

Solubility of  $\text{CoNa}_2(\text{SO}_4)_2, 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4,$   
 $10\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t° 100 g  $\text{H}_2\text{O}$  dissolve  
 grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$

t°	g $\text{CoSO}_4$	g $\text{Na}_2\text{SO}_4$
18 5	25 50	25 65
20	23 18	27 26
25	16 07	35 18
30	9 20	43 74

(Koppel)

Solubility of  $\text{CoNa}_2(\text{SO}_4)_2, 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$   
 (anhydrous) in  $\text{H}_2\text{O}$  at t° 100 g  $\text{H}_2\text{O}$   
 dissolve grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$

t°	g $\text{CoSO}_4$	g $\text{Na}_2\text{SO}_4$
35	7 204	50 79
40	7 456	50 095

(Koppel)

See also  $\text{CoSO}_4 + \text{Na}_2\text{SO}_4$  under  $\text{CoSO}_4$

**Cobaltous zinc sulphate**  
 Efflorescent Decomp on air (Link,  
 Crell Ann 1790, 1 32)

**Cobaltous sulphate ammonia**,  $\text{CoSO}_4, 6\text{NH}_3$   
 Sol in  $\text{H}_2\text{O}$  with separation of ppt (Rose,  
 Pogg 20 152) Very easily sol in  $\text{NH}_4\text{OH} +$   
 Aq (Fremy)  
 Decomp by alcohol

**Cobaltous sulphate hydrazine**,  $\text{CoSO}_4, 3\text{N}_2\text{H}_4$   
 Insol in  $\text{H}_2\text{O}$  Decomp by boiling with  
 $\text{H}_2\text{O}$  Very sol in dil acids and  $\text{NH}_4 + \text{Aq}$   
 (Franzen, Z anorg 1908, 60 272)

**Cobaltous sulphate hydroxylamine,  $\text{CoSO}_4 \cdot \text{NH}_2\text{OH} \cdot 2\text{H}_2\text{O}$** 

Insol in cold, sol in hot  $\text{H}_2\text{O}$  with decomp (Feldt, B 1894, 27 403)

**Columbium sulphate**

Sol in  $\text{H}_2\text{O}$  (Blomstrand)

**Cuprous sulphate,  $\text{Cu}_2\text{SO}_4$** 

Decomp by  $\text{H}_2\text{O}$  Sol in conc  $\text{HCl}$ , in ammonia and sl sol in glacial acetic acid (Recoura, C R 1909, 148 1107)

**Cupric sulphate, basic,  $10\text{CuO} \cdot \text{SO}_3$** 

(Pickering, Chem Soc 1907, 91 1984)

$8\text{CuO} \cdot \text{SO}_3 \cdot 12\text{H}_2\text{O}$  Ppt (Kane, A ch 72 269)

$5\text{CuO} \cdot \text{SO}_3 \cdot 6\text{H}_2\text{O}$  Ppt (Smith, Phil Mag J 23 196)

$4\text{CuO} \cdot \text{SO}_3 \cdot 3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Roucher, J Pharm (3) 37 50)

Min *Brochantite* Sol in acids and  $\text{NH}_4\text{OH} + \text{Aq}$

$+3\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Easily sol in dil acids, even  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  Sl sol in  $\text{CaSO}_4$  Insol in  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Cas-

) (Proust) Sol and more easily in  $\text{NH}_4\text{Cl}$ , (Lea)

$\text{H}_2\text{O}$  dissolves 0.017 g (Pickering, C N 1883, 47 182)

$+5\text{H}_2\text{O}$  Min *Langite*

$+16\text{H}_2\text{O}$  (Andre, C R 100 1138)

$7\text{CuO} \cdot 2\text{SO}_3 \cdot 5\text{H}_2\text{O}$  (Reindel, J pr 100 1)

$+6\text{H}_2\text{O}$  Wholly insol in cold or hot  $\text{H}_2\text{O}$  (Habermann, M Ch 5 432)

$+7\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , easily sol in acids Insol in boiling  $\text{CuSO}_4 + \text{Aq}$  (Reindel)

$3\text{CuO} \cdot \text{SO}_3 \cdot 1\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , easily sol in acids (Stenmann, B 15 1412)

$+2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Shenstone, Chem Soc 47 375)

$+2\frac{1}{2}\text{H}_2\text{O}$  (Reindel, J pr 102 204)

$+4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Grimbert and Barré, J Pharm (5) 21 414)

$5\text{CuO} \cdot 2\text{SO}_3 \cdot 3\text{H}_2\text{O}$  (Wibel, Dissert 1864)

$11\text{CuO} \cdot 4\text{SO}_3 \cdot 8\text{H}_2\text{O}$  (Clowes, C N 1898, 78 155)

$8\text{CuO} \cdot 3\text{SO}_3 \cdot 10\text{H}_2\text{O}$  (Marchlewski and Sachs, Z anorg 1892, 1 405)

$7\text{CuO} \cdot 3\text{SO}_3 \cdot 12\text{H}_2\text{O}$  (Étard, C R 1887, 104 1615)

$5\text{CuO} \cdot 2\text{SO}_3 \cdot 5\text{H}_2\text{O}$  (Sabatier, Gm K 5 1, 839)

$6\text{H}_2\text{O}$  Min *Arnamite* (Weisbach, J B 1886 2253)

$2\text{CuO} \cdot \text{SO}_3$  Decomp by cold  $\text{H}_2\text{O}$  into  $\text{CuSO}_4$  and  $4\text{CuO} \cdot \text{SO}_3$  (Roucher)

Insol in  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$  Sol in dil acids (Pozzi-Escot, Bull Soc 1913 (4) 13 816)

According to Pickering (C N 47 181) only

$3\text{CuO} \cdot \text{SO}_3 + 2\frac{1}{2}\text{H}_2\text{O}$  and  $4\text{CuO} \cdot \text{SO}_3 + 4\text{H}_2\text{O}$  are true chemical compounds

There is at  $25^\circ$  no definite basic sulphate of copper, all the basic sulphates being solid solutions The solutions in contact with these basic sulphates contain  $\text{SO}_3$  and  $\text{CuO}$  in equivalent quantities and are all sl acid in reaction (Bell, J phys Chem 1908, 12 179)

**Cupric sulphate,  $\text{CuSO}_4$** 

*Anhydrous* Absorbs  $\text{H}_2\text{O}$  from the air Combines with, and dissolves in  $\text{H}_2\text{O}$  with great evolution of heat

$+ \text{H}_2\text{O}$  Permanent Sol in  $\text{H}_2\text{O}$  (Étard, C R 87 602)

$+ 2\text{H}_2\text{O}$  (?) (Storer's Dict)

$+ 3\text{H}_2\text{O}$  (Étard, C R 104 1614)

Does not exist (Cross, C N 49 220)

See Foote, p 965

$+ 5\text{H}_2\text{O}$  Superficially efflorescent in dry air

Sol in 2.34 pts  $\text{H}_2\text{O}$  at  $18^\circ$  and sat solution has sp gr 1.2147 (Schiff A 109 326)

100 pts  $\text{CuSO}_4 + \text{Aq}$  sat at b pt 102.2 contain 45 pts of the dry salt or 100 pts  $\text{H}_2\text{O}$  at  $102.2^\circ$  dissolve 81.82 pts  $\text{CuSO}_4$  (Griffiths Q J Sci 18 90)

Sol in less than 4 pts  $\text{H}_2\text{O}$  at ord temp and much more sol in boiling  $\text{H}_2\text{O}$  (Bergmann)

Sol in 4 pts cold and 2 pts hot  $\text{H}_2\text{O}$  (Schubarth)

100 pts  $\text{H}_2\text{O}$  dissolve 33.103 pts  $\text{CuSO}_4 + 5\text{H}_2\text{O}$  at  $15^\circ$  and solution has sp gr = 1.1859 (Michel and Krafft A ch (3) 41 478)

$\text{CuSO}_4 + \text{Aq}$  sat at  $8^\circ$  has 1.17 sp gr (Anthon A 24 210)

1 pt  $\text{CuSO}_4 + 5\text{H}_2\text{O}$  dissolves at

	$4^\circ$	19	$31^\circ$	$37.5^\circ$	$40^\circ$
in 3.32	2.71	1.84	1.7	1.14	pts H <sub>2</sub> O

	$62.5^\circ$	75	$87.5^\circ$	$106^\circ$	$101^\circ$
in 1.27	1.07	0.75	0.5	0.47	pts H <sub>2</sub> O

(Brands and Cramer 1826)

Sol at 17.5 in 2.412 pts  $\text{H}_2\text{O}$  (Kuttin)

100 pts  $\text{H}_2\text{O}$  dissolve at

$9^\circ$	$10^\circ$	$20^\circ$	$30^\circ$
31.61	36.95	42.31	48.81

pts  $\text{CuSO}_4 + 5\text{H}_2\text{O}$ ,

$40^\circ$	$50^\circ$	$60^\circ$	$70^\circ$
56.90	65.83	77.39	94.60

pts  $\text{CuSO}_4 + 5\text{H}_2\text{O}$ ,

$80^\circ$	$90^\circ$	$100^\circ$
118.03	156.44	203.32

pts  $\text{CuSO}_4 + 5\text{H}_2\text{O}$  (Poggiale, A ch (3) 8 463)

100 pts  $\text{H}_2\text{O}$  dissolve at

$0^\circ$	$20^\circ$	$35^\circ$	$54^\circ$
17	24.3	28.6	36.1

pts anhydrous  $\text{CuSO}_4$  (Tobler, A 95 193)

100 pts  $\text{CuSO}_4 + \text{Aq}$  sat at  $11-14^\circ$  contain 16.23 pts anhydrous  $\text{CuSO}_4$  (v Hauer, J pr 103 114)

100 pts  $\text{H}_2\text{O}$  dissolve 15.107 pts  $\text{CuSO}_4$  at  $0^\circ$  (Pfaff, A 99 224)

100 pts H<sub>2</sub>O dissolve pts CuSO<sub>4</sub> at t°

t°	Pts CuSO <sub>4</sub>
0	14 99
17 9	20 16
24 1	22 37

(Diacon, J B 1866 61)

100 pts H<sub>2</sub>O dissolve pts CuSO<sub>4</sub> at t°

t°	Pts CuSO <sub>4</sub>	t	Pts CuSO <sub>4</sub>	t°	Pts CuSO <sub>4</sub>
0	14 15	40	28 50	80	54 53
10	17 50	50	33 31	90	64 35
20	20 53	60	39 01	100	75 22
30	24 34	70	45 74		

(Patrick and Aubert, Transactions of Kansas Acad of Sci 1874 19)

Solubility in 100 pts H<sub>2</sub>O at t°

t°	Pts CuSO <sub>4</sub>	t°	Pts CuSO <sub>4</sub>	t°	Pts CuSO <sub>4</sub>
0	15 5	35	27 5	70	45 7
1	16 3	36	27 9	71	46 4
2	16 6	37	28 3	72	47 2
3	16 9	38	28 7	73	47 9
4	17 2	39	29 1	74	48 7
5	17 5	40	29 5	75	49 5
6	17 8	41	29 9	76	50 3
7	18 1	42	30 3	77	51 1
8	18 4	43	30 7	78	51 9
9	18 7	44	31 1	79	52 7
10	19 1	45	31 5	80	53 5
11	19 3	46	31 9	81	54 3
12	19 6	47	32 3	82	55 1
13	19 9	48	32 7	83	55 9
14	20 2	49	33 2	84	56 8
15	20 5	50	33 6	85	57 8
16	20 8	51	34 1	86	58 7
17	21 1	52	34 5	87	59 7
18	21 4	53	35 0	88	60 7
19	21 7	54	35 5	89	61 7
20	22 0	55	36 0	90	62 7
21	22 3	56	36 6	91	63 7
22	22 6	57	37 2	92	64 8
23	23 0	58	37 8	93	65 8
24	23 3	59	38 4	94	66 9
25	23 7	60	39 0	95	68 0
26	24 0	61	39 6	96	69 1
27	24 4	62	40 2	97	70 2
28	24 7	63	40 9	98	71 3
29	25 1	64	41 5	99	72 4
30	25 5	65	42 2	100	73 5
31	25 9	66	42 9	101	74 6
32	26 3	67	43 6	102	75 7
33	26 7	68	44 3	103	76 8
34	27 1	69	45 0	104	77 9 5

(Mulder, Scheik Verhandel 1864 79)

If solubility S=pts anhydrous CuSO<sub>4</sub> in 100 pts solution, S=11 6+0 2614t from -2° to 55°, S=26 5+0 3700t from 55° to 105°, S=45 0-0 0293t from 105° to 190° (Étard, C R 104 1614)

Solubility decreases above 120°, owing to formation of basic salt (Tilden and Shennstone, Phil Trans 1884 23)

100 ccm H<sub>2</sub>O dissolve 14 92 g CuSO<sub>4</sub> at 0° (Engel, C R 102 113)

100 ccm H<sub>2</sub>O dissolve 22 28-22 30 g CuSO<sub>4</sub> at 20° (Trevor, Z phys Ch 7 468)

Sat CuSO<sub>4</sub>+Aq contains % CuSO<sub>4</sub> at t°

t°	% CuSO <sub>4</sub>	t°	% CuSO <sub>4</sub>
-1	12 1	88	38 8
+7	14 1	89	38 9
9	14 5	94	41 8
18	16 9	96	41 9
20	17 2	97	42 0
20	17 4	100	43 6
35	21 3	108	43 8
39	21 8	110	43 4
45	23 9	116	43 8
54	26 9	116	44 0
54	26 6	120	44 8
61	28 8	132	44 8
63	29 1	133	44 7
65	30 0	143	45 0
70	31 6	160	44 2
71 7	32 6	165	44 5
76	34 5	179	42 9
80	36 6	189	42 2
86	37 8		

(Étard, A ch 1894, (7) 2 551)

Solubility in H<sub>2</sub>O at t°

t	g CuSO <sub>4</sub> per 100 g H <sub>2</sub> O
0	14 15
10	17 68
15	19 25
20	20 78
25	22 29 (by interpolation)

(Cohen, Z phys Ch 1907, 60 71)

1 399 mol are sol in 1 l H<sub>2</sub>O at 25° (Herz, Z anorg 1910, 67 366)

100 g CuSO<sub>4</sub>+Aq sat at 30° contain 20 32 anhyd CuSO<sub>4</sub> (Schreinemakers, Z phys Ch 1910, 71 110)

+7H<sub>2</sub>O (Boisbaudran, C R 65 1249)

+6H<sub>2</sub>O (Boisbaudran, C R 66 487)

Sp gr of  $\text{CuSO}_4 + \text{Aq}$  at  $18^\circ$  % = %  
 $\text{CuSO}_4 + 5\text{H}_2\text{O}$

%	Sp gr	%	Sp gr	%	Sp gr
1	1 0063	11	1 0716	21	1 1427
2	1 0126	12	1 0785	22	1 1501
3	1 0190	13	1 0854	23	1 1585
4	1 0254	14	1 0923	24	1 1659
5	1 0319	15	1 0993	25	1 1738
6	1 0384	16	1 1063	26	1 1817
7	1 0450	17	1 1135	27	1 1898
8	1 0516	18	1 1208	28	1 1980
9	1 0582	19	1 1281	29	1 2063
10	1 0649	20	1 1354	30	1 2146

(Schiff, calculated by Gerlach, Z anal **8** 288)

Sp gr of  $\text{CuSO}_4 + \text{Aq}$  at  $23.9^\circ$  a=no of  $\frac{1}{2}$   
 mols in grms dissolved in 1000 grms  
 $\text{H}_2\text{O}$ , b=sp gr if a is  $\text{CuSO}_4 + 5\text{H}_2\text{O}$  ( $\frac{1}{2}$   
 mol wt = 125), c=sp gr if a is  $\text{CuSO}_4$   
 ( $\frac{1}{2}$  mol wt = 80)

a	b	c
1	1 076	1 080
2	1 142	1 154
3	1 200	1 225

(Favre and Valson, C R **79** 968)

Sp gr of  $\text{CuSO}_4 + \text{Aq}$  at  $15^\circ$   
 % = %  $\text{CuSO}_4 + 5\text{H}_2\text{O}$

%	Sp gr	%	Sp gr
5	1 0335	20	1 1443
10	1 0688	25	1 1848
15	1 1060	mother liquor	1 185

(Gerlach, Dingl **181** 131)

Sp gr of  $\text{CuSO}_4 + \text{Aq}$  at  $18^\circ$

% $\text{CuSO}_4$	Sp gr	% $\text{CuSO}_4$	Sp gr
5	1 0513	15	1 1675
10	1 1073	17.5	1 2003

(Kohlrausch, W Ann **1879** 1)

Sp gr of  $\text{CuSO}_4 + \text{Aq}$  at  $0^\circ$  S=pts  $\text{CuSO}_4$   
 in 100 pts solution

S	Sp gr	S	Sp gr
11 9315	1 1371	5 2181	1 0578
9 8159	1 1108	2 6460	1 0290
7 5474	1 0833		

(Charpy, A ch (6) **29** 26)

Sp gr of  $\text{CuSO}_4 + \text{Aq}$  at room temp

% $\text{CuSO}_4$	Sp gr
6.79	1 055
12.57	1 1151
17.49	1 1635

(Wagner, W Ann 1883, **18** 265)

Sp gr of  $\text{CuSO}_4 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{CuSO}_4 + \text{Aq}$	Sp gr
1-normal	1 0790
$\frac{1}{2}$ " "	1 0402
$\frac{1}{4}$ " "	1 0205
$\frac{1}{8}$ " "	1 0103
$\frac{1}{16}$ " "	1 0050

(Wagner, Z phys Ch 1890, **5** 38)

B-pt  $\text{CuSO}_4 + \text{Aq}$  containing pts  $\text{CuSO}_4$  to  
 100 pts  $\text{H}_2\text{O}$

B pt	Pts $\text{CuSO}_4$	B pt	Pts $\text{CuSO}_4$
100 $5^\circ$	21.3	103 $0^\circ$	69.0
101 0	36.9	103 5	74.9
101 5	48.0	104 0	80.1
102 0	56.2	104 2	82.2
102 5	63.0		

(Gerlach, Z anal **26** 434)

Sat  $\text{CuSO}_4 + \text{Aq}$  boils at  $102.2^\circ$ , and contains  
 81.8 pts  $\text{CuSO}_4$  to 100 pts  $\text{H}_2\text{O}$   
 (Griffiths)

Crust forms at  $102.3^\circ$ , and solution contains  
 60.3 pts  $\text{CuSO}_4$  to 100 pts  $\text{H}_2\text{O}$ , highest temp  
 observed,  $104.8^\circ$  (Gerlach, Z, anal **26** 426)

Sol in  $\text{HCl} + \text{Aq}$ , causing a reduction of  
 temperature of about  $17^\circ$

Very sl sol in conc  $\text{H}_2\text{SO}_4$  (Schulz)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $0^\circ$

G per 100 g $\text{H}_2\text{O}$		Sp gr
$\text{H}_2\text{SO}_4$	$\text{CuSO}_4$	
0 00	14.85	1 144
2 03	14.29	1 143
7 16	15.65	1 158
15 20	9.90	1 170
26 57	6.43	1 195
27 57	6.19	1 211
35 2	3.99	1 224

(Engel, C R 1887, **104** 507)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

Solution			Solid phase
Sp gr	% CuO	% $\text{SO}_3$	
1 2142	9 17	9 26	CuSO <sub>4</sub> + 5H <sub>2</sub> O
1 2248	5 91	15 90	
1 2593	3 39	23 09	
1 2934	1 82	28 75	
1 4061	1 32	39 74	
1 4256		41 29	
1 4249		41 04	CuSO <sub>4</sub> + 5H <sub>2</sub> O and CuSO <sub>4</sub> + 3H <sub>2</sub> O
1 4516	1 38	43 63	
1 4915	1 02	47 82	CuSO <sub>4</sub> + 3H <sub>2</sub> O
1 5124		49 07	
1 5408	0 38	51 46	CuSO <sub>4</sub> + H <sub>2</sub> O
1 5643	0 368	53 51	
1 6824	0 109	62 14	
1 7752	0 105	68 34	
1 8118	0 15	72 41	CuSO <sub>4</sub>
1 8266	0 07	74 26	

These results show that the hydrates of CuSO<sub>4</sub> which are stable at  $25^\circ$  are CuSO<sub>4</sub> + 5H<sub>2</sub>O, +3H<sub>2</sub>O and +H<sub>2</sub>O

(Bell and Taber, J phys Chem 1908, **12** 175)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

Solution contains		Solid phase
% CuSO	% H <sub>2</sub> SO <sub>4</sub>	
18 47	none	CuSO <sub>4</sub> + 5H <sub>2</sub> O
12 62	11 14	
5 92	25 53	
3 25	36 77	
2 63	42 15	
2 59	47 66	
2 83	49 00	CuSO <sub>4</sub> + 5H <sub>2</sub> O and CuSO <sub>4</sub> + 3H <sub>2</sub> O
2 83	49 20	
2 84	49 29	CuSO <sub>4</sub> + 3H <sub>2</sub> O
2 70	50 23	
2 19	54 78	CuSO <sub>4</sub> + 3H <sub>2</sub> O and CuSO <sub>4</sub> + H <sub>2</sub> O
2 11	55 84	
2 15	55 60	CuSO <sub>4</sub> + H <sub>2</sub> O
0 95	61 79	
0 17	77 93	CuSO <sub>4</sub> + H <sub>2</sub> O
0 15	83 29	
0 19	85 46	CuSO <sub>4</sub> + H <sub>2</sub> O and CuSO <sub>4</sub>
0 44	85 72	
0 42	85 81	CuSO <sub>4</sub>
0 40	86 04	
0 19	92 70	

These results show that the hydrates of CuSO<sub>4</sub> which are stable at  $25^\circ$  are CuSO<sub>4</sub> + 5H<sub>2</sub>O, +3H<sub>2</sub>O and +H<sub>2</sub>O

(Foote, J Am Chem Soc 1915, **37** 290)

Sl sol in sat NH<sub>4</sub>Cl + Aq, with separation of a double sulphate

Solubility of CuSO<sub>4</sub> in CuCl<sub>2</sub> + Aq at  $30^\circ$ 

% CuCl <sub>2</sub>	% CuSO <sub>4</sub>	Solid phase
0	20 32	CuSO <sub>4</sub> , 5H <sub>2</sub> O
6 58	13 62	"
15 68	8 93	"
25 67	4 77	"
39 48	3 21	"
42 47	2 90	CuSO <sub>4</sub> , 5H <sub>2</sub> O + CuCl <sub>2</sub> , 2H <sub>2</sub> O
43 25	1 14	CuCl <sub>2</sub> , 2H <sub>2</sub> O
43 95	0	"

(Schreinemakers, Arch Néer Sci 1910, (2) **15** 117)

Solubility of CuSO<sub>4</sub> in LiCl + Aq at  $25^\circ$ 

Solid phase, CuSO<sub>4</sub>, 5H<sub>2</sub>O  
(G mols per l of solution)

LiCl	CuSO <sub>4</sub>
0	1 399
0 73	1 257
1 40	1 176
2 83	1 067

(Herz, Z anorg 1910, **67** 366)

Solubility of CuSO<sub>4</sub> in KCl + Aq at  $25^\circ$ 

Solid phase, CuSO<sub>4</sub> + 5H<sub>2</sub>O  
(G mols per l of solution)

KCl	CuSO <sub>4</sub>
0 56	1 496
1 17	1 561
2 34	1 819

(Herz)

Solubility of CuSO<sub>4</sub> in NaCl + Aq at  $25^\circ$ 

Solid phase, CuSO<sub>4</sub> + 5H<sub>2</sub>O  
(G mols per l of solution)

NaCl	CuSO <sub>4</sub>
0	1 399
0 36	1 404
1 32	1 426
2 53	1 507

(Herz)

Solubility of CuSO<sub>4</sub> in RbCl + Aq at  $25^\circ$ , containing 1094 g mols per l = 1568 g mols (Herz)

Slowly sol in sat KNO<sub>3</sub> + Aq, with separation of a double sulphate

Very slowly sol in sat NaNO<sub>3</sub> + Aq, with separation of a double sulphate (Karsten, Berl Abhandl 1840 10)



Solubility of  $\text{CuSO}_4$  in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $0^\circ$ 

g per 100 cc solution		Sp gr	g p r 100 cc solution		Sp gr
$(\text{NH}_4)_2\text{SO}_4$	$\text{CuSO}_4$		$(\text{NH}_4)_2\text{SO}_4$	$\text{CuSO}_4$	
0	14 79	1 144	5 59	5 13	1 081
3 61	16 09	1 190	7 51	2 95	1 071
4 63	8 38	1 108	12 31	0 94	1 082
4 90	7 26	1 099	20 65	0 80	1 116

(Engel, C R 1886, 102 114)

See also under  $(\text{NH}_4)_2\text{SO}_4$ Solubility of  $\text{CuSO}_4$  in  $\text{Li}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$ 

Composition of the solution		Solid phase
% by wt $\text{CuSO}_4$	% by wt $\text{Li}_2\text{SO}_4$	
20 32	0	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
17 50	3 54	"
16 10	6 08	"
13 55	11 94	"
12 14	15 72	"
11 04	17 92	"
10 05	20 55	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} + \text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
10 08	20 51	"
10 07	20 49	"
6 41	22 23	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
3 39	23 59	"
0	25 24	"

(Schrenemakers, Z phys Ch 1909, 66 692)

Sol in  $\text{CuCl}_2$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $30^\circ$  (Schrenemakers, Z phys Ch 1909, 69 565)Sol in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Li}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$  (Schrenemakers, Z phys Ch 1909, 66 694)100 pts sat solution of  $\text{CuSO}_4$  and  $\text{FeSO}_4$  contain 17 43 pts of the salts at  $11-14^\circ$  (v Hauer, J pr 103 114)100 pts  $\text{H}_2\text{O}$  dissolve 10 85 pts  $\text{CuSO}_4$ , 17 47 pts  $\text{MgSO}_4$ , and 5 78 pts  $\text{Na}_2\text{SO}_4$  at  $0^\circ$  (Diacon)100 pts  $\text{H}_2\text{O}$  dissolve 7 169 pts  $\text{CuSO}_4$ , 21 319 pts  $\text{MgSO}_4$ , and 6 830 pts  $\text{Na}_2\text{SO}_4$  at  $0^\circ$  (Plaff)Slowly and sl sol in sat  $\text{MgSO}_4 + \text{Aq}$  (Karsten)Solubility of  $\text{CuSO}_4$  in  $\text{H}_2\text{O}$  in presence of  $\text{MgSO}_4$ . 100 pts  $\text{H}_2\text{O}$  dissolve—

No	$\text{CuSO}_4$	$\text{MgSO}_4$	No	$\text{CuSO}_4$	$\text{MgSO}_4$
1	0	26 37	5	12 03	15 67
2	2 64	25 91	6	13 61	8 64
3	4 75	25 30	7	14 99	0
4	9 01	23 54			

In 1, 2, and 3,  $\text{MgSO}_4$  was in excess and given amt  $\text{CuSO}_4$  added, in 4, both  $\text{CuSO}_4$  and $\text{MgSO}_4$  were in excess, in 5, 6, and 7,  $\text{CuSO}_4$  was in excess (Diacon, l c)100 pts sat solution of  $\text{CuSO}_4$  and  $\text{MgSO}_4$  contain 28 58 pts of the salts at  $11-14^\circ$  (v Hauer, J pr 103 114)100 pts sat solution of  $\text{CuSO}_4$  and  $\text{MnSO}_4$  contain 37 90 pts of the salts at  $11-14^\circ$  (v Hauer)Solubility of  $\text{CuSO}_4 + \text{MnSO}_4$  in  $\text{H}_2\text{O}$  at  $25^\circ$ 

G per 100 g $\text{H}_2\text{O}$		G per 100 g $\text{H}_2\text{O}$	
$\text{CuSO}_4$	$\text{MnSO}_4$	$\text{CuSO}_4$	$\text{MnSO}_4$
20 2	0	9 39	46 77
19 76	3 69	6 47	53 39
13 65	31 52	3 01	58 93
11 61	39 41	0 0	61 83

(Stortenbecker Z phys Ch 1900, 34 112)

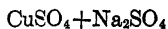
100 pts sat solution of  $\text{CuSO}_4$  and  $\text{NiSO}_4$  contain 31 03 pts of the salts at  $11-14^\circ$  (v Hauer)Solubility of  $\text{CuSO}_4 + \text{NiSO}_4$  in  $\text{H}_2\text{O}$ 

g per 100 g $\text{H}_2\text{O}$			Mol % $\text{CuSO}_4$	
$t^\circ$	$\text{CuSO}_4$	$\text{NiSO}_4$	Solution	Solid phase
35	9 62	583 9	1 57	0 35
	41 66	484 4	7 69	2 12
	75 39	553 5	11 66	4 77
	106 40	506 5	16 92	6 52
	172 0	483 8	25 6	13 88
67	186 9	468 8	27 90	18 77
				94 91
	20 04	729 3	2 65	0 93
	66 01	706 2	8 31	2 86
	88 08	501 6	13 55	3 92
	147 94	675 0	16 39	6 66
	249 9	747 8	24 46	23 32

(Fock, Z Kryst Min 1897, 28 387)

More easily sol in sat  $\text{K}_2\text{SO}_4 + \text{Aq}$  than in  $\text{Na}_2\text{SO}_4$  or  $\text{MgSO}_4 + \text{Aq}$ , forming a double sulphate, which separates out (Karsten) $\text{K}_2\text{SO}_4$  and  $\text{CuSO}_4$  mutually displace each other in saturated solutions (Rudorff, Pogg 148 555)When  $\text{K}_2\text{SO}_4$  and  $\text{CuSO}_4$ , both in excess, are dissolved in  $\text{H}_2\text{O}$ , a maximum of solubility of 15 61 pts of the two salts in 100 pts  $\text{H}_2\text{O}$  at  $25^\circ$  is reached in 30 minutes, after which the solubility decreases. This result is obtained either by treating excess of the two salts with  $\text{H}_2\text{O}$  at  $25^\circ$ , or cooling solutions of the two salts sat at higher temp to  $25^\circ$ . The salts are in the proportion of 5 2 pts  $\text{K}_2\text{SO}_4$  to 10 4 pts  $\text{CuSO}_4$ . If present in the same proportion as in their saturated solutions, 5 41 pts  $\text{K}_2\text{SO}_4$  to 10 13 pts  $\text{CuSO}_4$  would be required

If sat solution of one salt is added to sat solution of the other,  $K_2Cu(SO_4)_2 + 6H_2O$  separates, as it is less sol than either simple salt, until a state of equilibrium is reached, after which there is no separation, contrary to Rudorff (see above) (Trevor, Z phys Ch 7 486)



Solubility of  $CuSO_4$  in presence of  $Na_2SO_4$  at 0° 100 pts  $H_2O$  dissolve—

No	$CuSO_4$	$Na_2SO_4$	No	$CuSO_4$	$Na_2SO_4$
1	0	4 53	5	15 84	3 55
2	6 01	5 34	6	15 33	1 98
3	9 81	5 73	7	14 99	0
4	16 67	6 48			

In 1, 2, and 3,  $Na_2SO_4$  was in excess and given amt  $CuSO_4$  added, in 4, both  $CuSO_4$  and  $Na_2SO_4$  were in excess, in 5, 6, and 7,  $CuSO_4$  was in excess and  $Na_2SO_4$  added (Dracon, J B 1866 61)

100 pts  $H_2O$  dissolve 8 038 pts  $CuSO_4$  and 6 31 pts  $Na_2SO_4$  at 0° (Pfaff, A 99 224)

100 pts  $H_2O$  dissolve 20 7 pts  $CuSO_4$  and 15 9 pts  $Na_2SO_4$  at 15° (Rudorff, B 6 484)

Solubility of  $CuSO_4 + Na_2SO_4$

1 Solid phase, 3 mol  $CuSO_4 + 1$  mol  $Na_2SO_4$

2 Solid phase, 1 mol  $CuSO_4 + 1$  mol  $Na_2SO_4$

3 Solid phase, 1 mol  $CuSO_4 + 3$  mol  $Na_2SO_4$

(G in 100 g  $H_2O$ )

t	1		2		3	
	$CuSO_4$	$Na_2SO_4$	$CuSO_4$	$Na_2SO_4$	$CuSO_4$	$Na_2SO_4$
10	19 75	12 49	19 70	12 50	19 69	12 55
15	20 69	15 88	20 75	15 90	20 70	15 92
30	22 03	16 36	21 00	20 14	15 28	22 70
50	32 37	11 75	31 45	13 41	28 76	15 25

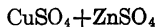
(Massol and Males, C R 1901, 133 287)

Solubility of  $CuSO_4, 5H_2O + Na_2SO_4, 10H_2O$

t°	% $CuSO_4$	% $Na_2SO_4$
0	13 40	6 23
12	14 83	9 82
15	15 00	

(Koppel, Z phys Ch 1903, 42 8)

See also under  $CuNa_2(SO_4)_2 + 6H_2O$



Very slowly sol in sat  $ZnSO_4 + Aq$ , forming a double salt which separates (Karsten)

100 pts sat solution of  $CuSO_4$  and  $ZnSO_4$  contain 32 70 pts of the salts at 11–14° (v Hauer)

Solubility of  $CuSO_4 + ZnSO_4$  in  $H_2O$  at 25°

Mols per 100 mols $H_2O$		Mols per 100 mols $H_2O$	
Cu	Zn	Cu	Zn
2 28	0	0 82	5 03
1 83	2 08	0 51	5 59
1 41	3 60	0 30	5 56
1 19	5 01	0 00	6 42
1 86	3 36	1 19	5 01
1 22	4 45	0 51	5 59
1 01	4 72	0 267	5 77
		0 00	5 94

(Stortenbecker, Z phys Ch 1897, 22 62)

Insol in liquid  $NH_3$  (Franklin, Am Ch J 1898, 20 827)

Insol in liquid  $CO_2$  (Buchner, Z phys Ch 1906, 54 674)

100 pts of a sat solution in 40% alcohol contains 0 25 pt  $CuSO_4 + 5H_2O$ , 20% alcohol, 3 1 pts, 10% alcohol, 13 3 pts (Schiff, A 118 362)

Anhydrous  $CuSO_4$  is sol in absolute methyl alcohol, but insol in absolute ethyl alcohol  $CuSO_4 + xH_2O$  is insol in methyl or ethyl alcohol (Klepl, J pr (2) 25 526)

100 pts absolute methyl alcohol dissolve 1 05 pts anhydrous  $CuSO_4$  at 18°

100 pts absolute methyl alcohol dissolve 15 6 pts  $CuSO_4 + 5H_2O$  at 18°, 100 pts 93 5% methyl alcohol dissolve 0 93 pt  $CuSO_4 + 5H_2O$  at 18°, 100 pts 50% methyl alcohol dissolve 0 4 pt  $CuSO_4 + 5H_2O$  at 18°, 100 pts absolute methyl alcohol dissolve 13 4 pts  $CuSO_4 + 5H_2O$  at 3°

100 pts absolute ethyl alcohol dissolve 1 1 pts  $CuSO_4 + 5H_2O$  at 3° (de Bruyn, Z phys Ch 10 786)

Methyl alcohol dissolves 11 5%  $CuSO_4 + 5H_2O$  at 0° (Auger, C R 1906, 142 1272)

Glacial acetic acid precipitates  $CuSO_4$  completely from  $CuSO_4 + Aq$

100 g 95% formic acid dissolve 0 05 g  $CuSO_4 + 5H_2O$  at 18 5° (Aschan, Ch Ztg 1913, 37 1117)

Sol in glycerine (Pelouze), picoline (Unverdorben)

100 g glycerine dissolve 36 3 g  $CuSO_4 + 5H_2O$  at 15–16° (Ossendowski, Pharm J 1907, 79 575)

100 g glycerine dissolve 30 0 g  $CuSO_4$  at 15 5°

100 g solution of  $CuSO_4$  in glycol contain 7 6 g at 14 6° (de Coninck, Bull Ac Belg 1905 257)

Anhydrous  $CuSO_4$  is insol in acetone (Krug and M'Elroy, J Anal Ch 6 184)

Insol in acetone (Eidmann, C C 1899, II 1014), methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314), benzonitrile (Naumann, B 1914, 47 1370)

Min *Chalcanthite*

**Cupric glucinum sulphate**,  $\text{CuSO}_4 \cdot 4\text{H}_2\text{SO}_4 + 20\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Klatzo, J B 1868 205)  
Does not exist (Marignac, A ch (4) 30 45)  
 $9\text{CuSO}_4 \cdot \text{H}_2\text{SO}_4 + 50\text{H}_2\text{O}$  As above  
Does not exist (Marignac, l c)

**Cupric hydrazine sulphate**,  $\text{CuH}_2(\text{SO}_4)_2 \cdot 2\text{N}_2\text{H}_4$

1 pt is sol in 1148 pts  $\text{H}_2\text{O}$  at  $10^\circ$   
Decomp by acids  
Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp (Curtius, J pr 1894, (2) 50 331)

**Cupric iron (ferrous) sulphate**,  $\text{CuSO}_4 \cdot \text{FeSO}_4$

Insol in  $\text{H}_2\text{O}$  (Étard, C R 87 602)  
 $+2\text{H}_2\text{O}$  (Étard)  
 $\text{CuSO}_4 \cdot 2\text{FeSO}_4 + 21\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (v Hauer)  
 $\text{CuSO}_4 \cdot 3\text{FeSO}_4 + 28\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  dissolve 75 pts salt at  $7^\circ$  (Lefort)  
 $4\text{CuSO}_4 \cdot \text{FeSO}_4 + 34\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 75.91 pts (Thomson)

**Cupric iron (ferric) sulphate**,  $\text{CuSO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Bastick)

**Cupric iron (ferrous) potassium sulphate**,  $\text{CuSO}_4 \cdot \text{FeSO}_4 \cdot 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vohl)

**Cupric lead sulphate**,  $\text{CuO} \cdot \text{PbO} \cdot \text{SO}_3 + \text{H}_2\text{O}$

Min *Immarite*  
 $3\text{CuO} \cdot 7\text{PbO} \cdot 5\text{SO}_3 + 5\text{H}_2\text{O}$  Min *Caledonite*  
Sol in  $\text{HNO}_3 + \text{Aq}$

**Cupric magnesium sulphate**,  $\text{CuSO}_4 \cdot \text{MgSO}_4 + 14\text{H}_2\text{O}$

Efflorescent Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)  
 $+2\text{H}_2\text{O}$  (Arrot, 1834)  
 $\text{CuSO}_4 \cdot 2\text{MgSO}_4 + 21\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (v Hauer, Fogg 126 638)  
 $\text{CuSO}_4 \cdot 7\text{MgSO}_4 + 56\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Scheff, A 107 64)

**Cupric magnesium manganous potassium sulphate**,  $\text{CuSO}_4 \cdot \text{MgSO}_4 \cdot \text{MnSO}_4 \cdot 3\text{K}_2\text{SO}_4 + 18\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vohl)

**Cupric magnesium potassium sulphate**,  $\text{CuSO}_4 \cdot \text{MgSO}_4 \cdot 2\text{K}_2\text{SO}_4 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)  
Does not exist (Aston and Pickering, Chem Soc 49 123)

**Cupric magnesium potassium zinc sulphate**,  $\text{CuSO}_4 \cdot \text{MgO}_4 \cdot 3\text{K}_2\text{SO}_4 \cdot \text{ZnSO}_4 + 18\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vohl)

**Cupric manganous sulphate**,  $5\text{CuSO}_4 \cdot 2\text{MnSO}_4 + 35\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Schaufele, J B 1852 340)  
 $2\text{CuSO}_4 \cdot 3\text{MnSO}_4 + 25\text{H}_2\text{O}$  As above (S)  
 $\text{CuSO}_4 \cdot \text{MnSO}_4 + \text{H}_2\text{O}$  (Étard, C R 87 602)

**Cupric manganous potassium sulphate**,  $\text{CuSO}_4 \cdot \text{MnSO}_4 \cdot 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vohl)

**Cupric nickel sulphate**,  $\text{CuSO}_4 \cdot \text{NiSO}_4 + 3\text{H}_2\text{O}$

(Étard, C R 87 602)  
 $\text{CuSO}_4 \cdot 2\text{NiSO}_4 + 21\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (v Hauer)  
 $+18\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Boisbaudran, C R 66 497)  
 $2\text{CuSO}_4 \cdot 2\text{NiSO}_4 \cdot 3\text{H}_2\text{SO}_4$  (Étard)

**Cupric nickel potassium sulphate**,  $\text{CuSO}_4 \cdot \text{NiSO}_4 \cdot 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vohl)  
Sol in 4 pts  $\text{H}_2\text{O}$ , insol in alcohol (Bette)  
 $4\text{CuSO}_4 \cdot \text{K}_2\text{SO}_4 + 4\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$   
 $\text{K}_2\text{O} \cdot 4\text{CuO} \cdot 4\text{SO}_3 + 4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , but decomp by boiling  $\text{H}_2\text{O}$  into  $3\text{CuO} \cdot \text{SO}_3$

**Cupric potassium sulphate**,  $\text{K}_2\text{Cu}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve 66.666 pts at  $102.8^\circ$  (Griffiths)  
Much more sol in hot than cold  $\text{H}_2\text{O}$  (Pierre)  
Easily sol in  $\text{H}_2\text{O}$  by boiling decomp into basic salt (Persoz A ch (3) 25 272)

100 pts  $\text{H}_2\text{O}$  dissolve 11.14 pts anhydrous salt at  $25^\circ$  (Trevor, Z phys Ch 7 470)  
1 l  $\text{H}_2\text{O}$  dissolves 116.9 g anhydrous salt at  $25^\circ$  (Locke, Am Ch J 1902, 27 459)

See also  $\text{CuSO}_4 \cdot \text{K}_2\text{SO}_4$

Min *Cyanochroite*

**Cupric potassium zinc sulphate**,  $\text{CuSO}_4 \cdot 2\text{K}_2\text{SO}_4 \cdot \text{ZnSO}_4 + 12\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Vohl)

**Cupric rubidium sulphate**,  $\text{CuSO}_4 \cdot \text{Rb}_2\text{SO}_4 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Tutton)  
1 l  $\text{H}_2\text{O}$  dissolves 102.8 g anhydrous salt at  $25^\circ$  (Locke, Am Ch J 1902, 27 459)

**Cupric sodium sulphate, basic**,  $\text{Na}_2\text{SO}_4 \cdot \text{Cu}(\text{OH})_2 \cdot 3\text{CuSO}_4 + 2\text{H}_2\text{O}$

Min *Natrochalcite*

Sl sol in  $\text{H}_2\text{O}$ , easily sol in acids (Palache and Warren, Am J Sci 1908, (4) 26 346)

**Cupric sodium sulphate**,  $\text{CuSO}_4, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

Solubility of the pure double salt  $\text{CuSO}_4, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

t°	100 grams solution contain	
	$\text{CuSO}_4$ grams	$\text{Na}_2\text{SO}_4$ grams
17 7	14 34	13 34
19 5	14 54	12 90
23	14 36	12 76
30	14 07	12 37
40 15	13 73	12 26

(Koppel, Z phys Ch 1903, 42 8)

Solubility of the mixture of  $\text{CuSO}_4, \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$  and  $\text{CuSO}_4$

t°	100 g solution contain	
	$\text{CuSO}_4$ grams	$\text{Na}_2\text{SO}_4$ grams
17 7	14 99	13 48?
19 5	15 62	12 06
23	16 41	11 35
30	17 97	9 95
40 15	20 56	8 00

(Koppel)

Solubility of the mixture of  $\text{CuSO}_4, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$  and  $\text{Na}_2\text{SO}_4$

t°	100 g solution contain	
	$\text{CuSO}_4$ grams	$\text{Na}_2\text{SO}_4$ grams
18	13 53	13 844
19 5	11 847	15 116
20	11 339	15 697
23	8 185	18 723
25	6 284	21 198
26	5 507	22 44
28	3 746	24 963
28 3	3 661	
30	2 607	28 383
30 2	2 422	
32 2	1 465	32 442
33 9	1 475	32 299
35 3	1 471	32 072
37 2	1 494	31 96

(Koppel)

Solubility of  $\text{CuSO}_4, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$  in presence of varying amounts of  $\text{Na}_2\text{SO}_4$

t°	100 g solution contain	
	$\text{CuSO}_4$ grams	$\text{Na}_2\text{SO}_4$ grams
30	5 38	22 17
30	5 41	21 92
30 1	3 69	25 37
40 15	3 97	23 90
30	1 57	32 09

(Koppel)

Copper sulphate and sodium sulphate unite to form a double salt,  $\text{CuSO}_4, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ , which is stable in the presence of the solution above 16 7°. In the presence of copper sulphate the solubility of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is greater than that of the pure salt (Koppel)

**Cupric thallous sulphate**,  $\text{CuSO}_4, \text{TL}_2\text{SO}_4 + 6\text{H}_2\text{O}$

Decomp by recrystallising from  $\text{H}_2\text{O}$  (Willm, A ch (4) 5 55)

1 l  $\text{H}_2\text{O}$  dissolves 81 g anhydrous salt at 25° (Locke, Am Ch J 1902, 27 459)

**Cupric zinc sulphate**,  $\text{CuSO}_4, 3\text{ZnSO}_4 + 28\text{H}_2\text{O}$

Efflorescent 100 pts  $\text{H}_2\text{O}$  dissolve 80 pts salt at 8° Sol in all proportions in boiling  $\text{H}_2\text{O}$  (Lefort)

$\text{CuSO}_4, 2\text{ZnSO}_4 + 21\text{H}_2\text{O}$  (v Hauer, Pogg 125 637)

$\text{CuSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$  (Boisbaudran)  
 $2\text{CuSO}_4, 2\text{ZnSO}_4, \text{H}_2\text{SO}_4$  (Étard)

**Cuprous sulphate ammonia**,  $\text{Cu}_2\text{SO}_4, 4\text{NH}_3$

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , decomp by pure  $\text{H}_2\text{O}$  (Péchar, C R 1903, 136 504)

+  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Foerster and Blankenburg, B 1906, 39 4434)

**Cupric sulphate ammonia, basic**,  $\text{CuSO}_4, 3\text{CuO}, 2\text{NH}_3 + 5\text{H}_2\text{O}$

Decomp by hot  $\text{H}_2\text{O}$  (Pickering, Chem Soc 43 336)

**Cupric sulphate ammonia (Cuprammonium sulphate)**,  $\text{CuSO}_4, \text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  (Kane)

Decomp by  $\text{H}_2\text{O}$  giving a basic sulphate (Bouzat, C R 1902, 135 535)

$\text{CuSO}_4, 2\text{NH}_3, [\text{CuSO}_4, 2\text{NH}_3 + 3\text{H}_2\text{O}]$  (Mendelejeff, B 3 422)] Decomp by excess of  $\text{H}_2\text{O}$  into—

$\text{CuSO}_4, 4\text{NH}_3 + \text{H}_2\text{O}$  Sol in 1 5 pts  $\text{H}_2\text{O}$ , but decomp by much  $\text{H}_2\text{O}$  Insol in alcohol Insol in conc  $\text{NH}_4\text{OH} + \text{Aq}$  (André, C R 100 1138)

Sol in small quantity of  $\text{H}_2\text{O}$ , decomp in dil solution (Bouzat)

100 g  $\text{H}_2\text{O}$  dissolve 44 56 g anhydrous comp at 25° (Pudschies, Dissert)

100 g  $\text{H}_2\text{O}$  dissolve 18 05 g at 21–22° (Horn and Taylor, Am Ch J 1904, 32 268)

$\text{CuSO}_4, 5\text{NH}_3$  Completely sol in  $\text{H}_2\text{O}$  (Rose, Pogg 20 150)

Sol in small amt of  $\text{H}_2\text{O}$ , decomp in dil solution Insol in liquid  $\text{NH}_3$  (Bouzat, C R 1902, 135 535)

**Cuprous sulphate carbon monoxide**,  $\text{Cu}_2\text{SO}_4, 2\text{CO} + \text{H}_2\text{O}$

Very unstable (Joannis, C R 1903, 136 615)

**Cupric sulphate zinc oxide,  $\text{CuSO}_4, 2\text{ZnO} + 21\text{H}_2\text{O}$**

(Larsen, Ch Z Rept 1896, 20 317)  
 $2\text{CuSO}_4, 3\text{ZnO} + 12\text{H}_2\text{O}$  (Mailhe, A ch 1902, (7) 27 169)

**Didymium sulphate, basic,  $\text{D}_2\text{O}_3, \text{SO}_3 = (\text{D}_2\text{O})_2\text{SO}_4$**

Insol in cold or boiling  $\text{H}_2\text{O}$  (Marignac)  
 Slowly sol in hot dil  $\text{HCl} + \text{Aq}$  Easily sol in conc acids

+ $8\text{H}_2\text{O}$  Precipitate (Hermann)  
 Composition is  $2\text{D}_2\text{O}_3, 3\text{SO}_3 + 3\text{H}_2\text{O}$  or  $\text{D}_2(\text{SO}_4)_3 + \text{D}_2\text{O}_3\text{H}_2$  (Frerichs and Smith)  
 Composition is  $5\text{D}_2\text{O}_3, 3\text{SO}_3 + x\text{H}_2\text{O}$  (Cleve, B 11 910)

**Didymium sulphate,  $\text{D}_2(\text{SO}_4)_3$**

*Anhydrous* By saturating cold  $\text{H}_2\text{O}$  and warming the solution, the following results were obtained—100 pts  $\text{H}_2\text{O}$  dissolve at  
 12° 18° 25° 38° 50°  
 43 1 25 8 20 6 13 0 11 0 pts  $\text{D}_2(\text{SO}_4)_3$   
 + $6\text{H}_2\text{O}$   $\text{H}_2\text{O}$  dissolves this salt very slowly, 100 pts  $\text{H}_2\text{O}$  dissolve 13 pts  $\text{D}_2(\text{SO}_4)_3$  in 24 hours, and 16 4 pts in 2 days. If solution is evap in vacuo until  $\text{D}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  separates out, 34 pts  $\text{D}_2(\text{SO}_4)_3$  remain dissolved in 100 pts  $\text{H}_2\text{O}$

+ $5\text{H}_2\text{O}$  (Cleve)  
 + $8\text{H}_2\text{O}$  Solutions of this salt contain at  
 19° 40° 50° 100°  
 11 7 8 8 6 5 1 6 pts  $\text{D}_2(\text{SO}_4)_3$   
 (Marignac, A ch (3) 38 170)

+ $9\text{H}_2\text{O}$  (Zsch esche, J Pr 107 75)

**Didymium potassium sulphate,  $\text{K}_2\text{SO}_4, \text{D}_2(\text{SO}_4)_3 + 2\text{H}_2\text{O}$**

Sol in 63 pts  $\text{H}_2\text{O}$  Insol in sat  $\text{K}_2\text{SO}_4 + \text{Aq}$  (Marignac)

$3\text{K}_2\text{SO}_4, \text{D}_2(\text{SO}_4)_3$  Sol in 83 pts  $\text{H}_2\text{O}$  at 18° Insol in cold, sl sol in boiling sat  $\text{K}_2\text{SO}_4 + \text{Aq}$ , 100 ccm of which retain 55 mg  $\text{D}_2\text{O}_3$  in solution (Cleve)

$4\text{K}_2\text{SO}_4, \text{D}_2(\text{SO}_4)_3$  (Cleve)  
 $9\text{K}_2\text{SO}_4, 2\text{D}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$  (Cleve)

**Didymium sodium sulphate,  $\text{D}_2(\text{SO}_4)_3, \text{Na}_2\text{SO}_4$ , and  $+2\text{H}_2\text{O}$**

Sol in 200 pts  $\text{H}_2\text{O}$  (Marignac), and still less in sat  $\text{Na}_2\text{SO}_4 + \text{Aq}$ , 100 ccm of which dissolve only 70 mg  $\text{D}_2\text{O}_3$  at ord temp (Cleve)

**Didymium thallous sulphate,  $(\text{D}_2\text{SO}_4)_3, 3\text{Tl}_2\text{SO}_4$**

Ppt  
 $\text{D}_2(\text{SO}_4)_3, \text{Tl}_2\text{SO}_4 + 2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Zschiesche, J pr 107 98)

**Erbium sulphate,  $\text{Er}_2(\text{SO}_4)_3$**

*Anhydrous* Easily and rapidly sol in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  dissolve 43 pts anhydrous salt at 0°

+ $8\text{H}_2\text{O}$  Less sol in  $\text{H}_2\text{O}$  than anhydrous salt 100 pts  $\text{H}_2\text{O}$  dissolve 30 pts  $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  (=23 pts  $\text{Er}_2(\text{SO}_4)_3$ ) at about 20°, at 100°, 100 pts  $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  remain dissolved Sat solution deposits crystals when heated to 55° (Hoglund)  
 100 g of sat solution of  $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  at 25° in  $\text{H}_2\text{O}$  contains 11 94 g anhyd  $\text{Er}_2(\text{SO}_4)_3$  (Wirth, Z anorg 1912, 76 174)

Solubility of  $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  in  $\text{H}_2\text{SO}_4$  at 25°

N = equiv g  $\text{H}_2\text{SO}_4$  in 1 l of solvent

C = g oxide in 100 g of solution

C<sup>1</sup> = g anhyd salt in 100 g of solution

N	C	C <sup>1</sup>	N	C	C <sup>1</sup>
0	4 604	7 60	4 32	2 00	3 301
0 1	4 615	7 618	6 685	0 9115	1 505
1 1	3 64	6 00	9 68	0 4439	0 733
2 16	3 04	5 018	15 15	0 145	0 239

(Wirth, Z anorg 1912, 76 174)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

**Erbium potassium sulphate,  $\text{Er}_2(\text{SO}_4)_3, 3\text{K}_2\text{SO}_4$**

Slowly sol in  $\text{H}_2\text{O}$  (Hoglund)

**Erbium sodium sulphate,  $\text{Er}_2(\text{SO}_4)_3, 5\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  (Cleve)

**Europium sulphate,  $\text{Eu}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$**

Stable in the air (Urban and Lacombe, C R 1904, 138 628)

**Gadolinium sulphate,  $\text{Gd}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$**

Solubility in  $\text{H}_2\text{O}$

Temp	Pts of $\text{Gd}_2(\text{SO}_4)_3$ in 100 pts $\text{H}_2\text{O}$
0°	3 98
9 3-10 6°	3 33
14 0°	2 80
25 0°	2 40
34 4°	2 26

(Benedicks, Z anorg 1899, 22 409-410)

100 g sat solution of  $\text{Gd}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  at 25° in  $\text{H}_2\text{O}$  contain 2 981 g anhyd  $\text{Gd}_2(\text{SO}_4)_3$  (Wirth, Z anorg 1912, 76 174)

Solubility in  $\text{H}_2\text{SO}_4$  Solid phase,  $\text{Gd}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$

N = equiv g  $\text{H}_2\text{SO}_4$  in 1 l of solvent

C = g oxide in 100 g of solution

$\text{C}_1$  = g anhyd  $\text{Gd}_2(\text{SO}_4)_3$  in 100 g of solution

N	C	$\text{C}_1$	N	C	$\text{C}_1$
0	1 793	2 981	2 16	1 789	2 974
0 1	1 98	3 291	6 175	0 528	0 8777
0 505	2 365	3 931	12 6	0 0521	0 0867
1 1	2 29	3 807			

(Wirth)

Sol in sat  $\text{K}_2\text{SO}_4 + \text{Aq}$

**Gadolinium potassium sulphate**,  $\text{Gd}_2(\text{SO}_4)_3 \cdot \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$

100 grams sat solution in  $\text{K}_2\text{SO}_4 + \text{Aq}$  contains 0.87—0.77 grams  $\text{Gd}_2\text{O}_3$  (Benedicks, Z anorg 1900, 22 410)

**Gallium sulphate**,  $\text{Ga}_2(\text{SO}_4)_3$

Not deliquescent, but very sol in  $\text{H}_2\text{O}$   
Sol in 60% alcohol, insol in ether (Boisbaudran)

Aqueous solution decomp into basic salt by boiling, which redissolves, however, on cooling

**Gallium potassium sulphate**,  $\text{Ga}_2\text{K}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$

(Soret, Arch sc phys nat 1885, 14 96)

**Gallium rubidium sulphate**,  $\text{Rb}_2\text{Ga}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$

(Soret, Arch sc phys nat 1885, 14 96)

**Glucinum sulphate, basic**,  $3\text{GLO} \cdot \text{SO}_3 + 4\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , but decomp by heating or dilution (Berzelius)

$2\text{GLO} \cdot \text{SO}_3 + 3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

$9\text{GLO} \cdot \text{SO}_3 + 14\text{H}_2\text{O}$  (?) Precipitate Insol in  $\text{H}_2\text{O}$  (Berzelius)

According to Debray, this salt when carefully washed is  $\text{GLO}_2\text{H}_2$

**Glucinum sulphate**,  $\text{GISO}_4$

*Anhydrous*

Nearly insol in  $\text{H}_2\text{O}$ , but slowly attacked by cold, rapidly by hot  $\text{H}_2\text{O}$ , and is converted into  $\text{GISO}_4 + 4\text{H}_2\text{O}$  before dissolving (Parrons, Z anorg 1904, 42 253)

Sp gr of  $\text{GISO}_4 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{GISO}_4 + \text{Aq}$	Sp gr
1—normal	1 0451
$\frac{1}{2}$ —	1 0229
$\frac{1}{4}$ —	1 0114
$\frac{1}{16}$ —	1 0027

(Wagner, Z phys Ch 1890, 5 35)

Solubility of  $\text{GISO}_4$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$

$\text{H}_2\text{SO}_4 + \text{Aq}$ % $\text{H}_2\text{SO}_4$	100 g of the solution con- tain g $\text{GISO}_4$	Solid phase
5 23	8 212	$\text{GISO}_4 + 6\text{H}_2\text{O}$
9 61	8 429	
18 70	7 944	
34 00	6 603	
40 35	5 631	
45 51	5 773	
50 63	6 628	$\text{GISO}_4 + 4\text{H}_2\text{O}$
56 59	5 438	
63 24	3 640	
65 24	2 244	
65 24	2 128	
73 64	2 185	

(Wirth, Z anorg 1913, 79 359)

See also under +2, 4, and  $6\text{H}_2\text{O}$

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J, 1898, 20 828)

+ $\text{H}_2\text{O}$  (Levi-Malvano, Z anorg 1906, 48 447)

+ $2\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	G $\text{GISO}_4$ per 100 g	
	$\text{H}_2\text{O}$	Solution
80	84 76	45 87
91 4	97 77	49 42
105	118 4	54 21
119	149 3	59 88

(Levi-Malvano)

+ $4\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$

Sol in its own weight of  $\text{H}_2\text{O}$  at  $14^\circ$ , and in every proportion of boiling  $\text{H}_2\text{O}$  Less sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  than in water (Debray, A ch (3) 44 25)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

t	g $\text{GISO}_4$ per 100 g		$t^\circ$	g $\text{GISO}_4$ per 100 g	
	H O	solution		H O	solution
30	43 78	30 45	95 4	90 63	47 55
40	46 74	31 85	107 2	115 3	53 58
68	61 95	38 27	111	128 3	56 19
85	76 30	43 28			

(Levi-Malvano)

Sl sol in dilute, insol in absolute alcohol  
Can be completely pptd from  $\text{GISO}_4 + \text{Aq}$  by  $\text{HC}_2\text{H}_3\text{O}_2$  (Persoz)

Insol in acetone (Naumann, B 1904, 37 4329)

Solubility in H<sub>2</sub>O at t°

t°	g GISO <sub>4</sub> per 100 g	
	H <sub>2</sub> O	solution
31	52 23	34 32
50	60 67	37 77
72 2	74 94	42 85
77 4	81 87	45 01

(Levi-Malvano)

100 g of the aqueous solution contain at 25°, 8.212 g GISO<sub>4</sub> (Wirth, Z anorg 1913, 79 358)

**Glucinum iron (ferrous) sulphate**, GISO<sub>4</sub>, FeSO<sub>4</sub>+17½H<sub>2</sub>O

Sol in H<sub>2</sub>O (Klatzo, J B 1868 204)

3GISO<sub>4</sub>, FeSO<sub>4</sub>+28H<sub>2</sub>O Sol in H<sub>2</sub>O (Klatzo)

Does not exist (Marignac, A ch (4) 30 45)

**Glucinum nickel sulphate**, (Gl,Ni)SO<sub>4</sub>+4H<sub>2</sub>O, or 7H<sub>2</sub>O

(Klatzo, J B 1868 205)

Does not exist (Atterberg, Sv V A F 1873, 4 81)

**Glucinum potassium sulphate**, GISO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>+2H<sub>2</sub>O

Sl sol in cold, slowly but more sol in hot H<sub>2</sub>O (Debray)

+3H<sub>2</sub>O (Klatzo)

**Glucinum potassium hydrogen sulphate**, GlH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, 2K<sub>2</sub>SO<sub>4</sub>+4H<sub>2</sub>O

Easily sol in H<sub>2</sub>O Partly decomp by recrystallisation (Atterberg)

**Glucinum sodium sulphate**, 2GISO<sub>4</sub>, 3Na<sub>2</sub>SO<sub>4</sub>+18H<sub>2</sub>O

Sol in H<sub>2</sub>O (Atterberg)

**Glucinum zinc sulphate**, 2GISO<sub>4</sub>, 3ZnSO<sub>4</sub>+35H<sub>2</sub>O

Sol in H<sub>2</sub>O (Klatzo, J B 1868 205)

Does not exist (Atterberg)

**Gold (auroauric) sulphate**, Au<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>

Decomp by moist air, H<sub>2</sub>O, glacial acetic acid, or HNO<sub>3</sub>+Aq (142 sp gr) Insol in conc H<sub>2</sub>SO<sub>4</sub> (Schottlander, A 217 375)

**Gold (auric) sulphate**, Au<sub>2</sub>O<sub>3</sub>, 2SO<sub>3</sub>+H<sub>2</sub>O, or Auryl hydrogen sulphate, (AuO)HSO<sub>4</sub>

Deliquescent Decomp by H<sub>2</sub>O Sol in HCl+Aq, not attacked by conc HNO<sub>3</sub>+Aq Sol in 6 pts conc H<sub>2</sub>SO<sub>4</sub> (Schottlander)

**Gold (auric) potassium sulphate**, Au<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, K<sub>2</sub>SO<sub>4</sub>

Not decomp immediately by cold H<sub>2</sub>O (Schottlander)

**Hydrazine mercuric sulphate hydrazine**, (N<sub>2</sub>H<sub>5</sub>)<sub>2</sub>SO<sub>4</sub>, 3HgSO<sub>4</sub>, 2N<sub>2</sub>H<sub>4</sub>

Insol in H<sub>2</sub>O Sol in H<sub>2</sub>O containing HCl (Ferratin, Gazz ch it 1912, 42 (1) 142)

**Hydroxylamine uranyl sulphate**,

(NH<sub>2</sub>OH)<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>, 2(UO<sub>2</sub>)SO<sub>4</sub>+5H<sub>2</sub>O

Extremely sol in H<sub>2</sub>O from which it can be cryst (Rumbach, Dissert 1904)

**Indium sulphate**, In<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>

Easily sol in H<sub>2</sub>O+9H<sub>2</sub>O Easily sol in H<sub>2</sub>O

**Indium hydrogen sulphate**, InH(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O

Very deliquescent (Meyer)

**Indium potassium sulphate**, InK(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O

Sol in H<sub>2</sub>O, but decomp by boiling (Rossler, J pr (2) 7 14)

(InO)<sub>3</sub>K(SO<sub>4</sub>)<sub>2</sub>+3H<sub>2</sub>O Insol in H<sub>2</sub>O (Rossler)

**Indium rubidium sulphate**,

In<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Rb<sub>2</sub>SO<sub>4</sub>+24H<sub>2</sub>O

44 28 pts are sol in 100 pts H<sub>2</sub>O at 15° (Chabrie, C R 1901, 132 473)

Melts in crystal H<sub>2</sub>O at 42° (Locke, Am Ch J 1901, 26 183)

**Indium sodium sulphate**, InNa(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O

Sol in H<sub>2</sub>O (Rossler, J pr (2) 7 14)

**Iodine sulphate**, I<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>

Ppt Decomp by H<sub>2</sub>O (Fichter, Z anorg 1915, 91 140)

**Iodyl sulphate**, (IO)<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>

Possible composition of Weber's (B 20 86) I<sub>2</sub>O<sub>3</sub>, 3SO<sub>3</sub>

**Iridium sulphate**

Sol in  $H_2O$  or alcohol (Berzelius)  
 $Ir_2(SO_4)_3$  Sol in  $H_2O$  (Rimbach, Z anorg 1907, 52 409)

**Iridium potassium sulphate,  $Ir_2(SO_4)_3 \cdot K_2SO_4 + 24H_2O$** 

Mpt 102–103°  
 Easily sol in  $H_2O$  (Marino, Z anorg 1904, 42 220)  
 $Ir_2(SO_4)_3 \cdot 3K_2SO_4$  Sol in  $H_2O$  or dil  $H_2SO_4 + Aq$ , nearly insol in sat  $K_2SO_4 + Aq$  (Boisbaudran, C R 96 1406)

**Iridium rubidium sulphate,  $Ir_2(SO_4)_3 \cdot Rb_2$** 

Sol in cold, very sol in hot  $H_2O$  (Marino, Gazz ch it 1903, 32, (2) 511)  
 Mpt 108–109° (Marino, Z anorg 1904, 42 219)

**Iridium thallium sulphate,  $Ir_2(SO_4)_3 \cdot Tl_2SO_4 + 24H_2O$** 

Very sol in  $H_2O$  (Marino, Z anorg 1904, 42 222)

**Iron (ferrous) sulphate,  $FeSO_4$** 

+ $H_2O$   
 + $2H_2O$  Not more sol in  $H_2O$  than gypsum (Mitscherlich)  
 + $3H_2O$  Sol in  $H_2O$  (Kane)  
 + $4H_2O$  Separates from conc  $FeSO_4 + Aq$  at 80°  
 + $7H_2O$  Efflorescent at 33°

1 pt  $FeSO_4 + 7H_2O$  dissolves in 16 pts cold and 0.3 pt boiling  $H_2O$

1 pt  $FeSO_4 + 7H_2O$  dissolves at

10° 15° 25° 33° 46° 60° 81° 90° 100°  
 in 1.64 1.43 0.87 0.66 0.41 0.38 0.37 0.27 0.3 pts  $H_2O$   
 (Brandes and Linnhaber Br Arch 7 83)

When boiled with insufficient  $H_2O$  for solution a white hydrate is formed which separates out. Solubility increases up to 87°, and then diminishes owing to the above separation (Brandes Pogg 20 381)

Sol in 2 pts cold and 1 pt boiling  $H_2O$  (Fourcroy) sol in 2 pt cold  $H_2O$  at 18.75° (Abt) sol in 6 pts  $H_2O$  at moderate heat and 0.7 pt at 100° (Bergmann)

100 pts  $H_2O$  at 15° dissolve 45–50 pts (Urcs Diet)

100 pts  $H_2O$  dissolve pts  $FeSO_4$  at t

t°	1 pt $FeSO_4$	t	1 pt $FeSO_4$	t	1 pt $FeSO_4$
0	15.8	21	27.4	45	42.9
10	19.9	30	32.6	55	47.0
12	21.3	37	36	70	56
20	25.0				

(Tobler A 95 198)

100 pts  $FeSO_4 + Aq$  sat at 11–14° contain 17.02%  $FeSO_4$  (v Hauer, J pr 103 114)

100 pts  $FeSO_4 + Aq$  sat at 15° contain 37.2%  $FeSO_4 + 7H_2O$ , solution has sp gr 1.2232 (Schiff, A 118 362)

**Solubility in 100 pts  $H_2O$  at t°**

t°	Pts $FeSO_4$	t°	Pts $FeSO_4$	t°	Pts $FeSO_4$
0	7.9	34	37.1	67	65.1
1	8.7	35	38.0	68	65.0
2	9.5	36	38.9	69	64.9
3	10.4	37	39.8	70	64.8
4	11.2	38	40.7	71	64.7
5	12.0	39	41.7	72	64.5
6	12.9	40	42.6	73	64.4
7	13.7	41	43.5	74	64.2
8	14.5	42	44.4	75	64.0
9	15.3	43	45.3	76	63.7
10	16.2	44	46.2	77	63.4
11	17.0	45	47.1	78	63.1
12	17.9	46	48.1	79	62.7
13	18.7	47	49.0	80	62.3
14	19.5	48	50.0	81	61.9
15	20.4	49	51.0	82	61.5
16	21.2	50	51.9	83	61.0
17	22.1	51	52.9	84	60.4
18	23.0	52	53.8	85	59.8
19	23.8	53	54.8	86	59.2
20	24.7	54	55.7	87	58.5
21	25.6	55	56.7	88	57.7
22	26.4	56	57.7	89	57.0
23	27.3	57	58.7	90	56.2
24	28.1	58	59.7	91	55.3
25	29.0	59	60.7	92	54.3
26	29.9	60	61.7	93	53.3
27	30.8	61	62.7	94	52.2
28	31.7	62	63.7	95	51.0
29	32.6	63	64.8	96	49.6
30	33.5	63.5	65.4	97	48.0
31	34.4	64	65.4	98	46.3
32	35.3	65	65.3	99	44.5
33	36.2	66	65.2	100	42.6

(Mulder, Scheik Verhandel 1864 141)

If solubility  $S =$  pts anhydrous  $FeSO_4$  in 100 pts solution,  $S = 13.5 + 0.3788t$  from  $-2^\circ$  to  $+65^\circ$ ,  $S = 37.5$  constant from  $65^\circ$  to  $98^\circ$ ,  $S = 37.5 - 0.6685t$  from  $98^\circ$  to  $156^\circ$ . Practically insol at  $156^\circ$  (Étard, C R 106 740)

Sat  $FeSO_4 + Aq$  contains at

—1°	+5°	24°	34°	52°
13.0	15.1	22.7	26.3	32.5% $FeSO_4$
60°	67°	77°	86°	94°
36.4	37.7	37.8	37.8	36.7% $FeSO_4$
102°	112°	130°	152°	
34.7	28.0	17.3	2.5% $FeSO_4$	

(Étard, A ch 1894, (7) 2 553)

100 g  $H_2O$  dissolve 26.69 g  $FeSO_4$  at  $25^\circ$  (Stortenbecker, Z phys Ch 1900, 34 109)



Solubility of  $\text{FeSO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$   
100 g  $\text{H}_2\text{O}$  dissolve g  $\text{FeSO}_4$

$t^\circ$	G $\text{FeSO}_4$	$t^\circ$	G $\text{FeSO}_4$
0 00	15 65	52 00	50 20
10 00	20 51	54 03	52 07
15 25	23 86	60 01	54 95
20 13	26 56	65 00	55 59
25 02	29 60	68 02	52 31
30 03	32 93	70 04	56 08
35 07	36 87	77 00	45 90
40 05	40 20	80 41	43 58
45 18	44 32	85 02	40 46
50 21	48 60	90 13	37 27

$\text{FeSO}_4 + 7\text{H}_2\text{O}$  is stable from  $-1.82^\circ$  to  $+56.6^\circ$ ,  $\text{FeSO}_4 + 4\text{H}_2\text{O}$  from  $56.6^\circ$  to  $64.4^\circ$ ,  $\text{FeSO}_4 + \text{H}_2\text{O}$  above this point

(Fraenckel, Z anorg 1907, 55 228)

$\text{FeSO}_4 + \text{Aq}$  sat at  $30^\circ$  contains 24.9 g  $\text{FeSO}_4$  in 100 g of solution (Schreinemakers, Z phys Ch 1912, 71 110)

Sp gr of  $\text{FeSO}_4 + \text{Aq}$  at  $15^\circ$   
% = %  $\text{FeSO}_4 + 7\text{H}_2\text{O}$

%	Sp gr	%	Sp gr	%	Sp gr
1	1.005	15	1.082	28	1.161
2	1.011	16	1.088	29	1.168
3	1.016	17	1.094	30	1.174
4	1.021	18	1.100	31	1.180
5	1.027	19	1.106	32	1.187
6	1.032	20	1.112	33	1.193
7	1.037	21	1.118	34	1.200
8	1.043	22	1.125	35	1.206
9	1.048	23	1.131	36	1.213
10	1.054	24	1.137	37	1.219
11	1.059	25	1.143	38	1.226
12	1.065	26	1.149	39	1.232
13	1.071	27	1.155	40	1.239
14	1.077				

(Gerlach, Z anal 8 287)

Sp gr  $16.6^\circ$  of sat solution = 1.219 (Greenish and Smith, Pharm J 1903, 71 881)

Sat  $\text{FeSO}_4 + \text{Aq}$  boils at  $102.2^\circ$  (Griffiths), and solution contains 64%  $\text{FeSO}_4$ . Crust forms at  $102.3^\circ$ , highest temp observed,  $104.8^\circ$  (Gerlach, Z anal 26 426)

B-pt of  $\text{FeSO}_4 + \text{Aq}$  containing pts  $\text{FeSO}_4$  to 100 pts  $\text{H}_2\text{O}$

B pt	Pts $\text{FeSO}_4$	B pt	Pts $\text{FeSO}_4$
100 $5^\circ$	17.7	101 $5^\circ$	50.4
101 0	34.4	101 6	53.2

(Gerlach, Z anal 26 433)

100 g of the sat solution contain 22.84 g  $\text{FeSO}_4$  at  $25^\circ$  (Wirth, Z anorg 1913, 79 364)

Sol in hot  $\text{HCl} + \text{Aq}$  (Kane)  
Somewhat sol in conc  $\text{H}_2\text{SO}_4$  (Bussy and Lecann)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$

$\text{H}_2\text{SO}_4 + \text{Aq}$ Normality	100 g of the solution contain g $\text{FeSO}_4$	Solid phase
0	22.84	$\text{FeSO}_4 + 7\text{H}_2\text{O}$
2 25	19.03	
6 685	13.40	
10 2	10.30	
12 46	7.26	$\text{FeSO}_4 + \text{H}_2\text{O}$
15 15	4.015	
19 84	0.1522	

(Wirth, Z anorg 1913, 79 364)

More sol in water containing NO than in pure  $\text{H}_2\text{O}$  (Gay, Bull Soc (2) 44 175)  
Completely pptd from  $\text{FeSO}_4 + \text{Aq}$  by glacial  $\text{HC}_2\text{H}_3\text{O}_2$  (Persoz)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  See under  $(\text{NH}_4)_2\text{SO}_4$

Solubility in  $\text{Li}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$

Composition of the solution		Solid phase
% by wt $\text{FeSO}_4$	% by wt $\text{Li}_2\text{SO}_4$	
24.87	0	$\text{FeSO}_4, 7\text{H}_2\text{O}$
22.45	4.00	"
21.15	5.58	"
18.79	11.16	"
16.51	15.81	"
16.18	16.52	$\text{FeSO}_4, 7\text{H}_2\text{O} + \text{I}_2\text{SO}_4, \text{H}_2\text{O}$
16.04	16.49	"
15.39	16.80	$\text{I}_2\text{SO}_4, \text{H}_2\text{O}$
12.68	18.31	"
5.32	22.15	"
3.74	23.15	"
0	25.1	"

(Schreinemakers, Z phys Ch 1910, 71 110)

Solubility of  $\text{FeSO}_4, \text{H}_2\text{O} + \text{Na}_2\text{SO}_4, 10\text{H}_2\text{O}$ , in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$

t	Grams $\text{FeSO}_4$	Grams $\text{Na}_2\text{SO}_4$
0	18.06	6.13
15 5	25.05	15.97

(Koppel, Z phys Ch 1905, 52 405)

See also under  $\text{FeNa}_2(\text{SO}_4)_2$

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Insol in liquid  $\text{CO}_2$  (Buchner, Z phys Ch 1906, 54 674)

100 pts sat solution of  $\text{FeSO}_4$  in 40% alcohol contains 0.3%  $\text{FeSO}_4$  (Schiff)

Insol in alcohol of 0.905 sp gr or less (Anthon, J pr 14 125)

Alcohol and  $\text{H}_2\text{SO}_4$  precipitate  $\text{FeSO}_4$  from  $\text{FeSO}_4 + \text{Aq}$ , also glacial acetic acid

Anhydrous  $\text{FeSO}_4$  is insol in acetone (Krug and M'Elroy, 1893)

Insol in acetone (Fidmann, C C 1899, II 1014)

100 g sat solution in glycol contain 60 g  $\text{FeSO}_4$  at ord temp (de Connick)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3601)

**Iron (ferrous) sulphate, acid,  $2\text{FeO}$ ,  $3\text{SO}_3$ ,  $2\text{H}_2\text{O}$**

This salt exists in contact with solutions containing  $\text{SO}_3 + 1.637 \text{ H}_2\text{O}$  to about  $\text{SO}_3 + 2.186 \text{ H}_2\text{O}$  (Kenrick, J phys Chem 1908, 12 704)

$\text{FeO}$ ,  $2\text{SO}_3 + \text{H}_2\text{O}$  This compd exists with solutions containing  $\text{SO}_3 + 1.342 \text{ H}_2\text{O}$  to (about)  $\text{SO}_3 + 1.595 \text{ H}_2\text{O}$  (Kenrick)

$\text{FeO}$ ,  $4\text{SO}_3 + 3\text{H}_2\text{O}$  This compd is stable with solutions containing from  $\text{SO}_3 + 1.122 \text{ H}_2\text{O}$  to (about)  $\text{SO}_3 + 1.342 \text{ H}_2\text{O}$  Rapidly sol in  $\text{H}_2\text{O}$  with ppt of  $\text{FeSO}_4 + \text{H}_2\text{O}$  (Kenrick)

Min *Melanterite*

**Iron (ferric) sulphate, basic,  $10\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3 + \text{H}_2\text{O}$**

(Athanasesco, C R 103 27)

$6\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3 + 10\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  SI sol in warm  $\text{HCl} + \text{Aq}$  (Scheerer, Pogg 45 188)

$4\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3 + 11\text{H}_2\text{O}$  (Anthon, Repert 81 237)

$3\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3 + 4\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Rather easily sol. in acids (Scheerer, Pogg 44 453, Meister, B 8 771)

$2\text{Fe}_2\text{O}_3$ ,  $\text{O}_3 + 6\text{H}_2\text{O}$  When pptd from cold solutions, is sol in  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$ , but insol therein when pptd from hot solutions (Maus)

Only basic sulphate which is a true chemical compound (Pickering, Chem Soc 37 807)

Min *Glockerite* Insol in  $\text{H}_2\text{O}$  Sol in conc  $\text{H}_2\text{SO}_4$

+  $7\text{H}_2\text{O}$  (Meister)

+  $8\text{H}_2\text{O}$  (Muhlhauser)

+  $15\text{H}_2\text{O}$  Min *Pissophanite*

$\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3 = (\text{FeO})_2\text{SO}_4 + 3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Soubeiran, A ch 44 329)

$3\text{Fe}_2\text{O}_3$ ,  $4\text{SO}_3 + 9\text{H}_2\text{O}$  (Athanasesco)

$2\text{Fe}_2\text{O}_3$ ,  $3\text{SO}_3 + 8\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Wittstein)

+  $18\text{H}_2\text{O}$  Min *Fibroferrite* SI sol in cold, more easily in hot  $\text{H}_2\text{O}$

$\text{Fe}_2\text{O}_3$ ,  $2\text{SO}_3 + 10\text{H}_2\text{O}$  Min *Styphcite*

+  $15\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , decomp by heat or evaporation (Muck, J pr 99 103)

$2\text{Fe}_2\text{O}_3$ ,  $5\text{SO}_3 + 13\text{H}_2\text{O}$  Min *Copiapite*

$\text{Fe}_2\text{S}_2\text{O}_7 + 18\text{H}_2\text{O} = 2\text{Fe}_2\text{O}_3$ ,  $5\text{SO}_3 + 18\text{H}_2\text{O}$  *a-Copiapite* This salt is in equilibrium at  $25^\circ$

with solutions in which the molecular ratio  $\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3$  lies between 1.2889 and 1.2614 (Wirth, Z anorg 1914, 87 37)

$(\text{OH})\text{Fe}_2(\text{SO}_4)_4 + 13\text{H}_2\text{O}$   *$\beta$ -Copiapite* This salt is in equilibrium at  $25^\circ$  with solutions in which the molecular ratio  $\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3$  lies between 1.3472 and 1.2889 (Wirth, Z anorg 1914, 87 37)

According to Pickering (Chem Soc 37 807), all basic ferric sulphates are mixtures excepting  $2\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3$

**Iron (ferric) sulphate,  $\text{Fe}_2(\text{SO}_4)_3$**

*Anhydrous* Slowly deliquescent Nearly insol in  $\text{H}_2\text{O}$ , and  $\text{HCl} + \text{Aq}$  Insol in conc  $\text{H}_2\text{SO}_4$  Very rapidly sol in  $\text{FeSO}_4 + \text{Aq}$ , even when very dil (Barreswil, C R 20 1366)

Sp gr of  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$  According to F = Franz at  $17.5^\circ$  (J pr (2) 5 280), G = Gerlach at  $15^\circ$  (Z anal 28 494), H = Hager at  $18^\circ$  (Z anal 27 280)

	5	10	15	20 % $\text{Fe}_2(\text{SO}_4)_3$
F	1.0426	1.0854	1.1324	1.1826
G		1.096		1.205
H	1.046	1.097	1.151	1.208
	25	30	35	40 % $\text{Fe}_2(\text{SO}_4)_3$
F	1.2426	1.3090	1.3782	1.4506
G		1.331		1.478
H	1.271	1.337	1.411	1.490
	45	50	55	60 % $\text{Fe}_2(\text{SO}_4)_3$
F	1.5298	1.6148	1.7050	1.8006
G		1.650		

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$

$\text{H}_2\text{SO}_4 + \text{Aq}$ Normality	100 g. of the solution contain g. $\text{Fe}(\text{SO}_4)_3$
2.25	25.02
6.685	14.58
19.84	0.05

(Wirth, Z anorg 1913, 79 364)

Solubility in  $\text{Al}(\text{SO}_4)_3 + \text{Aq}$  at  $25^\circ$

100 g. of the solution contain	
G $\text{Al}_2(\text{SO}_4)_3$	C $\text{Fe}_2(\text{SO}_4)_3$
	44.97
2.312	12.44
5.200	38.83
6.626	35.82
8.819	34.02
10.03	32.42
*10.23	31.90
10.70	31.91

\*Solution sat with respect to both salts (Wirth and Bakke, Z anorg 1914, 87 48)  
(See also under  $\text{Al}_2(\text{SO}_4)_3$ )

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 828)

Completely pptd from  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$  by  $\text{HC}_2\text{H}_3\text{O}_2$  Sol to large extent in alcohol

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Insol in acetone  
 $+x\text{H}_2\text{O}$  Very deliquescent, and sol in  $\text{H}_2\text{O}$  Conc  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$  may be boiled without decomp, but dil solutions are decomp on heating A solution containing 1 pt. salt to 100 pts  $\text{H}_2\text{O}$  becomes turbid at  $76^\circ$ , 1 pt to 200 pts, at  $56^\circ$ , 1 pt to 400 pts, at  $47^\circ$ , 1 pt to 800 pts, at  $40^\circ$ , 1 pt to 1000 pts, at  $38^\circ$ , 1 pt to 10,000 pts, at  $14^\circ$  (Scheerer)

$+9\text{H}_2\text{O}$  Min *Coquimbite*  
 81.43 pts are sol in 18.57 pts  $\text{H}_2\text{O}$  (Wirth, Z anorg 1914, 87 23)

This salt is stable at  $25^\circ$  only in contact with solutions in which the molecular ratio  $\text{Fe}_2\text{O}_3 : \text{SO}_3$  lies between 1.3472 and 1.6699 (Wirth, Z anorg 1914, 87 35)

$+10\text{H}_2\text{O}$  Slowly sol in  $\text{H}_2\text{O}$  (Oudemans, R t c 3 331)

**Iron (ferroferic) sulphate,  $6\text{FeSO}_4$ ,  $\text{Fe}_2(\text{SO}_4)_3 + 60\text{H}_2\text{O}$**

Sol in all proportions in  $\text{H}_2\text{O}$  (Poumarède, C R 18 854)

$3\text{FeSO}_4, 2\text{Fe}_2(\text{SO}_4)_3 + 12\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  Easily sol in dil  $\text{HCl} + \text{Aq}$  Insol in alcohol (Abich, 1842)

$\text{FeSO}_4, \text{Fe}_2(\text{SO}_4)_3 + 12\text{H}_2\text{O}$  Min *Voltaire*  
 Difficultly sol in  $\text{H}_2\text{O}$

$\text{FeO}, \text{Fe}_2\text{O}_3, 6\text{SO}_3 + 15\text{H}_2\text{O}$  Deliquescent (Lefort, J Pharm (4) 10 87)

**Iron (ferrous) pyrosulphate,  $\text{FeS}_2\text{O}_7$**

Deliquescent Decomp by  $\text{H}_2\text{O}$  (Bolas, Chem Soc (2) 12 212)

**Iron (ferric) hydrogen sulphate,  $\text{Fe}_2(\text{SO}_4)_3, \text{H}_2\text{SO}_4 + 8\text{H}_2\text{O}$**

This salt is in equilibrium at  $25^\circ$  only with solutions where the molecular ratio  $\text{Fe}_2\text{O}_3 : \text{SO}_3$  is more acid than 1.6699 (Wirth and Bakke, Z anorg 1914, 87 34)

Sat solution of  $\text{Fe}_2(\text{SO}_4)_3, \text{H}_2\text{SO}_4 + 8\text{H}_2\text{O}$  in abs alcohol at  $25^\circ$  contains 8 g  $\text{Fe}_2\text{O}_3 + 17.18$  g  $\text{SO}_3$  per 100 g sat solution (Wirth and Bakke)

Decomp by  $\text{H}_2\text{O}$  (Recoura, C R 1903, 137 118)

In contact with solutions containing 25% to 28%  $\text{SO}_3$  at  $25^\circ$ , the stable solid is  $\text{Fe}_2\text{O}_3, 3\text{SO}_3 + 10\text{H}_2\text{O}$  In contact with solutions containing more than 28%, the stable solid is  $\text{Fe}_2\text{O}_3, 4\text{SO}_3 + 10\text{H}_2\text{O}$  (Cameron and Robin son, J phys Chem 1907, 11 650)

**Iron (ferroferic) hydrogen sulphate,  $\text{Fe}_2(\text{SO}_4)_3, \text{FeSO}_4, 2\text{H}_2\text{SO}_4$**

Insol in  $\text{H}_2\text{O}$ , but slowly decomp thereby Sol in  $\text{H}_2\text{SO}_4$  (Étard, C R 87 602)

**Iron (ferrous) hydrazine sulphate,  $\text{FeH}_2(\text{SO}_4)_2, 2\text{N}_2\text{H}_4$**

1 pt issol in 325 pts  $\text{H}_2\text{O}$  at  $12^\circ$  (Curtius, J pr 1894, (2) 50 331)

**Iron (ferrous) magnesium sulphate,  $\text{FeSO}_4, \text{MgSO}_4 + 4\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  (Schiff)

**Iron (ferric) magnesium sulphate,  $\text{Fe}_2(\text{SO}_4)_3, \text{MgSO}_4 + 24\text{H}_2\text{O}$**

(Bastick)

**Iron (ferrous) magnesium potassium sulphate,  $2\text{K}_2\text{SO}_4, \text{FeSO}_4, \text{MgSO}_4 + 12\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)

**Iron (ferric) manganous hydrogen sulphate,  $\text{Fe}_2(\text{SO}_4)_3, 2\text{MnSO}_4, \text{H}_2\text{SO}_4$**

Insol in cold  $\text{H}_2\text{O}$  (Étard)

$\text{Fe}_2(\text{SO}_4)_3, 2\text{MnSO}_4, 3\text{H}_2\text{SO}_4$  Sol in  $\text{H}_2\text{O}$  (Étard, C R 86 1399)

**Iron (ferric) manganic sulphate,  $\text{Fe}_2(\text{SO}_4)_3, \text{Mn}_2(\text{SO}_4)_3$**

Insol in cold  $\text{H}_2\text{O}$ , decomp by hot  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq}$  (Étard)

**Iron (ferrous) manganous potassium sulphate,  $\text{FeSO}_4, \text{MnSO}_4, 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)

**Iron (ferrous) nickel sulphate,  $2\text{FeSO}_4, 2\text{NiSO}_4, \text{H}_2\text{SO}_4$**

(Étard, C R 87 602)

**Iron (ferric) nickel sulphate,  $\text{Fe}_2(\text{SO}_4)_3, \text{NiSO}_4, 2\text{H}_2\text{SO}_4$**

Insol in  $\text{H}_2\text{O}$ , but gradually decomp thereby (Étard, C R 87 602)

**Iron (ferrous) nickel potassium sulphate,  $\text{FeSO}_4, \text{NiSO}_4, 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$**

Sol in  $\text{H}_2\text{O}$  (Vohl, A 94 57)

**Iron (ferrous) potassium sulphate,  $\text{FeSO}_4, \text{K}_2\text{SO}_4$**

$+2\text{H}_2\text{O}$  (Marignac, Ann Min (5) 9 19)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$

t	% $\text{FeK}_2(\text{SO}_4)$	t	% $10\text{K}_2(\text{SO}_4)$
0.5	22.79	80	42.34
17.2	31.98	90	42.73
40.1	40.86	95	41.01
60	42.63		

(Küster and Thiel, Z anorg 1899, 21 116)

+4H<sub>2</sub>OSolubility in H<sub>2</sub>O at t°

t°	% FeK <sub>2</sub> (SO <sub>4</sub> ) <sub>2</sub>	t°	% FeK <sub>2</sub> (SO <sub>4</sub> ) <sub>2</sub>
0 5	22 94	80	40 46
17 2	26 79	90	43 82
40 1	32 41	95	44 11
60	35 68		

(Kuster and Thiel)

+6H<sub>2</sub>O 100 pts H<sub>2</sub>O dissolve at t°

0° 10° 14 5° 16° 25°  
 19 6 24 5 29 1 30 9 36 5 pts anhydrous salt,

35° 40° 55° 65° 70°  
 41 45 56 59 3 64 2 pts anhydrous salt  
 (Tobler, A 95 193)

Solubility in H<sub>2</sub>O at t°

t°	% FeK <sub>2</sub> (SO <sub>4</sub> ) <sub>2</sub>	t°	% FeK <sub>2</sub> (SO <sub>4</sub> ) <sub>2</sub>
0 5	18 36	60	42 93
17 2	25 16	80	45 29
40 1	36 72		

(Kuster and Thiel)

**Iron (ferric) potassium sulphate, basic,**  
 4Fe<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, 7SO<sub>3</sub>+9H<sub>2</sub>O=4(Fe<sub>2</sub>O<sub>3</sub>,  
 2H<sub>2</sub>O, SO<sub>3</sub>), K<sub>2</sub>SO<sub>4</sub>+7H<sub>2</sub>O

Insol in boiling H<sub>2</sub>O Sl sol in HCl+Ag,  
 more readily in aqua regia (Rammelsberg)  
 3Fe<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, 4SO<sub>3</sub>+6H<sub>2</sub>O=K(FeO)<sub>3</sub>(SO<sub>4</sub>)<sub>2</sub>  
 +3H<sub>2</sub>O Min *Jarosite*  
 Fe<sub>2</sub>O<sub>3</sub>, H<sub>2</sub>O, 2SO<sub>3</sub>, 2K<sub>2</sub>SO<sub>4</sub>+5H<sub>2</sub>O Sol in  
 6 pts cold H<sub>2</sub>O Solution soon decomposes  
 (Maus, Pogg 11 78)

Sol in 12 5 pts H<sub>2</sub>O at 10° (Anthon, Rept  
 76 361)

Formula is given as 3Fe<sub>2</sub>O<sub>3</sub>, 5K<sub>2</sub>O, 12SO<sub>3</sub>+  
 18H<sub>2</sub>O by Marignac

3Fe<sub>2</sub>O<sub>3</sub>, 6SO<sub>3</sub>, 2K<sub>2</sub>SO<sub>4</sub>+22H<sub>2</sub>O Sol when  
 moist in H<sub>2</sub>O Solution soon decomposes  
 Insol in alcohol (Soubeiran, A ch 44 329)

3Fe<sub>2</sub>O<sub>3</sub>, 7SO<sub>3</sub>, 5K<sub>2</sub>SO<sub>4</sub>+12H<sub>2</sub>O, and  
 +17H<sub>2</sub>O (Scheerer, Pogg 87 81)

2Fe<sub>2</sub>O<sub>3</sub>, 5SO<sub>3</sub>, 3K<sub>2</sub>SO<sub>4</sub>+9H<sub>2</sub>O (S)  
 3Fe<sub>2</sub>O<sub>3</sub>, 8SO<sub>3</sub>, 4K<sub>2</sub>SO<sub>4</sub>+20H<sub>2</sub>O and 24H<sub>2</sub>O  
 (S)

**Iron (ferric) potassium sulphate, K<sub>2</sub>SO<sub>4</sub>,  
 2Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>**

Insol in H<sub>2</sub>O, but is gradually decomp  
 thereby (Grimm and Ramdohr, A 98 127)  
 +2H<sub>2</sub>O Nearly insol in H<sub>2</sub>O (Weinland,  
 Z anorg 1913, 84 364)

K<sub>2</sub>Fe<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O *Iron alum*  
 Sol in 5 pts H<sub>2</sub>O at 12 5° (Anthon)

Aqueous solution is decomp by heating  
 Insol in alcohol

Sp gr of aqueous solution According to

G=Gerlach, at 15° (Z anal 28 496), F=  
 Franz, at 17 5° (J pr (2) 5 288), containing  
 5 10 15% K<sub>2</sub>Fe<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O,  
 F 1 0268 1 0466 1 0672  
 G 1 025 1 0507 1 0773

20 25 30% K<sub>2</sub>Fe<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O,  
 F 1 0894 1 1136 1 1422  
 G 1 1050 1 1340 1 1645

35 % K<sub>2</sub>Fe<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O  
 G 1 1967

Melts in crystal H<sub>2</sub>O at 28° (Locke, Am  
 Ch J 1901, 26 183)

Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3K<sub>2</sub>SO<sub>4</sub> Insol in H<sub>2</sub>O, but  
 slowly decomp thereby (Etard, C R 84  
 1089)

**Iron (ferric) potassium sulphate sulphite**  
*See Sulphate sulphate, ferric potassium*

**Iron (ferrous) potassium zinc sulphate, FeSO<sub>4</sub>,  
 2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O**  
 Sol in H<sub>2</sub>O

**Iron (ferrous) rubidium sulphate, FeSO<sub>4</sub>,  
 Rb<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Tutton, Chem Soc 63 337)  
 1 l H<sub>2</sub>O dissolves 242 g anhydrous salt  
 at 25° (Locke, Am Ch J 1902, 27 459)

**Iron (ferric) rubidium sulphate, Rb<sub>2</sub>Fe<sub>2</sub>  
 (SO<sub>4</sub>)<sub>2</sub>+24H<sub>2</sub>O**

Solubility in H<sub>2</sub>O

Temp	G per litre	Gram mols of anhydrous salt per litre
25	97 4	0 294
30	202 4	0 617
35	Basic salt formed	

(Locke, Am Ch J 1901, 26 180)

**Iron (ferrous) sodium sulphate, FeSO<sub>4</sub>,  
 Na<sub>2</sub>SO<sub>4</sub>+4H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Marignac, Ann Min (5) 9  
 25)

Solubility of FeNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O in 100 g  
 H<sub>2</sub>O at t°

t	Grams FeSO <sub>4</sub>	Grams Na <sub>2</sub> SO <sub>4</sub>
21 8	24 34	22 51
24 92	23 62	22 04
34 95	23 91	21 83
40	24 01	22 62

(Koppel, Z phys Ch 1905, 52 406)

Solubility of  $\text{FeNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{FeSO}_4$   
7H<sub>2</sub>O in 100 g H<sub>2</sub>O at t°

t°	grams FeSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>	t°	grams FeSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
18 8	26 63	20 28	31°	33 99	14 41
23	28 82	18 40	35°	35 66	13 85
27	30 95	16 68	40°	39 98	11 92

(Koppel)

Solubility of  $\text{FeNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$   
10H<sub>2</sub>O in 100 g H<sub>2</sub>O at t°

t°	grams FeSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>	t°	grams FeSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
18 8	27 23	22 16	28°	11 28	35 94
23	20 31	26 48	31°	6 95	44 75

(Koppel)

Solubility of  $\text{FeNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$   
(anhydrous) in 100 g H<sub>2</sub>O at t°

t°	grams FeSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
35	6 16	46 58
40	6 27	46 99

(Koppel)

See also under FeSO<sub>4</sub>

**Iron (ferric) sodium sulphate, basic, 2Na<sub>2</sub>O,**  
Fe<sub>2</sub>O<sub>3</sub>, 4SO<sub>3</sub>+7H<sub>2</sub>O

Only sl sol in H<sub>2</sub>O with decomp (Skrabal,  
Z anorg 1904, 38 319)

+8H<sub>2</sub>O Min *Urusate* Insol in H<sub>2</sub>O,  
easily sol in HCl+Aq

3Na<sub>2</sub>O, Fe<sub>2</sub>O<sub>3</sub>, 6SO<sub>3</sub>+6H<sub>2</sub>O Sol in H<sub>2</sub>O  
with decomp (Skrabal)

4Fe<sub>2</sub>O<sub>3</sub>, Na<sub>2</sub>O, 5SO<sub>3</sub>+9H<sub>2</sub>O

Insol in H<sub>2</sub>O, difficultly sol in HCl+Aq  
(Scheerer, Pogg 45 190)

**Iron (ferric) sodium sulphate, [Fe(SO<sub>4</sub>)<sub>3</sub>]Na<sub>3</sub>**  
+3H<sub>2</sub>O

Ppt Nearly insol in H<sub>2</sub>O (Weinland, Z  
anorg 1913, 84 365)

**Iron (ferrous) thallium sulphate, FeSO<sub>4</sub>,**  
Tl<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O

Easily decomp by solution in H<sub>2</sub>O (Willm,  
A ch (4) 5 56)

**Iron (ferric) thallium sulphate, Tl<sub>2</sub>Fe<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>**  
+24H<sub>2</sub>O

Not efflorescent Very easily sol in H<sub>2</sub>O  
361.5 g anhydrous, or 646 g hydrated

salt are sol in 1 l H<sub>2</sub>O at 25° or 0.799 mol  
of the anhydrous salt is sol in 1 l H<sub>2</sub>O at 25°  
Melts in crystal H<sub>2</sub>O at 37° (Locke, Am  
Ch J 1901, 26 175)

**Iron (ferrous) zinc sulphate, FeSO<sub>4</sub>, ZnSO<sub>3</sub>+14H<sub>2</sub>O**

2FeSO<sub>4</sub>, 2ZnSO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub> (Étard, C R 87  
602)

**Iron (ferric) zinc sulphate, Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, ZnSO<sub>4</sub>**  
+24H<sub>2</sub>O

(Bastick)

**Iron (ferrous) sulphate nitric oxide, FeSO<sub>4</sub>,**  
NO

The solubility of NO in FeSO<sub>4</sub>+Aq is  
diminished by the presence of H<sub>2</sub>SO<sub>4</sub>, HCl,  
phosphoric acid and by the presence of cer-  
tain salts (Manchot, A 1910, 372 157)

Fe(NO)SO<sub>4</sub>, FeSO<sub>4</sub>+13H<sub>2</sub>O Decomp in  
the air Sol in water (Manchot)

**Lanthanum sulphate, basic, 2La<sub>2</sub>O<sub>3</sub>, 3SO<sub>3</sub>+3H<sub>2</sub>O**

Precipitate (Frerichs and Smith)

Formula is 3La<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>+xH<sub>2</sub>O (Cleve,  
B 11 910)

**Lanthanum sulphate, La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>**

*Anhydrous* Much less sol in warm than  
in cold H<sub>2</sub>O 1 pt is sol in less than 6 pts  
H<sub>2</sub>O, if added in small portions thereto at  
2-3°, and the temperature not allowed to rise  
to 13°, but if heated to 30°, La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+9H<sub>2</sub>O  
separates out until the solution is solid  
(Mosander)

100 pts H<sub>2</sub>O dissolve 2.208 pts La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>  
at 16.5°, 2.130 pts at 18°, 1.641 pts at 34°

See also under +9H<sub>2</sub>O

The solubility of La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> in H<sub>2</sub>O is dim-  
inished by the presence of (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>  
or Na<sub>2</sub>SO<sub>4</sub> (Barre, C R 1910, 151 871)

Solubility in (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq at 18°

Pts per 100 pts H <sub>2</sub> O		Solid phase
(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	La <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	
0 00	2 130	La <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> +9H <sub>2</sub> O
4 011	0 393	La <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> , (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> +2H <sub>2</sub> O
8 727	0 279	"
18 241	0 253	"
27 887	0 476	"
36 112	0 277	"
47 486	0 137	2La <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> , 5(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>
53 823	0 067	La <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> , 5(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>
65 286	0 017	"
73 782	0 0033	"

(Barre)

Solubility in K<sub>2</sub>SO<sub>4</sub>+Aq at 16.5°

Pts per 100 pts H <sub>2</sub> O		Solid phase
K <sub>2</sub> SO <sub>4</sub>	La <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	
0 00	2 198	La <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> +9H <sub>2</sub> O
0 247	0 727	La <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> , K <sub>2</sub> SO <sub>4</sub> +2H <sub>2</sub> O
0 496	0 269	"
0 846	0 185	"
1 029	0 054	La <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> , 5K <sub>2</sub> SO <sub>4</sub>
1 516	0 022	"

(Barre)

Solubility in $\text{Na}_2\text{SO}_4 + \text{Aq}$ at $18^\circ$		
Pts per 100 pts $\text{H}_2\text{O}$		Solid phase
$\text{Na}_2\text{SO}_4$	$\text{La}_2(\text{SO}_4)_3$	
0 00	2 130	$\text{La}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$
0 395	0 997	$\text{La}_2(\text{SO}_4)_3, \text{Na}_2\text{SO}_4$
0 689	0 353	"
0 774	0 299	"
1 136	0 129	"
2 480	0 044	"
3 802	0 019	"
5 548	0 016	"

(Barre)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 830)

Insol in acetone (Naumann, B 1904, 37 4329)

+  $9\text{H}_2\text{O}$  Sol in 42.5 pts  $\text{H}_2\text{O}$ , calculated as anhydrous salt, at  $23^\circ$ , and 115 pts  $\text{H}_2\text{O}$  at  $100^\circ$  (Mosander)

Solubility in $\text{H}_2\text{O}$		
100 pts $\text{H}_2\text{O}$ dissolve	pts $\text{La}_2(\text{SO}_4)_3$ at $t^\circ$	
$t^\circ$		
0	3 02	
14	2 60	
30	1 90	
50	1 49	
75	0 94	
100	0 68	

(Muthmann and Rohg, B 1898, 31 1723)

Solubility in $\text{H}_2\text{SO}_4 + \text{Aq}$ at $25^\circ$		
Normality $\text{H}_2\text{SO}_4$	In 100 g of the liquid are dissolved	
	g oxide	g sulphate
0	1 43	2 483
0 505	1 69	2 934
1 10	1 796	3 118
2 16	1 818	3 156
3 39	1 42	2 465
4 321	1 11	1 927
6 685	0 5309	0 9217
9 68	0 2659	0 4617
12 60	0 2136	0 3709
15 15	0 177	0 3073

(Wirth, Z anorg 1912, 76 189)

**Lanthanum hydrogen sulphate**,  $\text{La}(\text{SO}_4)\text{H}_3$   
(Brauner, Z anorg 1904, 38 330)

**Lanthanum potassium sulphate**,  $\text{La}_2(\text{SO}_4)_3, \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$

$\text{La}_2(\text{SO}_4)_3, 5\text{K}_2\text{SO}_4$  (Barre, C R 1910, 151 872)

$\text{La}_2(\text{SO}_4)_3, 3\text{K}_2\text{SO}_4$  Sl sol in  $\text{H}_2\text{O}$  Insol in sat  $\text{K}_2\text{SO}_4 + \text{Aq}$  (Cleve)

$\text{La}_2(\text{SO}_4)_3, 4\text{K}_2\text{SO}_4$  As above (Cleve)  
 $2\text{La}_2(\text{SO}_4)_3, 9\text{K}_2\text{SO}_4$  As above (Cleve)

**Lanthanum rubidium sulphate**,

$\text{La}_2(\text{SO}_4)_3, \text{Rb}_2\text{SO}_4$

(Baskerville, J Am Chem Soc 1904, 26 67)

+  $2\text{H}_2\text{O}$  (Baskerville)

$3\text{La}_2(\text{SO}_4)_3, 2\text{Rb}_2\text{SO}_4$  (Baskerville)

**Lanthanum sodium sulphate**,  $\text{La}_2(\text{SO}_4)_3,$

$\text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Cleve) (Barre, C R 1910, 151 872)

**Lead sulphate, basic**,  $2\text{PbO}, \text{SO}_3$

Not completely insol in  $\text{H}_2\text{O}$  Decomp by acids, even dil  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq}$ , with formation of  $\text{PbSO}_4$  (Barfoed, 1869)

0.050 millimole calc as Pb is sol in 1 l  $\text{H}_2\text{O}$  at  $18^\circ$  (Pleissner, C C 1907, II 1056)

$5\text{PbO}, 3\text{SO}_3$  (Frankland, Proc Roy Soc 46 364)

$\text{Pb}_3\text{O}_4, 2\text{SO}_3$  (Frankland)

$3\text{PbO}, \text{PbSO}_4 + \text{H}_2\text{O}$  Ppt (Stromholm, Z anorg 1904, 38, 442)

$\text{Pb}_4(\text{SO}_4)(\text{OH})$  0.106 millimole calc as Pb is sol in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$  (Pleissner, C C 1907 II, 1056)

**Lead sulphate**,  $\text{PbSO}_4$

Sol in 22,816 pts  $\text{H}_2\text{O}$  at  $11^\circ$  (Fresenius, A 59 125)

Sol in 31,569 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Rodwell, C N 11 50)

Sol in 13,000 pts  $\text{H}_2\text{O}$  (Kremers, Pogg 85 247)

Calculated from electrical conductivity of  $\text{PbSO}_4 + \text{Aq}$ , 1 l  $\text{H}_2\text{O}$  dissolves 46 mg  $\text{PbSO}_4$  at  $18^\circ$  (Kohlrausch and Rose, Z phys Ch 12 241)

$4.23 \times 10^{-2}$  gr are dissolved in 1 liter of sat solution at  $20^\circ$ ,  $4.41 \times 10^{-2}$  at  $25^\circ$  (Bottger, Z phys Ch 1903, 46 604)

1 l  $\text{H}_2\text{O}$  dissolves 41 mg  $\text{PbSO}_4$  at  $18^\circ$  (Kohlrausch, Z phys Ch 1904, 50 356)

0.126 millimole Pb is sol in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$  (Pleissner, C C 1907, II 1056)

40 mg are dissolved in 1 l of sat solution at  $18^\circ$  (Kohlrausch, Z phys Ch 1908, 64 168)

0.0824 g  $\text{PbSO}_4$  is sol in 1000 cc  $\text{H}_2\text{O}$  at  $18^\circ$  and also at  $100^\circ$ . The fact that  $\text{PbSO}_4$  dissolves in  $\text{H}_2\text{O}$  is ascribed to hydrolysis, and in support of this it is shown that the solubility of hydrated oxide of lead,  $\text{PbO}, \text{H}_2\text{O}$ , in dil  $\text{H}_2\text{SO}_4$  is the same as the solubility of  $\text{PbSO}_4$  in  $\text{H}_2\text{O}$  (Sehnal, C R 1909, 148 1395)

1 l  $\text{H}_2\text{O}$  dissolves 26 mg at  $18^\circ$ , 30 mg at  $25^\circ$ , 38 mg at  $37^\circ$  (Beck and Stegmüller, Arb K Gesund Amt 1910, 34 447)

Solubility in  $H_2O$  at  $t^\circ$   
(Millimols per l)

$t^\circ$	$PbSO_4$
18	0 126
25	0 144
37	0 183

(Beck and Stegmüller, Arb K Gesund Amt 1910, **34** 446)

Sol in hot conc  $HCl + Aq$  (Fresenius)

Solubility of  $PbSO_4$  in  $HCl + Aq$

Sp gr of $HCl + Aq$	% $HCl$ in $HCl + Aq$	Pts $HCl + Aq$ for 1 pt $PbSO_4$
1 0519	10 602	681 89
1 0800	16 310	281 73
1 1070	22 010	105 65
1 1359	27 525	47 30
1 1570	31 602	35 03

(Rodwell, Chem Soc **15** 59)

Solubility of  $PbSO_4$  in  $HCl + Aq$  at  $t^\circ$   
(Millimols per l)

$t^\circ$	0 1N	0 2N	0 3N	0 4N
18	0 126	1 72	2 67	3 63
25	0 144	2 07	3 14	4 29
37	0 183	2 63	4 06	5 43

(Beck and Stegmüller, Arb K Gesund Amt 1910, **34** 446)

Above measurements in  $HCl + Aq$  show solubility directly proportional to the hydrogen ions (Beck and Stegmüller)

Sol in  $HNO_3 + Aq$ , and more sol in hot or conc than in cold or dil  $HNO_3 + Aq$

Sol in 172 pts  $HNO_3 + Aq$  of 1 144 sp gr at  $12.5^\circ$  (Bischof)

Pptd from  $HNO_3$  solution by dil  $H_2SO_4 + Aq$  and not by  $H_2O$  (Bischof, **1827**)

Solubility of  $PbSO_4$  in  $HNO_3 + Aq$

Sp gr of $HNO_3 + Aq$	% $HNO_3$ in $HNO_3 + Aq$	Pts $HNO_3 + Aq$ for 1 pt $PbSO_4$
1 079	11 55	303 10
1 123	17 50	173 75
1 250	34 00	127 48
1 420	60 00	10282 78

(Rodwell, Chem Soc **15** 59)

Solubility in  $HNO_3$  at  $18^\circ$   
(Millimols per l)

$HNO_3$	$PbSO_4$
0 1N	0 506
0 2N	0 844
0 3N	1 13
0 4N	1 44

(Beck and Stegmüller)

Sol in 36,504 pts dil  $H_2SO_4 + Aq$  (Fresenius) See also under solubility in alcohol  
Sl sol in conc  $H_2SO_4$ , from which it is partially pptd by  $H_2O$  or completely by alcohol (Fresenius)

100 pts conc  $H_2SO_4$  dissolve 6 pts  $PbSO_4$  (Schultz, Pogg **133** 137)

Conc  $H_2SO_4$  dissolves 0 005 pt  $PbSO_4$  (Ure)

100 pts  $H_2SO_4$  dissolve 0 13 pt  $PbSO_4$ , and 100 pts fuming  $H_2SO_4$  dissolve 4 19 pts (Struve, Z anal **9** 31)

More sol in commercial  $H_2SO_4$  than in the more conc acid (Hayes)

100 pts  $H_2SO_4 + Aq$  of 1 841 sp gr dissolve 0 039 pts  $PbSO_4$ , of 1 793 sp gr dissolve 0 011 pt  $PbSO_4$ , of 1 540 sp gr dissolve 0 003 pt  $PbSO_4$

Presence of  $SO_2$  does not increase the solubility,  $HNO_3$  increases the solubility somewhat, *e*, 100 pts  $H_2SO_4 + Aq$  of 1 841 sp gr with 5 pts  $HNO_3$  of 1 352 sp gr dissolve 0 044 pt  $PbSO_4$ , 100 pts  $H_2SO_4$  of 1 749 sp gr with 5 pts  $HNO_3$  of 1 352 sp gr dissolve 0 014 pt  $PbSO_4$ , 100 pts  $H_2SO_4$  of 1 512 sp gr with 5 pts  $HNO_3$  of 1 352 sp gr dissolve only a trace

Nitrous oxides do not increase the action (Kolb, Dingl **209** 268)

Solubility in dil  $H_2SO_4 + Aq$  at  $18^\circ$   
(G per l)

$H_2SO_4$	$PbSO_4$	$H_2SO_4$	$PbSO_4$
0	0 0382	0 0245	0 0194
0 0049	0 0333	0 0490	0 0130
0 0098	0 0306	0 4904	0 0052

(Pleissner, Arb K Gesund Amt 1907, **26** 384)

A trace of  $H_2SO_4$  has a considerable effect in reducing the solubility of  $PbSO_4$  in  $H_2O$  (Sehnal, C R 1909, **148** 1395)

Solubility in dil  $H_2SO_4 + Aq$  at  $20^\circ$   
(G per l)

$H_2SO_4$	$PbSO_4$	$H_2SO_4$	$PbSO_4$
0	0 082	0 0980	0 013
0 0098	0 051	0 4900	0 006
0 0196	0 025	0 9800	0

(Sehnal)

Pptd from solution in  $H_2SO_4$  by  $HCl$  (Bolley, A **91** 113)

Not more insol in dil  $HC_2H_3O_2 + Aq$  than in  $H_2O$  (Bischof)

Solubility in other acids is prevented by great excess of  $H_2SO_4$  (Wackenroder)

Sol in warm  $NH_4OH + Aq$ , separating on cooling Completely sol in warm  $KOH$  or  $NaOH + Aq$

Decomp by boiling with  $K_2CO_3$ ,  $Na_2CO_3$ , and  $(NH_4)_2CO_3 + Aq$

Sol in  $NH_4$  salts + Aq, but repptd by  $H_2SO_4 + Aq$  (Fresenius, A 59 125)

The best solvents of the  $NH_4$  salts are the nitrate, citrate, and tartrate, the two latter should be strongly alkaline with  $NH_4OH + Aq$  (Wackenroder)

Sol in  $NH_4Cl + Aq$  at 12.5–25°

Sl decomp by  $NaCl + Aq$  (Bley)

1 l sat  $NaCl + Aq$  dissolves 0.66 g  $PbSO_4$  (Bequerel)

Sol in 100 pts cold conc  $NaCl + Aq$ , and  $PbCl_2$  is deposited after a few hours (Field)

Solubility of  $PbSO_4$  in  $NaCl + Aq$  at 18° (Millimols per l)

NaCl	$PbSO_4$
0.1N	0.546
0.2N	0.904
0.3N	1.28
0.4N	1.68

(Beck and Stegmüller, Arb. K. Gesund. Amt 1910, 34 446)

Sol in  $Fe_2Cl_6 + Aq$  (Fresenius, Z anal 19 419)

Sol in  $Na_2S_2O_3 + Aq$  (Lowe)

Sol in  $(NH_4)_2SO_4 + Aq$  (Rose)

Solubility of  $PbSO_4 + PbSO_4$ ,  $K_2SO_4$  in  $H_2O$

t°	$K_2SO_4$		Solid phase
	cc in 100 cc of solution	Mol in 100 cc of solution	
0	0.195	0.0112	$K_2SO_4$ , $PbSO_4 + PbSO_4$
22	0.396	0.0227	"

(Bronsted, Z. phys. Ch. 1911, 77 316)

Sol in 47 pts  $NH_4C_2H_3O_2 + Aq$  (1.036 sp gr), and 969 pts  $NH_4NO_3 + Aq$  (1.269 sp gr), from the solution in  $NH_4C_2H_3O_2$  it is pptd by  $H_2SO_4$  or  $K_2SO_4$ , from solution in  $NH_4NO_3$  by  $K_2SO_4$  but not by  $H_2SO_4$  (Bischof)

Sol in acetates of  $NH_4$ ,  $Na$ ,  $K$ ,  $Ca$ ,  $Al$ , and  $Mg$  (Müller)

Solubility in  $NH_4C_2H_3O_2 + Aq$ . Excess of  $PbSO_4$  was boiled with solution of  $NH_4C_2H_3O_2 + Aq$  of varying conc

$NH_4C_2H_3O_2$ in 100 cc	$PbSO_4$ contained in 1 cc solution		
	Hot	Cooled	Cooled 24 hrs
25	0.356		
30	0.418		0.224
32	0.494	0.451	0.242
35	0.513	0.452	
37	0.529		0.238
40	0.539		0.263
45	0.555	0.488	

(Dunnington and Long, Am. Ch. J. 1899, 22 218)

Solubility in ammonium acetate + Aq at 25°

$NH_4C_2H_3O_2$ Millimol per l	Solubility of $PbSO_4$	
	Millimols per l	g per l
0.0	0.134	0.041
103.5	2.10	0.636
207.1	4.55	1.38
414.1	10.10	3.06

(Noyes and Whitecomb, J. Am. Chem. Soc. 1905, 27 756)

Solubility in  $KC_2H_3O_2 + Aq$  at 25°

Solid phase,  $PbSO_4 + PbK_2(SO_4)_2$

Composition of the solutions

$KC_2H_3O_2$	$Pb(C_2H_3O_2)_2$	$KC_2H_3O_2$	$Pb(C_2H_3O_2)_2$
4.33	2.54	26.58	9.83
9.03	3.55	28.82	11.40
17.81	5.43	28.93	19.41
22.07	5.95		

(Fox, Chem. Soc. 1909, 95 887)

100 pts  $H_2O$  containing a drop of  $HC_2H_3O_2$  and 2.05 pts  $NaC_2H_3O_2$  dissolve 0.054 pt  $PbSO_4$ , containing 8.2 pts  $NaC_2H_3O_2$  dissolve 0.900 pt  $PbSO_4$ , containing 41.0 pts  $NaC_2H_3O_2$  dissolve 11.200 pts  $PbSO_4$  (Dibbitts, Z. anal. 1874, 13 139)

Solubility in  $NaC_2H_3O_2 + Aq$  at 25°

Composition of the solutions

% Na acetate	% Pb acetate	% $Na_2SO_4$	% $H_2O$
6.69	0.78	0.34	92.19
11.76	2.73	1.26	84.25
16.90	5.70	2.49	74.91
19.92	8.24	3.60	65.24
21.51	10.75	4.68	63.10
6.95	0.81	0.35	91.90

The proportion of sulphate in solution in each case corresponded with the amount of  $Pb$  present, but was calculated to sodium sulphate, since  $Na_2SO_4 + 10H_2O$  cryst. from the solutions on cooling. The solid phase in these solutions was  $PbSO_4$ .

(Fox, Chem. Soc. 1909, 95 887)

Sol in  $Mn(C_2H_3O_2)_2$ ,  $Zn(C_2H_3O_2)_2$ ,  $Ni(C_2H_3O_2)_2$ , and  $Cu(C_2H_3O_2)_2$  but not in  $Hg(C_2H_3O_2)_2$  or  $Ag_2C_2H_3O_2 + Aq$

Solubility in  $KC_2H_3O_2 + Aq$  is not less than that in  $NH_4C_2H_3O_2 + Aq$  (Dibbitts, Z. anal. 13 137)

Insol in  $Pb(C_2H_3O_2)_2 + Aq$  (Smith)

Sol in basic lead acetate + Aq, but not in neutral  $Pb(C_2H_3O_2)_2 + Aq$  (Stummer, Z. anal. 23 67)

12.2 pts  $Ca(C_2H_3O_2)_2$  in very dil solution dissolve 1 pt  $PbSO_4$  (Stadel, Z. anal. 2 180)

Sol in  $Al(C_2H_3O_2)_3 + Aq$  (Lennsen)



Very easily and abundantly sol in  $\text{NH}_4$  tartrate + Aq (Wohler, A 34 235)

Even when native, easily sol in  $\text{NH}_4$  citrate + Aq (Smith)

Insol in alcohol (18%) and  $\text{H}_2\text{SO}_4$  when  $\text{NH}_4$  acetate, K tartrate, or  $\text{NH}_4$  succinate are present. Insol in alcohol (18%) and  $\text{H}_2\text{SO}_4$  or  $(\text{NH}_4)_2\text{SO}_4$  when Na acetate, Na or  $\text{NH}_4$  oxalate are present. Sol in  $\text{NH}_4$  dicitrate and K tricitrate in presence of  $\text{H}_2\text{SO}_4$ , in  $\text{NH}_4$  succinate and  $\text{NH}_4$  acetate in presence of  $(\text{NH}_4)_2\text{SO}_4$ , and in  $\text{NH}_4$  citrate in presence of  $\text{H}_2\text{SO}_4$  or  $(\text{NH}_4)_2\text{SO}_4$  (Storer, C N 21 17)

Alcohol (59%) alone, or with ethylsulphuric acid or sugar, does not dissolve Pb by 3 months action (Storer)

Insol in acetone (Naumann, B 1904, 37 4329), methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314)

Min *Anglesite* Sol in cold citric acid + Aq (Bolton, C N 37 14)

**Lead hydrogen sulphate,  $\text{PbSO}_4$ ,  $\text{H}_2\text{SO}_4$  +  $\text{H}_2\text{O}$**

Decomp by  $\text{H}_2\text{O}$

**Lead pyrosulphate,  $\text{Pb S}_2\text{O}_7$**

Decomp by  $\text{H}_2\text{O}$  (Schultz)

**Lead potassium sulphate,  $\text{PbSO}_4$ ,  $\text{K}_2\text{SO}_4$**

When  $\text{PbSO}_4$  is added to potassium acetate + Aq at  $25^\circ$  a double salt,  $\text{PbK}_2(\text{SO}_4)_2$  is formed. This salt is insol in the solution which contains only potassium acetate and lead acetate (Fox, Chem Soc 1909, 95 882)

Decomp by  $\text{H}_2\text{O}$  Stable only in solutions of  $\text{K}_2\text{SO}_4$ , containing at least 0.56%  $\text{K}_2\text{SO}_4$  at  $7^\circ$ , 0.62% at  $17^\circ$ , 1.09% at  $50^\circ$ , 1.37% at  $75^\circ$ , 1.69% at  $100^\circ$  (Barre, C R 1909, 149 294)

**Lead sulphate chloride,  $\text{PbSO}_4$ ,  $2\text{PbCl}_2$  +  $\text{H}_2\text{O}$**

Insol in  $\text{H}_2\text{O}$  or  $\text{NaCl}$  + Aq (Becquerel, C R 20 1523)

**Lead sulphate fluoride,  $\text{PbSO}_4$ ,  $2\text{PbF}_2$**

Not decomp by  $\text{H}_2\text{SO}_4$  (Lonyet, C R 24 434)

**Lithium sulphate,  $\text{Li}_2\text{SO}_4$**

More sol in cold than in hot  $\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve 34.6 pts  $\text{Li}_2\text{SO}_4$  at  $18^\circ$  (Wittstein)

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{Li}_2\text{SO}_4$  at  $t^\circ$

$t^\circ$	Pts $\text{Li}_2\text{SO}_4$	$t^\circ$	Pts $\text{Li}_2\text{SO}_4$	$t^\circ$	Pts $\text{Li}_2\text{SO}_4$
0	35.34	45	32.38	100	29.24
20	34.36	65	30.3		

(Kremers, Pogg 95 468)

Sat  $\text{Li}_2\text{SO}_4$  + Aq contains at

$-20^\circ$   $-16^\circ$   $-15^\circ$   $-12^\circ$   
18.4 22.5 22.6 24.4 %  $\text{Li}_2\text{SO}_4$

$-4^\circ$   $+15^\circ$   $+90^\circ$   
25.7 25.3 23.9 %  $\text{Li}_2\text{SO}_4$   
(Étard, A ch 1894, (7) 2 547)

Sat solution boils at  $105^\circ$  (Kremers)

Sp gr of  $\text{Li}_2\text{SO}_4$  + Aq at  $19.5^\circ$  containing  
6.5 7.4 12.5 15.3 %  $\text{Li}_2\text{SO}_4$   
1.05 1.06 1.098 1.118

22.6 24.4 29.4 %  $\text{Li}_2\text{SO}_4$   
1.167 1.178 1.208

(Kremers, Pogg 114 47)

Sp gr of  $\text{Li}_2\text{SO}_4$  + Aq at  $15^\circ$  containing 5%  
 $\text{Li}_2\text{SO}_4 = 1.0430$ , 10%  $\text{Li}_2\text{SO}_4 = 1.0877$   
(Kohlrausch, W Ann 1879 1)

Sp gr of  $\text{Li}_2\text{SO}_4$  + Aq at  $25^\circ$

Concentration of $\text{Li}_2\text{SO}_4$ + Aq	Sp gr
1—normal	1.0453
$1/2$ —	1.0234
$1/4$ —	1.0115
$1/8$ —	1.0057

(Wagner, Z phys Ch 1890, 5 38)

Sp gr of  $\text{Li}_2\text{SO}_4$  + Aq

$1/2 \text{Li}_2\text{SO}_4$ g in 1000 g of solution	Sp gr $16/16^\circ$
0	1.000000
2.9198	1.002589
16.0461	1.014093

(Dijken, Z phys Ch 1897, 24 109)

Sp gr of  $\text{Li}_2\text{SO}_4$  + Aq at  $20^\circ$

Normality of $\text{Li}_2\text{SO}_4$ + Aq	% $\text{Li}_2\text{SO}_4$	Sp gr
2.60	23.48	1.2330
1.96	18.53	1.1650
1.708	16.41	1.1449
1.320	13.01	1.1133
0.747	7.71	1.0678

(Forchheimer, Z phys Ch 1900, 34 24)

Insol in  $\text{SO}_3$  (Weber, B 17 2497)

10 ccm of sat  $\text{Li}_2\text{SO}_4$  in absolute  $\text{H}_2\text{SO}_4$  contain approx 2.719 g  $\text{Li}_2\text{SO}_4$  (Bergius, Z phys Ch 1910, 72 355)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$ 

Composition of the solution		Solid phase
% by wt $\text{H}_2\text{SO}_4$	% by wt $\text{Li}_2\text{SO}_4$	
5 05	22 74	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
12 23	20 45	"
15 37	19 11	"
16 60	19 10	"
32 70	13 37	"
36 90	11 90	"
42 98	10 57	"
48 00	10 20	"
52 72	11 44	"
54 54	12 92	"
55 08	13 69	$\text{Li}_2\text{SO}_4$
56 30	13 87	"
61 46	17 10	"
61 82	17 00	"
62 14	17 97	"
62 49	18 89	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{SO}_4$
65 70	16 55	"
69 40	13 75	"
77 30	11 31	"
78 23	11 64	"
81 20	13 28	"
81 70	13 85	"
82 30	15 50	"
83 43	15 65	"

(Van Dorp, Z phys Ch 1910, **73** 289)

Solution in  $\text{H}_2\text{SO}_4$  contains 17.2%  $\text{Li}_2\text{SO}_4$  at  $30^\circ$  (Van Dorp, Z phys Ch 1913, **86** 112)

Solubility of  $\text{Li}_2\text{SO}_4 + \text{Th}(\text{SO}_4)_2$  in  $\text{H}_2\text{O}$  at  $25^\circ$ 

Solid phase,  $\text{Th}(\text{SO}_4)_2$   
G in 100 g  $\text{H}_2\text{O}$

$\text{Li}_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$	$\text{Li}_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$
0 0	1 722	11 13	11 05
2 57	4 13	13 18	12 54
4 93	6 20	16 12	14 52
6 98	7 95	20 49	16 92
9 23	9 68	16 92	18 87

(Barre, Bull Soc 1912, (4) **11** 647)

Easily sol (Kastner), sl sol (Berzelus) in alcohol

Solubility of  $\text{Li}_2\text{SO}_4$  in alcohol + Aq at  $30^\circ$ Solid phase  $\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$ 

G per 100 g sat solution			
$\text{C}_2\text{H}_5\text{OH}$	$\text{Li}_2\text{SO}_4$	$\text{C}_2\text{H}_5\text{OH}$	$\text{Li}_2\text{SO}_4$
0	25 1	47 28	3 04
11 75	16 16	58 59	1 22
21 19	11 52	69 39	0 4
29 40	8 17	80 74	0
33 31	6 66	94 11	0

(Schreinemakers and van Dorp, Chem Weekbl 1906, **3** 557)

Insol in methyl acetate (Naumann, B 1909, **42** 3790), ethyl acetate (Naumann B 1904, **37** 3601), acetone (Eidmann, C C, **1899**, II 1014, Naumann, B 1904, **37** 4329) +  $\text{H}_2\text{O}$  Very sl efflorescent (Rammelsberg)

Aq solution contains 25.1%  $\text{Li}_2\text{SO}_4$  at  $30^\circ$  (Schreinemakers, C C **1910**, I 1801), 24.3 g at  $50^\circ$  (Schreinemakers and Cocheret, Chem Weekbl 1905, **2** 771)

Lithium hydrogen sulphate,  $\text{LiHSO}_4$ Decomp by  $\text{H}_2\text{O}$ Cryst from  $\text{H}_2\text{SO}_4$  (Gmelin)

$\text{LiH}_3(\text{SO}_4)_2$  Cryst from  $\text{H}_2\text{SO}_4$  (Schultz, Pogg **133** 137)

$\text{Li}_2\text{SO}_4 \cdot 7\text{H}_2\text{SO}_4$  (Bergius, Z phys Ch 1910, **72** 355)

Lithium potassium sulphate,  $\text{Li}_2\text{SO}_4 \cdot \text{K}_2\text{SO}_4$ 

This is the only compd of  $\text{Li}_2\text{SO}_4$  and  $\text{K}_2\text{SO}_4$  which exists below  $100^\circ$  (Spielrein, C R 1913, **157** 48)

$\text{K}_4\text{Li}_2(\text{SO}_4)_3$  (Knobloch) Has the formula  $\text{K}_2\text{Li}_3(\text{SO}_4)_5 + 8\text{H}_2\text{O}$ , according to Rammelsberg

Lithium sodium sulphate,  $\text{Na}_3\text{Li}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$  $\text{Na}_4\text{Li}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$  $\text{Na Li}_3(\text{SO}_4)_5 + 5\text{H}_2\text{O}$  (Rammelsberg)

Do not exist (Troost)

$\text{Li}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4 + 5.5\text{H}_2\text{O}$  Exists from  $0^\circ$ – $16^\circ$

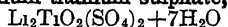
 $+ 3\text{H}_2\text{O}$  Exists from  $32^\circ$ – $100^\circ$ 

$\text{Li}_2\text{SO}_4$ ,  $3\text{Na}_2\text{SO}_4 + 12\text{H}_2\text{O}$  Exists from  $16^\circ$ – $24^\circ$

$4\text{Li}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4 + 5\text{H}_2\text{O}$  Exists from  $24^\circ$ – $32^\circ$

(Spielrein, C R 1913, **157** 47)Lithium thallic sulphate,  $\text{LiTi}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ 

(Meyer and Goldschmidt, C C **1903**, I 495)

**Lithium titanium sulphate,**

Less hygroscopic than K compound  
(Mazzuchelli and Pontanelli, C C 1909, II 420)

**Lithium uranyl sulphate,  $\text{Li}_2\text{SO}_4, \text{UO}_2\text{SO}_4 + 4\text{H}_2\text{O}$** 

(de Coninck, Chem Soc 1905, 88 (2) 530)

**Magnesium sulphate basic,**

Sl sol in cold or hot  $\text{H}_2\text{O}$

Sol in  $\text{HCl} + \text{Aq}$  (Thugutt, Z anorg 1892, 2 150)

**Magnesium sulphate,  $\text{MgSO}_4$** 

*Anhydrous* Very slowly sol in  $\text{H}_2\text{O}$ , sol in hot conc  $\text{H}_2\text{SO}_4$ , less in  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$

$+ \text{H}_2\text{O}$  Min *Kieserite* Easily sol in warm, but slowly dissolved by cold  $\text{H}_2\text{O}$

100 g sat solution at  $83^\circ$  contain 40.2 g  $\text{MgSO}_4$  (Geiger, Dissert 1904)

$+ 6\text{H}_2\text{O}$ , and  $+ 7\text{H}_2\text{O}$  The latter exists in two modifications, (a) hexagonal, and (b) the ordinary or rhombic salt

$\text{MgSO}_4 + \text{Aq}$ , which on cooling or keeping in closed vessels has deposited  $\text{MgSO}_4 + 6\text{H}_2\text{O}$ , always contains for 100 pts  $\text{H}_2\text{O}$  at

$0^\circ$	$10^\circ$	$20^\circ$
40.75	42.23	43.87

pts  $\text{MgSO}_4$

If only hexagonal  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  has been deposited, then the mother liquor contains for 100 pts  $\text{H}_2\text{O}$  at

$0^\circ$	$10^\circ$	$20^\circ$
34.67	38.71	42.84

pts  $\text{MgSO}_4$

Solutions prepared from rhombic  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  contain for 100 pts  $\text{H}_2\text{O}$  at

$0^\circ$	$10^\circ$	$20^\circ$
26.0	30.9	35.6

pts  $\text{MgSO}_4$

(Lowel)

These results may be given in tabular form as follows

Temp	A sat aqueous solution of $\text{MgSO}_4 + 7\text{H}_2\text{O}$ (b) contains for 100 pts $\text{H}_2\text{O}$	
	Anhydrous $\text{MgSO}_4$	$7\text{H}_2\text{O}$ (b) salt
$0^\circ$	26.0	73.31
$10^\circ$	30.9	93.75
$20^\circ$	35.6	116.54

Temp	A sat aqueous solution of $\text{MgSO}_4 + 7\text{H}_2\text{O}$ (a) contains for 100 pts $\text{H}_2\text{O}$	
	Anhydrous $\text{MgSO}_4$	$7\text{H}_2\text{O}$ (a) salt
$0^\circ$	34.67	111.74
$10^\circ$	38.71	133.67
$20^\circ$	42.84	159.61

Temp	A sat aqueous solution of $\text{MgSO}_4 + 6\text{H}_2\text{O}$ contains for 100 pts $\text{H}_2\text{O}$		
	Anhydrous $\text{MgSO}_4$	$6\text{H}_2\text{O}$ salt	$7\text{H}_2\text{O}$ salt
$0^\circ$	40.75	122.22	146.02
$10^\circ$	42.32	129.44	155.53
$20^\circ$	43.87	137.72	167.97

It is seen from table that at the same temp the  $6\text{H}_2\text{O}$  salt is more sol than the  $7\text{H}_2\text{O}$  (b) salt, and the latter is more sol than  $7\text{H}_2\text{O}$  (a) salt, that the solubility of the  $7\text{H}_2\text{O}$  (b) salt increases rapidly from  $0^\circ$  to  $20^\circ$ , that the  $6\text{H}_2\text{O}$  salt is not much more sol at  $20^\circ$  than at  $0^\circ$ , and at  $20^\circ$  the  $7\text{H}_2\text{O}$  (b) salt is nearly as sol as the  $6\text{H}_2\text{O}$  salt (Lowel, A ch (3) 43 405)

100 pts  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve pts  $\text{MgSO}_4$  G L = according to Gay Lussac (A ch (2) 11 311) T = according to Tobler (A 95 198)

$t^\circ$	G L	T	$t^\circ$	G I	I
0	25.8	24.7	50	49.7	52.8
10	30.5		55		
20	37.0		60	55.9	
25		37.1	70	60.4	
30	39.8		80	66.1	
40	45.2		90	70.3	

100 pts  $\text{H}_2\text{O}$  at  $105.5^\circ$  dissolve 133.2 pts  $\text{MgSO}_4$  (Griffiths)

$\text{MgSO}_4 + \text{Aq}$  sat at  $17.5^\circ$  has sp gr = 1.2932 and contains 55.57 %  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  or 100 pts  $\text{H}_2\text{O}$  dissolve 123.06 pts  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  or 60 pts  $\text{MgSO}_4$  at  $17.5^\circ$  (Karsten)

100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 53.8 pts and 123.4 pts at ord temp (Otto Graham)

Sol in 2 pts cold and 0.5 pt boiling  $\text{H}_2\text{O}$  (four croy)

The aqueous solution contains for 100 pts  $\text{H}_2\text{O}$  92.217 pts  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  at  $1^\circ$  (Michel and Kraft)

1 pt  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  is sol in 0.933 pt  $\text{H}_2\text{O}$  at  $1^\circ$  (Cerlach) in 0.92 pt  $\text{H}_2\text{O}$  at  $23^\circ$  (Schiff)

100 pts  $\text{H}_2\text{O}$  dissolve 25.067 pts  $\text{MgSO}_4$  at  $0^\circ$  (Pfaff A 99 224)

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{MgSO}_4$  at  $t^\circ$

t	pts $\text{MgSO}_4$
0	26.57
17.9	33.28
24.1	35.98

(Diacon, J B 1886 62)

100 pts  $\text{MgSO}_4 + \text{Aq}$  sat at  $18-20^\circ$  contain 25.67-26.38 pts  $\text{MgSO}_4$  (v Hauer, J pr 98 137)

Solubility in 100 pts  $H_2O$  at  $t^\circ$ , using  
 $MgSO_4 + 7H_2O$

$t^\circ$	Pts $MgSO_4$	$t^\circ$	Pts $MgSO_4$	$t^\circ$	Pts $MgSO_4$
0	26.9	37	44.2	74	61.4
1	27.4	38	44.7	75	61.9
2	27.9	39	45.2	76	62.3
3	28.3	40	45.6	77	62.8
4	28.8	41	46.1	78	63.2
5	29.3	42	46.5	79	63.7
6	29.7	43	47.0	80	64.2
7	30.2	44	47.5	81	64.6
8	30.6	45	48.0	82	65.1
9	31.1	46	48.4	83	65.6
10	31.5	47	48.9	84	66.0
11	32.0	48	49.3	85	66.5
12	32.4	49	49.8	86	67.0
13	32.9	50	50.3	87	67.5
14	33.4	51	50.7	88	68.0
15	33.8	52	51.2	89	68.4
16	34.3	53	51.7	90	68.9
17	34.7	54	52.2	91	69.4
18	35.2	55	52.7	92	69.9
19	35.7	56	53.2	93	70.4
20	36.2	57	53.6	94	70.9
21	36.7	58	54.1	95	71.4
22	37.1	59	54.5	96	71.9
23	37.6	60	55.0	97	72.4
24	38.0	61	55.5	98	72.8
25	38.5	62	55.9	99	73.3
26	39.0	63	56.4	100	73.8
27	39.5	64	56.8	101	74.3
28	39.9	65	57.3	102	74.8
29	40.4	66	57.7	103	75.2
30	40.9	67	58.2	104	75.7
31	41.4	68	58.6	105	76.2
32	41.8	69	59.1	106	76.7
33	42.3	70	59.6	107	77.2
34	42.8	71	60.0	108	77.7
35	43.3	72	60.5	108.4	77.9
36	43.7	73	61.0		

(Mulder, calculated from his own and other observations, *Schick Verh* undel **1864** 52)

100 pts  $H_2O$  dissolve 72.4 pts  $MgSO_4 + 7H_2O$  at  $0^\circ$ , 178 pts at  $40^\circ$ , and 212.6 pts at  $49^\circ$  (Tilden, *Chem Soc* **45** 409)

Supersat  $MgSO_4 + Aq$  is brought to crystallization by addition of crystal of  $MgSO_4 + 7H_2O$ , or an isomorphous substance as  $ZnSO_4 + 7H_2O$ ,  $NiSO_4 + 7H_2O$ ,  $FeSO_4 + 7H_2O$ , or  $CoSO_4 + 7H_2O$  (Thomson, *Chem Soc* **35** 199)

Sat  $MgSO_4 + Aq$  contains at

$2^\circ$        $7^\circ$        $23^\circ$        $67^\circ$        $81^\circ$   
20.9    22.5    26.0    35.6    38.6 %  $MgSO_4$ ,

$94^\circ$      $130^\circ$      $145^\circ$      $164^\circ$      $188^\circ$   
41.5    45.3    38.0    29.3    20.4 %  $MgSO_4$

Readily forms supersat solutions

(Étard, *Ann* 1894, (7) **2** 551)

M-pt of  $MgSO_4 + 7H_2O$  is  $70^\circ$  (Tilden, *Chem Soc* **45** 409)

$MgSO_4 + Aq$  with sp gr 1.50 contains 44.4 %  $MgSO_4$ , sp gr 1.42 39% sp gr 1.30 30%  $MgSO_4$  (Dalton)

Sp gr of  $MgSO_4 + Aq$  sat at  $15^\circ = 1.275$  (Michel and Krafft), at  $8^\circ = 1.267$  (Anthon), at  $18.75^\circ = 1.293$  (Karsten)

Sp gr of  $MgSO_4 + Aq$  at  $15^\circ$

% $MgSO_4$	Sp gr	% $MgSO_4$	Sp gr
5	1.054	30	1.326
10	1.108	35	1.384
15	1.161	40	1.446
20	1.215	45	1.511
25	1.269	50	1.580

(Calculated from Anthon by Schiff, *A* **107** 303)

Sp gr of  $MgSO_4 + Aq$  at  $23^\circ$

% $MgSO_4 + 7H_2O$	Sp gr	% $MgSO_4 + 7H_2O$	Sp gr
1	1.0048	28	1.1426
2	1.0096	29	1.1481
3	1.0144	30	1.1536
4	1.0193	31	1.1592
5	1.0242	32	1.1648
6	1.0290	33	1.1704
7	1.0339	34	1.1760
8	1.0387	35	1.1817
9	1.0437	36	1.1875
10	1.0487	37	1.1933
11	1.0537	38	1.1991
12	1.0587	39	1.2049
13	1.0637	40	1.2108
14	1.0688	41	1.2168
15	1.07.9	42	1.2228
16	1.0790	43	1.2288
17	1.0842	44	1.2349
18	1.0894	45	1.2410
19	1.0945	46	1.2472
20	1.0997	47	1.2534
21	1.1050	48	1.2596
22	1.1103	49	1.2659
23	1.1156	50	1.2722
24	1.1209	51	1.2786
25	1.1261	52	1.2850
26	1.1316	53	1.2915
27	1.1371	54	1.2980

(Schiff, *A* **113** 185)

Sp gr of  $\text{MgSO}_4 + \text{Aq}$  at  $12^\circ$ 

% $\text{MgSO}_4 + 7\text{H}_2\text{O}$	Sp gr	% $\text{MgSO}_4 + 7\text{H}_2\text{O}$	Sp gr
1	1 0046	21	1 1071
2	1 0096	22	1 1125
3	1 0146	23	1 1179
4	1 0196	24	1 1234
5	1 0246	25	1 1289
6	1 0296	26	1 1344
7	1 0346	27	1 1399
8	1 0396	28	1 1454
9	1 0446	29	1 1510
10	1 0497	30	1 1566
11	1 0548	31	1 1622
12	1 0599	32	1 1679
13	1 0650	33	1 1736
14	1 0702	24	1 1793
15	1 0754	35	1 1850
16	1 0807	36	1 1908
17	1 0859	37	1 1965
18	1 0911	38	1 2023
19	1 0964	39	1 2082
20	1 1018	40	1 2140

(Oudemans, Z anal 7 419)

Sp gr of  $\text{MgSO}_4 + \text{Aq}$  at  $15^\circ$ 

% $\text{MgSO}_4$	Sp gr	% $\text{MgSO}_4$	Sp gr
1	1 01031	14	1 15083
2	1 02062	15	1 16222
3	1 03092	16	1 17420
4	1 04123	17	1 18618
5	1 05154	18	1 19816
6	1 06229	19	1 21014
7	1 07304	20	1 22212
8	1 08379	21	1 23465
9	1 09454	22	1 24718
10	1 10529	23	1 25972
11	1 11668	24	1 27225
12	1 12806	25	1 28478
13	1 13945	25 248	1 28802

(Gerlach, Z anal 8 287)

Sp gr of  $\text{MgSO}_4 + \text{Aq}$  at  $23.5^\circ$  a=no of  $\frac{1}{2}$  mols in grms dissolved in 1000 g  $\text{H}_2\text{O}$ , b=sp gr if a is  $\text{MgSO}_4 + 7\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol wt =123, c=sp gr if a is  $\text{MgSO}_4$ ,  $\frac{1}{2}$  mol wt =60

a	b	c	a	b	c
1	1 056	1 059	5	1 203	1 260
2	1 103	1 114	6	1 229	
3	1 141	1 166	7	1 252	
4	1 174	1 214	8	1 273	

(Favre and Valson, C R 79 968)

Sp gr of  $\text{MgSO}_4 + \text{Aq}$  at  $15^\circ$ 

% $\text{MgSO}_4$	Sp gr	% $\text{MgSO}_4$	Sp gr
5	1 0510	20	1 2200
10	1 1052	25	1 2861
15	1 1602		

(Kohlrausch, W Ann 1879 1)

Sp gr of  $\text{MgSO}_4 + \text{Aq}$  at  $0^\circ$  S=pts  $\text{MgSO}_4$  in 100 pts solution

S	Sp gr	S	Sp gr
13 800	1 1586	7 4046	1 0826
11 7458	1 1329	5 0447	1 0557
9 6218	1 1072	2 5907	1 0284

(Charpy, A ch (6) 29 26)

Sat  $\text{MgSO}_4 + \text{Aq}$  boils at  $105^\circ$  (Griffiths),  $108.4^\circ$  (Mulder)

Crust forms at  $103.5^\circ$  (solution containing 48.4 pts  $\text{MgSO}_4$  to 100 pts  $\text{H}_2\text{O}$ ), highest temp observed,  $105^\circ$  (Gerlach, Z anal 26 426)

B-pt of  $\text{MgSO}_4 + \text{Aq}$  containing pts  $\text{MgSO}_4$  to 100 pts  $\text{H}_2\text{O}$

B pt	Pts $\text{MgSO}_4$	B pt	Pts $\text{MgSO}_4$	B pt	Pts $\text{MgSO}_4$
100 $5^\circ$	8 8	102 $5^\circ$	34 7	104 $5^\circ$	51 3
101 0	16 7	103 0	39 5	105	54 6
101 5	23 5	103 5	43 8	108	75(?)
102 0	29 5	104 0	47 7		

(Gerlach, Z anal 26 432)

Sp gr of  $\text{MgSO}_4 + \text{Aq}$  at  $9.5^\circ$ 

Mass of salt per unit mass of solution	Density of solution (g per cc)
0 00191	1 00170
0 00380	1 00346
0 00569	1 00526
0 00758	1 00705
0 01132	1 01060

(McGregor, C N 1887, 55 6)

Sp gr of  $\text{MgSO}_4 + \text{Aq}$  at  $25^\circ$ 

Concentration of $\text{MgSO}_4 + \text{Aq}$	Sp gr
1—normal	1 0584
$\frac{1}{2}$ —“	1 0297
$\frac{1}{5}$ —“	1 0152
$\frac{1}{8}$ —“	1 0076

(Wagner, Z phys Ch 1890, 5 38)

Sp gr at  $16\frac{1}{4}^\circ$  of  $\text{MgSO}_4 + \text{Aq}$  containing 11.0222%  $\text{MgSO}_4 = 1.11471$ , containing 8.343%  $\text{MgSO}_4 = 1.08558$  (Schonrock, Z phys Ch 1893, 11 782)

Sp gr of $\text{MgSO}_4 + \text{Aq}$		
G-equivalents $\text{MgSO}_4$ per liter	t°	Sp gr t°/t°
0 002548	17 989	1 0001625
0 005093	18 020	1 000324
0 01015	17 995	1 000639
0 02023	17 980	1 001274
0 05023	18 047	1 003117
0 09950	18 033	1 006122
0 19773	18 014	1 012035
0 29459	17 997	1 017806
0 48671	17 994	1 029101
0 5022	17 90	1 03000
5 0220	17 95	1 26970
0 002616	14 096	1 0001672
0 005230	14 109	1 0003311
0 01042	14 098	1 000659
0 02077	14 092	1 001306
0 12462	14 199	1 007682
0 24567	14 092	1 014980

(Kohlrausch, W Ann 1894, **53** 27)

Sp gr of $\text{MgSO}_4 + \text{Aq}$	
$\frac{1}{2} \text{MgSO}_4$ g in 1000 g of solution	Sp gr 16°/16°
0	1 000000
0 5368	1 000570
1 0917	1 001157
"	1 001141
2 1076	1 002234
4 1367	1 004372
9 0608	1 009523
18 0846	1 018954
37 1342	1 038983
52 1362	1 054867

(Dyken, Z phys Ch 1897, **24** 108)

Sp gr of  $\text{MgSO}_4 + \text{Aq}$  at 18°, when p = per cent strength of the solution, d = observed density, and w = volume conc in grams per cc ( $\frac{\text{pd}}{100} = w$ )

p	d	w
26 25	1 2903	1 3374
25 91	1 2860	1 3319
24 53	1 2693	1 3101
21 60	1 2330	1 2650
18 41	1 1950	1 2187
13 79	1 1423	1 1562
12 63	1 1291	1 1413
11 29	1 1147	1 1246
8 08	1 0803	1 0859
2 01	1 0204	1 0191

(Barnes, J phys Chem 1898, **2** 542)

Sp gr of $\text{MgSO}_4 + \text{Aq}$ at 20°		
Normality of $\text{MgSO}_4 + \text{Aq}$	% $\text{MgSO}_4$	Sp gr
2 73	25 46	1 2879
1 86	18 61	1 2019
0 934	10 14	1 1049
(Forchheimer, Z phys Ch 1900, <b>34</b> 24)		
Sp gr of dil $\text{MgSO}_4 + \text{Aq}$ at 20 004°		
Conc = g equiv per l at 20 004°		
Sp gr compared with $\text{H}_2\text{O}$ at 20 004° = 1		
Conc		Sp gr
0 0000		1 000,000,0
0 0001		1 000,006,4
0 0002		1 000,012,9
0 0003		1 000,019,4
0 0004		1 000,025,9
0 0005		1 000,032,4
0 0010		1 000,064,8
0 0020		1 000,129,4
0 0050		1 000,322,4
0 0100		1 000,642,1

(Lamb and Lee, J Am Chem Soc 1913, **35** 1684)

More sol in  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Richter)

In sat  $\text{HCl} + \text{Aq}$ , anhydrous  $\text{MgSO}_4$  is scarcely sol,  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  dissolves, but is precipitated by a current of  $\text{HCl}$  gas (Hensgen, B **10** 259)

Margueritte (C R **43** 50) denies the precipitation

For solubility in  $\text{H}_2\text{SO}_4$ , see  $\text{MgH}_2(\text{SO}_4)_2$

Completely pptd from  $\text{MgSO}_4 + \text{Aq}$  by conc  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Persoz)

Somewhat sol in sat  $\text{NH}_4\text{Cl} + \text{Aq}$  with separation of a double sulphate

Rapidly sol in  $\text{KCl} + \text{Aq}$  with separation of  $\text{K}_2\text{SO}_4$

Sol in sat  $\text{NaCl} + \text{Aq}$  without pptn of the latter

Easily sol in sat  $\text{KNO}_3 + \text{Aq}$  without causing any pptn

Sol in sat  $\text{NaNO}_3 + \text{Aq}$  (Karsten)

Rapidly sol in sat  $\text{CuSO}_4 + \text{Aq}$ , when saturation is reached, a double salt separates out (Karsten)

100 pts sat  $\text{MgSO}_4 + \text{NiSO}_4 + \text{Aq}$  at 18–20° contain 30 93 pts of the two salts, 100 pts sat  $\text{MgSO}_4 + \text{ZnSO}_4 + \text{Aq}$  at 18–20° contain 35 45 pts, 100 pts sat  $\text{MgSO}_4 + \text{NiSO}_4 + \text{ZnSO}_4 + \text{Aq}$  at 18–20° contain 35 62 pts (v Hauer, J pr **98** 137)

100 pts  $\text{H}_2\text{O}$  dissolve 14 1 pts  $\text{MgSO}_4$  and 9 8 pts  $\text{K}_2\text{SO}_4$ , if sat  $\text{MgSO}_4 + \text{Aq}$  is sat with  $\text{K}_2\text{SO}_4$ , 32 4 pts  $\text{MgSO}_4$  and 8 2 pts  $\text{K}_2\text{SO}_4$ , if sat  $\text{K}_2\text{SO}_4 + \text{Aq}$  is sat with  $\text{MgSO}_4$ , all at 15° (Mulder, J B **1866**)

100 pts  $\text{H}_2\text{O}$  dissolve 25 95 pts  $\text{MgSO}_4$  and 5 21 pts  $\text{Na}_2\text{SO}_4$  at 0° (Diacon, J B **1866** 62)

100 pts H<sub>2</sub>O dissolve 15 306 pts MgSO<sub>4</sub> and 13 086 pts Na<sub>2</sub>SO<sub>4</sub> at 0° (Pfaff, A 99 224)

See also under MgNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O

Solubility of mixtures of MgSO<sub>4</sub> and MgNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O at t°

t°	g per 100 g H <sub>2</sub> O	
	Na <sub>2</sub> SO <sub>4</sub>	MgSO <sub>4</sub>
22	23 3	31 4
24 5	27 2	24 2
30	36 1	19 1
35	33 9	18 44

(Roozeboom, 1888, Z phys Ch 2 518)

See also under MgNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O

Slowly sol in sat ZnSO<sub>4</sub>+Aq without pptn until saturation, when a double salt separates out

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 828)

100 pts dil alcohol containing at 15°

10 20 40 % alcohol  
contain 39 3 21 3 1 62% MgSO<sub>4</sub>+7H<sub>2</sub>O  
(Schiff, A 118 365)

At higher temp the solubility increases proportional to the temp (Gerardin, A ch (4) 5 145)

100 pts absolute methyl alcohol dissolve 1 18 pts MgSO<sub>4</sub> at 18° (de Bruyn, Z phys Ch 10 783)

100 pts absolute methyl alcohol dissolve 41 pts MgSO<sub>4</sub>+7H<sub>2</sub>O at 17° 100 pts absolute methyl alcohol dissolve 29 pts MgSO<sub>4</sub>+7H<sub>2</sub>O at 3-4°, 100 pts 93% methyl alcohol dissolve 9 7 pts MgSO<sub>4</sub>+7H<sub>2</sub>O at 17°, 100 pts 50% methyl alcohol dissolve 4 1 pts MgSO<sub>4</sub>+7H<sub>2</sub>O at 3-4° (de Bruyn, R t c 11 112)

100 pts absolute ethyl alcohol dissolve 1 3 pts MgSO<sub>4</sub>+7H<sub>2</sub>O at 3° (de Bruyn)

Insol in CS<sub>2</sub> (Arctowski, Z anorg 1894, 6 257)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1910, 43 314), acetone (Naumann, B 1904, 37 4329)

100 g 95% formic acid dissolve 0 34 g MgSO<sub>4</sub> at 19° (Aschan, Ch Ztg 1913, 37 1117)

100 g sat solution of MgSO<sub>4</sub> and sugar in H<sub>2</sub>O contains 46 52, g sugar +14 0 g MgSO<sub>4</sub>, or 100 g H<sub>2</sub>O dissolve 119 6 g sugar +36 0 g MgSO<sub>4</sub> (Kohler, Z Ver Zuckerind, 1897, 47 447)

**Magnesium hydrogen sulphate, MgH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>**

Decomp by H<sub>2</sub>O Sol in H<sub>2</sub>SO<sub>4</sub> Insol in methyl acetate (Naumann, B 1909, 42 3790)

MgH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> Boiling H<sub>2</sub>SO<sub>4</sub> dissolves about 2% MgSO<sub>4</sub>, from which this compound crystallises (Schultz, Pogg 133 137)

**Magnesium pyrosulphate, MgS<sub>2</sub>O<sub>7</sub>**

Decomp by H<sub>2</sub>O

**Magnesium manganous sulphate, MgSO<sub>4</sub>, 2MnSO<sub>4</sub>+15H<sub>2</sub>O**

Min *Fausserite*

**Magnesium manganous zinc sulphate, MgSO<sub>4</sub>, MnSO<sub>4</sub>, ZnSO<sub>4</sub>+21H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Vohl, A 99 124)

**Magnesium nickel sulphate, MgSO<sub>4</sub>, 3NiSO<sub>4</sub>+28H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Schiff)

**Magnesium nickel potassium sulphate, MgSO<sub>4</sub>, NiSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>+12H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Vohl, A 94 57)

**Magnesium potassium sulphate, MgK<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+6H<sub>2</sub>O**

100 pts H<sub>2</sub>O dissolve 22 7 pts anhydrous salt at 16 5° (Mulder)

100 pts H<sub>2</sub>O dissolve at  

0°	10°	20°	30°	35°
14 1	19 6	25 0	30 4	33 3

 pts anhydrous salt,  

45°	55°	60°	65°	75°
40 5	47 0	50 2	53 0	59 8

 pts anhydrous salt

(Tobler, A 95 193)

100 g H<sub>2</sub>O dissolve 30 52 g MgK(SO<sub>4</sub>)<sub>2</sub>+6H<sub>2</sub>O at 15° (Lothian, Pharm J 1909, 82 292)

Solubility in H<sub>2</sub>O at t°

t	Sat solution concn		Mols K <sub>2</sub> SO <sub>4</sub> mols MgSO <sub>4</sub> in the solution	100 pt soln	
	% SO <sub>4</sub>	% MgSO <sub>4</sub>		K <sub>2</sub> SO <sub>4</sub>	MgSO <sub>4</sub>
10	9 4	9 8	1 1 52	11 63	12 1
20	10 9	10 8	1 1 43	13 92	13 79
30	12 4	11 8	1 1 38	16 36	15 56
40	13 8	13 1	1 1 37	18 88	17 92
50	14 7	14 8	1 1 46	20 85	20 99
60	15 2	16 3	1 1 55	22 19	23 79
70	15 6	16 8	1 1 52	23 07	21 85
80	16 0	17 1	1 1 56	23 91	25 56
80	16 6	18 1	1 1 58	25 42	27 72
90	17 2	18 2	1 1 54	26 62	28 17

(Precht, B 1882 15 1668)

Sp gr of aqueous solution at 15° containing

2 4 6 8% hydrous salt,  
1 0129 1 0261 1 0394 1 053

10 12 14 16% hydrous salt,  
1 0668 1 0808 1 095 1 1094

18 20 22% hydrous salt  
1 124 1 1388 1 1539  
(Schriff, A 113 183, calculated by Gerlach,  
Z anal 8 287)

Sp gr of  $\text{MgK}_2(\text{SO}_4)_2 + \text{Aq}$  at 18°

G-equiv of salt per l	Sp gr
1 0010	1 0633
0 8345	1 0531
0 6688	1 0427
0 3744	1 0243
0 0998	1 0040
0 02004	1 0015
0 01004	1 0004

These results lead the author to conclude that in dil solutions the double salt is decomposed into its constituents (McKay, Elektrochem Zeit 1899, 6 115)

Min *Picromerie*  
+4H<sub>2</sub>O (van der Heide, B 26 414)  
2MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, Min *Langbeinite*  
Deliquescent Absorbs 56.26% H<sub>2</sub>O from air to form K<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>+6H<sub>2</sub>O (Mallet, Chem Soc 1900, 77 220)  
4MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>+5H<sub>2</sub>O (van't Hoff and Kassatkin, B A B 1889 951)

**Magnesium potassium zinc sulphate**,  $\text{MgSO}_4$ ,  
2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O  
Sol in H<sub>2</sub>O (Vohl, A 94 57)

**Magnesium potassium sulphate chloride**,  
MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, MgCl<sub>2</sub>+6H<sub>2</sub>O  
Min *Karnit*

**Magnesium rubidium sulphate**,  $\text{MgSO}_4$ ,  
Rb<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O  
Sol in H<sub>2</sub>O (Lutton, Chem Soc 63 337)  
1 l H<sub>2</sub>O dissolves 202 g anhydrous salt at 25° (Locke, Am Ch J 1902, 27 459)  
2MgSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub> Deliquescent (Mallet, Chem Soc 1900, 77 223)

**Magnesium sodium sulphate**,  $\text{MgSO}_4$ , Na<sub>2</sub>SO<sub>4</sub>,  
+4H<sub>2</sub>O

Min *Bloite*, *Simonyite*  
Blodite is efflorescent, Simonyite, deliquescent  
+5H<sub>2</sub>O Min *Iowite*  
+6H<sub>2</sub>O Decomp on air Sol in 3 pts cold H<sub>2</sub>O  
Na<sub>2</sub>Mg(SO<sub>4</sub>)<sub>4</sub> Min *Vanthoffite* (van't Hoff, B A B 1902 414)  
MgNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O Min *Astrakanite*

100 mols H<sub>2</sub>O hold mols salt in solution at t°

t°	MgSO <sub>4</sub>	Na <sub>2</sub> SO <sub>4</sub>
22	4 70	2 95
24 5	3 68	3 45
30	3 60	3 60
35	3 69	3 69
47	3 60	3 60

(Roozeboom, R t c 1887, 6 333)

Solubility of mixtures of  $\text{MgNa}_2(\text{SO}_4)_2 + 4\text{H}_2\text{O}$  and Na<sub>2</sub>SO<sub>4</sub> at t°

t	g per 100 g H O	
	Na <sub>2</sub> SO <sub>4</sub>	MgSO <sub>4</sub>
18 5	43 0	45 5
22	35 2	48 9
24 5	32 5	50 3
30	25 9	55 0
35	23 5	59 4

(Roozeboom, Z phys Ch 1888, 2 518)  
See also under MgSO<sub>4</sub>

**Magnesium thallous sulphate**,  $\text{MgSO}_4$ , Tl<sub>2</sub>SO<sub>4</sub>,  
+6H<sub>2</sub>O

Sol in H<sub>2</sub>O, but decomp by repeated recrystallisations (Werther)

**Magnesium uranyl sulphate**,  
MgSO<sub>4</sub>, (UO<sub>2</sub>)SO<sub>4</sub>+5H<sub>2</sub>O  
(de Coninck, Chem Soc 1905, 88 (2) 530)

**Magnesium zinc sulphate**,  $\text{MgSO}_4$ , ZnSO<sub>4</sub>+  
14H<sub>2</sub>O

Sol in H O (Pierre, A ch (3) 16 244)  
+10H<sub>2</sub>O (Pierre)

3ZnSO<sub>4</sub>, 5MgSO<sub>4</sub>+56H<sub>2</sub>O (Schriff)  
There are only two compounds, 2(MgSO<sub>4</sub>, 7H<sub>2</sub>O), ZnSO<sub>4</sub>, 7H<sub>2</sub>O and MgSO<sub>4</sub>, 7H<sub>2</sub>O, ZnSO<sub>4</sub>, 7H<sub>2</sub>O (Hollmann, Z phys Ch 1901, 37 212, and 1902, 40 577)

**Magnesium sulphate potassium chloride**,  
MgSO<sub>4</sub>, KCl+3H<sub>2</sub>O or MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>,  
MgCl<sub>2</sub>+6H<sub>2</sub>O

Min *Karnit*  
100 pts H<sub>2</sub>O dissolve 79.56 pts at 18° (Krause, Arch Pharm (3) 6 326)

Not sol in a mixture of abs alcohol and ether, which dissolves out MgCl<sub>2</sub> (Lehmann, J B 1867 416)

Alcohol dissolves out MgCl<sub>2</sub>, also little H<sub>2</sub>O Much H<sub>2</sub>O dissolves completely (Zincken, Miner Jahrb 1865 310)

**Magnesium sulphate potassium chromate**,  
2MgSO<sub>4</sub>, K<sub>2</sub>CrO<sub>4</sub>+9H<sub>2</sub>O

Sol in H<sub>2</sub>O (Étard, C R 85 443)



**Manganous sulphate, basic,  $3\text{MnO}$ ,  $2\text{SO}_3 + 3\text{H}_2\text{O}$**

Insol in  $\text{H}_2\text{O}$ , but slowly decomp thereby (Gorgeu, C R **94** 1425)

**Manganous sulphate,  $\text{MnSO}_4$**

*Anhydrous*

Absorbs  $\text{H}_2\text{O}$  from the air to form  $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$   
1 pt  $\text{MnSO}_4$  is sol in pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{H}_2\text{O}$	$t^\circ$	Pts $\text{H}_2\text{O}$	$t^\circ$	Pts $\text{H}_2\text{O}$
6 25	1 77	18 75	1 667	75	1 494
10	1 631	37 5	1 457	101 25	2 031

Or—

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{MnSO}_4$  at  $t^\circ$

$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$
6 25	56 49	18 75	60 00	75	66 95
10	61 29	37 5	68 63	101 25	49 33

(Brandes Pogg **20** 575)

Sol in 25 pts  $\text{H}_2\text{O}$  at  $18.75^\circ$  at  $62.5^\circ$  it is difficult to dissolve 1 pt  $\text{MnSO}_4$  in 3 pts  $\text{H}_2\text{O}$  but the sat solution at  $62.5^\circ$  does not become cloudy on heating to  $100^\circ$  (Jahn)

100 pts  $\text{MnSO}_4 + \text{Aq}$  sat at  $11-14^\circ$  contain 37.5 pts  $\text{MnSO}_4$  (v Hauer, J pr **103** 114)

Sat  $\text{MnSO}_4 + \text{Aq}$  contains at

$-8^\circ$   $-5^\circ$   $+5^\circ$   $18^\circ$   $22^\circ$   
30 0 31 0 34 1 38 3 38 2%  $\text{MnSO}_4$ ,

$23^\circ$   $32^\circ$   $45^\circ$   $52^\circ$   $70^\circ$   
39 1 41 7 44 2 36 4 41 1%  $\text{MnSO}_4$ ,

$83^\circ$   $110^\circ$   $115^\circ$   $123^\circ$   $130^\circ$   $140^\circ$

36 3 18 4 21 5 16 7 13 6 9 4%  $\text{MnSO}_4$

(Étard, A ch 1894, (7) **2** 553)

Solubility in  $\text{H}_2\text{O}$  increases from  $0-55^\circ$ , and decreases from  $55-145^\circ$ . The increasing solubility is that of  $\text{MnSO}_4 + 5\text{H}_2\text{O}$ , and  $\text{MnSO}_4 + 2\text{H}_2\text{O}$  separates out at  $35^\circ$ , and is completely insol at  $145^\circ$  (Étard)

If solubility  $S = \text{pts anhydrous } \text{MnSO}_4$  in 100 pts solution,  $S = 30.0 + 0.2828t$  from  $-8^\circ$  to  $57^\circ$ ,  $S = 48.0 - 0.4585t$  from  $57^\circ$  to  $150^\circ$

Practically insol in  $\text{H}_2\text{O}$  at  $180^\circ$  (Étard, C R **106** 208)

Solubility varies according to the hydrate used. Above results of Étard show the solubility of  $\text{MnSO}_4 + 7\text{H}_2\text{O}$  at  $0^\circ$ , and  $\text{MnSO}_4 + 3\text{H}_2\text{O}$  at  $57^\circ$ . Anhydrous  $\text{MnSO}_4$  is stable only above  $117^\circ$  (Linebarger)

100 pts  $\text{H}_2\text{O}$  dissolve pts anhydrous  $\text{MnSO}_4$  at  $t^\circ$

$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$
120	67 18	141	41 18	155	26 49
132	63 16	146	38 83	170	16 15

(Linebarger, Am Ch J **15** 225)

$+ \text{H}_2\text{O}$  Stable only between  $57^\circ$  and  $117^\circ$

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{MnSO}_4$  from  $\text{MnSO}_4 + \text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$
48	87 98	78	79 13	115	69 78
53	86 10	90	75 63	117	68 81
65	84 33	100	71 27		
72	82 73	106	70 14		

(Linebarger)

Min *Szmkrite*

Solubility of  $\text{MnSO}_4 + \text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{MnSO}_4$ per 100 pts $\text{H}_2\text{O}$	$t^\circ$	Pts $\text{MnSO}_4$ per 100 pts $\text{H}_2\text{O}$
41 5	61 06	75	49 45
50 1	53 01	84 8	44 87
67 1	51 37	95	38 71
		99 6	34 27

Av of varying results

(Cottrell, J phys Ch 1900, **4** 652)

Linebarger's determinations are inaccurate (Cottrell)

$+ 2\text{H}_2\text{O}$  Stable between  $40^\circ$  and  $57^\circ$

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{MnSO}_4$  from  $\text{MnSO}_4 + 2\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$
35	68 88	42	77 63	50	83 16
40	75 31	45	80 07	55	86 27

(Linebarger)

$+ 3\text{H}_2\text{O}$  Stable between  $30^\circ$  and  $40^\circ$

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{MnSO}_4$  from  $\text{MnSO}_4 + 3\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$
5	54 68	25	66 85	68	71 89
12	60 56	30	67 38	53	72 81
16	63 41	35	68 31	57	73 17
19	65 12	40	70 63		

(Linebarger)

$+ 4\text{H}_2\text{O}$  Sl efflorescent Less sol in boil-  
ing than in cold  $\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  at  $4.4^\circ$  dissolve 31 pts  $\text{MnSO}_4$   
 $+ 4\text{H}_2\text{O}$  (Jahn)

100 pts H<sub>2</sub>O at t° dissolve pts MnSO<sub>4</sub>+4H<sub>2</sub>O

t°	Pts MnSO <sub>4</sub> + 4H <sub>2</sub> O	t°	Pts MnSO <sub>4</sub> + 4H <sub>2</sub> O
6 25	113 22	37 5	149
10	123	75	144
18 75	122	101 25	93

(Brandes Pogg 20 575)

Solubility of MnSO<sub>4</sub> in 100 pts H<sub>2</sub>O at t°, using MnSO<sub>4</sub>+4H<sub>2</sub>O

t°	Pts MnSO <sub>4</sub>	t°	Pts MnSO <sub>4</sub>	t°	Pts MnSO <sub>4</sub>
0	55 4	35	71 9	70	61 5
1	55 9	36	72 2	71	61 5
2	56 5	37	72 4	72	61 5
3	57 1	38	72 7	73	61 5
4	57 7	39	72 9	74	61 5
5	58 2	40	73 1	75	61 5
6	58 8	41	73 3	76	61 5
7	59 4	42	73 5	77	61 5
8	60 0	43	73 7	78	61 5
9	60 5	44	73 9	79	61 5
10	61 1	45	74 0	80	61 5
11	61 7	46	74 2	81	61 5
12	62 2	47	74 4	82	61 5
13	62 7	48	74 6	83	61 5
14	63 3	49	74 7	84	61 4
15	63 8	50	74 8	85	61 3
16	64 3	51	74 9	86	61 2
17	64 8	52	75 1	87	61 0
18	65 3	53	75 2	88	60 8
19	65 8	54	75 3	89	60 6
20	66 3	55	74 7	90	60 3
21	66 7	56	74 0	91	60 0
22	67 2	57	72 9	92	59 6
23	67 6	58	71 5	93	59 2
24	68 1	59	69 5	94	58 6
25	68 5	60	65 9	95	57 9
26	68 9			96	57 2
27	69 3	63 5	61 3	97	56 3
28	69 7	64	61 5	98	55 4
29	70 0	65	61 5	99	54 3
30	70 4	66	61 5	100	52 9
31	70 7	67	61 5	101	51 2
32	71 0	68	61 5	102	49 3
33	71 3	69	61 5	102 5	47 4
34	71 6				

(Mulder, Scheik Verhandel 1864 137)

100 pts H<sub>2</sub>O dissolve pts MnSO<sub>4</sub> from MnSO<sub>4</sub>+4H<sub>2</sub>O at t°

t	Pts MnSO <sub>4</sub>	t	Pts MnSO <sub>4</sub>	t°	Pts MnSO <sub>4</sub>
2 2	57 88	25	72 23	48	84 33
7 3	61 78	30	74 67	52	86 16
11	64 01	35 5	78 81	56	88 19
15	67 12	40	79 63		
20	69 93	45	83 06		

(Linebarger)

Stable in aqueous solution between 25° and 31° (Schieber, M 1898, 19 281)

Solubility of MnSO<sub>4</sub>+4H<sub>2</sub>O in H<sub>2</sub>O at t°

t°	Pts MnSO <sub>4</sub> per 100 pts H <sub>2</sub> O	t°	Pts MnSO <sub>4</sub> per 100 pts H <sub>2</sub> O
16 0	63 97	35 0	67 87
17 7	64 16	35 5	68 09
18 5	64 19	39 9	68 81
25 0	65 32	49 9	72 48
30 0	66 43	50 0	72 62
32 2	66 83		

(Cottrell, J phys Ch 1900, 4 651)

Linebarger's determinations are inaccurate (Cottrell)

Solubility in H<sub>2</sub>O at t°

t°	g MnSO <sub>4</sub> for 100 g H <sub>2</sub> O
30 15	66 38
35	68 22

(Richards and Fraprie, Am Ch J 1901, 26 77)

+5H<sub>2</sub>O Sol in 1 pt H<sub>2</sub>O at 18 75° (Jahn, A 28 110)

Stable from 8° to 18°

100 pts H<sub>2</sub>O dissolve pts MnSO<sub>4</sub> from MnSO<sub>4</sub>+5H<sub>2</sub>O at t°

t°	Pts MnSO <sub>4</sub>	t°	Pts MnSO <sub>4</sub>	t°	t° MnSO <sub>4</sub>
0	58 05	20	75 16	40	84 63
2 5	62 41	25	78 63	42	85 27
4	64 22	30	79 16	45	86 16
7	66 83	32	80 38	47 7	86 95
10	68 05	34	82 04	53	88 89
15	72 33	37	83 91	54	89 08

(Linebarger)

Stable in aqueous solution between 15° and 20° (Schieber, M 1898, 19 281)

Solubility of MnSO<sub>4</sub>+5H<sub>2</sub>O at t°

t°	Pts MnSO <sub>4</sub> per 100 pts H <sub>2</sub> O	t	Pts MnSO <sub>4</sub> per 100 pts H <sub>2</sub> O
5	58 06	16	61 59
9	59 23	25	64 78
12	60 19	30	67 76
12 3	60 16	31 1	67 92
15	61 08	35 5	71 61

(Cottrell, J phys Ch 1900, 4 651)

Linebarger's determinations are inaccurate (Cottrell)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 65.09 \text{ g MnSO}_4$   
for 100 g  $\text{H}_2\text{O}$  (Richards and Fraprie, Am  
Ch J 1901, 26 77)

+6 $\text{H}_2\text{O}$  Stable from  $-5^\circ$  to  $+8^\circ$

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{MnSO}_4$  from  
 $\text{MnSO}_4 + 6\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$
-4	55 87	9	70 88	30	76 24
0	64 21	15	72 45	34	77 02
3	66 87	20	74 35	35	77 23
5	67 49	25	75 38	38	7 481

(Linebarger)

+7 $\text{H}_2\text{O}$  Efflorescent

Sol in less than 0.5 pt  $\text{H}_2\text{O}$  at  $18.75^\circ$   
(Jahn)

Stable between  $-10^\circ$  and  $-5^\circ$

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{MnSO}_4$  from  
 $\text{MnSO}_4 + 7\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$	$t^\circ$	Pts $\text{MnSO}_4$
10	50 11	0	53 61	10	59 91
8	50 93	5	54 83	15	64 34
-5	51 53	7	56 62		

(Linebarger)

Stable in aqueous solution below  $0^\circ$   
(Schieber, M 1898, 19 281)

Solubility of  $\text{MnSO}_4 + 7\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{MnSO}_4$ per 100 pts $\text{H}_2\text{O}$	$t^\circ$	Pts $\text{MnSO}_4$ per 100 pts $\text{H}_2\text{O}$
-10	47 96	9	59 33
0	56 23	12	61 78
5	56 38	14 3	63 93

(Cottrell, l c)

M-pt of  $\text{MnSO}_4 + 7\text{H}_2\text{O}$  is  $54^\circ$  (Tilden,  
Chem Soc 45 409)

Sp gr of  $\text{MnSO}_4 + \text{Aq}$  at  $15^\circ$

% $\text{MnSO}_4$ +4 $\text{H}_2\text{O}$	Sp gr	% $\text{MnSO}_4$ +4 $\text{H}_2\text{O}$	Sp gr
1	1 006	29	1 208
2	1 013	30	1 2150
3	1 020	31	1 224
4	1 025	32	1 231
5	1 0320	33	1 244
6	1 038	34	1 250
7	1 044	35	1 2579
8	1 050	36	1 268
9	1 056	37	1 276
10	1 0650	38	1 285
11	1 072	39	1 295
12	1 079	40	1 3038
13	1 085	41	1 313
14	1 093	42	1 322
15	1 1001	43	1 331
16	1 106	44	1 340
17	1 114	45	1 3495
18	1 121	46	1 360
19	1 129	47	1 370
20	1 1363	48	1 380
21	1 144	49	1 389
22	1 150	50	1 3986
23	1 160	51	1 410
24	1 166	52	1 420
25	1 1751	53	1 430
26	1 183	54	1 440
27	1 190	55	1 4514
28	1 200		

(Gerlach, Z anal 8 288)

Sp gr of  $\text{MnSO}_4 + \text{Aq}$  at  $23^\circ$  a=no of  $\frac{1}{2}$   
mols in grms dissolved in 1000 g  $\text{H}_2\text{O}$ ,  
b=sp gr if a is  $\text{MnSO}_4 + 5\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol  
wt = 120.5, c=sp gr if a is  $\text{MnSO}_4$ ,  
 $\frac{1}{2}$  mol wt = 75.5

a	b	c	a	b	c
1	1 068	1 071	6	1 306	3 576
2	1 128	1 139	7	1 341	1 429
3	1 181	1 202	8	1 371	
4	1 227	1 262	9	1 399	
5	1 269	1 320	10	1 426	

(Favre and Valson, C R 79 968)

Above table recalculated by Gerlach (Z anal  
28 475)

% $\text{MnSO}_4$ +5 $\text{H}_2\text{O}$	Sp gr	% $\text{MnSO}_4$ +5 $\text{H}_2\text{O}$	Sp gr
10	1 0630		1 2900
20	1 1325	50	1 3800
30	1 2070		

Sp gr of  $\text{MnSO}_4 + \text{Aq}$  at  $15^\circ$  a=%, b=sp gr if a is  $\text{MnSO}_4$ , c=sp gr if a is  $\text{MnSO}_4 + 4\text{H}_2\text{O}$ , d=sp gr if a is  $\text{MnSO}_4 + 5\text{H}_2\text{O}$ , e=sp gr if a is  $\text{MnSO}_4 + 7\text{H}_2\text{O}$

a	b	c	d	e
5	1 0500	1 0340	1 0310	1 0270
10	1 1035	1 0690	1 0630	1 0545
15	1 1605	1 1055	1 0965	1 0830
20	1 2215	1 1435	1 1315	1 1130
25	1 2870	1 1835	1 1685	1 1440
30	1 3575	1 2255	1 2070	1 1765
35		1 2695	1 2470	1 2105
40		1 3155	1 2885	1 2455
45		1 3640	1 3315	1 2815
50			1 3760	1 3185
55				1 3565

(Gerlach, Z anal **28** 475)

Sp gr of  $\text{MnSO}_4 + \text{Aq}$  at  $0^\circ$  S=p'ts  $\text{MnSO}_4$  in 100 pts solution

S	Sp gr	S	Sp gr
16 7450	1 1834	8 8295	1 0928
14 0462	1 1519	6 0172	1 0622
11 5804	1 1239	3 0865	1 0315

(Charpy, A ch (6) **29** 26\*)

Sp gr of  $\text{MnSO}_4 + \text{Aq}$  at room temp containing

11 45	18 8	22 08	% $\text{MnSO}_4$
1 1469	1 2513	1 3082	

(Wagner, W Ann 1883, **18** 271)

Sp gr of  $\text{MnSO}_4 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{MnSO}_4 + \text{Aq}$	Sp gr
1—normal	1 0728
$\frac{1}{2}$ —	1 0365
$\frac{1}{4}$ —	1 0179
$\frac{1}{8}$ —	1 0087
$\frac{1}{16}$ —	1 0041

(Wagner, Z phys Ch 1890, **5** 39)

Sp gr at  $16\frac{1}{4}^\circ$  of  $\text{MnSO}_4 + \text{Aq}$  containing 30.819%  $\text{MnSO}_4 = 1.36267$  (Schonrock, Z phys Ch 1893, **11**, 781)

Sat  $\text{MnSO}_4 + \text{Aq}$  boils at  $102.4^\circ$ , crust forms at  $101.6^\circ$ , and solution contains 48.7 pts  $\text{MnSO}_4$  to 100 pts  $\text{H}_2\text{O}$

B-pt of  $\text{MnSO}_4 + \text{Aq}$  containing pts  $\text{MnSO}_4$  to 100 pts  $\text{H}_2\text{O}$

B pt	Pts $\text{MnSO}_4$	B pt	Pts $\text{MnSO}_4$
100 $5^\circ$	17 1	102 $0^\circ$	58 9
101 0	32 1	102 4	68 4
101 5	46 2		

(Gerlach, Z anal **26** 434)

Sol in about 20 pts boiling  $\text{H}_2\text{SO}_4$ , and more sol in boiling  $\text{H}_2\text{SO}_4 + \text{Aq}$  of 1.6 sp gr (Schultz, Pogg **133** 137)

Completely pptd from solution by  $\text{HC}_2\text{H}_3\text{O}_2$  (Persoz)

For solubility in  $(\text{NH}_4)_2\text{SO}_4$ , see under  $(\text{NH}_4)_2\text{SO}_4$

$\text{MnSO}_4 + \text{Aq}$  sat at  $10^\circ$ , then sat with  $\text{K}_2\text{SO}_4$  at same temp contains for 100 pts  $\text{H}_2\text{O}$  16.7 pts  $\text{MnSO}_4$  and 44.3 pts  $\text{K}_2\text{SO}_4$  (Mulder)

Solubility of  $\text{MnSO}_4 + \text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at  $35^\circ$

g per 100 g sat solution		
$\text{MnSO}_4$	$\text{Na}_2\text{SO}_4$	Solid phase
39 45	0	$\text{MnSO}_4, \text{H}_2\text{O}$
33 92	5 23	"
33 06	7 97	$\text{MnSO}_4, \text{H}_2\text{O} + 9\text{MnSO}_4, 10\text{Na}_2\text{SO}_4$
32 92	7 42	"
31 05	9 20	$9\text{MnSO}_4, 10\text{Na}_2\text{SO}_4$
27 67	10 76	"
22 14	14 28	"
14 58	20 01	"
13 96	21 91	"
12 19	22 49	$9\text{MnSO}_4, 10\text{Na}_2\text{SO}_4 + \text{MnSO}_4, 3\text{Na}_2\text{SO}_4$
10 45	23 41	$\text{MnSO}_4, 3\text{Na}_2\text{SO}_4$
7 43	26 58	"
5 69	29 31	"
5 11	30 52	$\text{MnSO}_4, 3\text{Na}_2\text{SO}_4 + \text{Na}_2\text{SO}_4$
2 96	31 33	$\text{Na}_2\text{SO}_4$
0	33	"

(Schrenemakers and Provije, Proc Ak Wet Amsterdam, 1913, **15** 326)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, **20** 825)

Anhydrous  $\text{MnSO}_4$  insol in absolute alcohol

1000 pts alcohol of 0.872 sp gr dissolve 6.3 pts  $\text{MnSO}_4$

Sol in 50 pts of 50% alcohol Insol in absolute alcohol (Brundes, Pogg **20** 556)

100 pts solution saturated at  $15^\circ$  in dil alcohol containing

0 10 50 60 % alcohol, contain 56.25 51.4 2.0 0.66 pts  $\text{MnSO}_4 + 5\text{H}_2\text{O}$

(Schiff, A **118** 365)

When  $\text{MnSO}_4 + 7\text{H}_2\text{O}$  is boiled with absolute alcohol none is dissolved but  $\text{MnSO}_4 + 3\text{H}_2\text{O}$  is formed

When  $\text{MnSO}_4 + 7\text{H}_2\text{O}$  is dissolved in 15–50% alcohol, the liquid separates into two layers, the lower containing less (12–14%) alcohol and more (47–49%) salt, the upper containing

more (50-55%) alcohol and less (13-22%) salt. If the alcohol has the above strength (15-50%) the separation takes place at ordinary temp., but with 13-14% or 60% or more alcohol, warming is necessary to effect the separation (Schuff, A 118 363)

Solubility of  $\text{MnSO}_4 + \text{H}_2\text{O}$  in alcohol + Aq at  $t^\circ$

Composition of two layers sat with the solid salt at  $t^\circ$

$t^\circ$	Alcohol layer		Water layer	
	% alcohol	% $\text{MnSO}_4$	% alcohol	% $\text{MnSO}_4$
30	45 20	2 49	8 69	30 15
31	43 90	2 74	8 47	30 10
35	41 71	3 44	9 24	28 61
37	38 26	4 84	11 03	26 47
41	34 01	5 86	11 93	24 97
42	32 37	6 89	13 57	23 09
43	31 42	8 51	14 33	22 01

(Schreinemakers and Deuss, Z phys Ch 1912, 79 559)

Composition of alcohol solutions sat with  $\text{MnSO}_4 + \text{H}_2\text{O}$  at  $t^\circ$

$t$	% $\text{H}_2\text{O}$	% alcohol	% $\text{MnSO}_4$
50	63 74	0	36 26
	65 21	6 67	28 12
	65 23	16 02	18 75
	64 83	22 63	12 54
	59 41	36 47	4 12
35	61 4	0	38 6
	62 13	5 50	32 37
	62 06	6 46	31 48
	62 01	7 48	30 51
	*62 15	9 24	28 61
	*54 85	41 71	3 44
	50 69	47 73	1 58
30	50 16	48 27	1 57
	61 4	0	38 6
	61 43	2 26	36 31
	61 25	5 09	33 66
	60 78	5 96	*33 26
	*61 16	8 69	30 15
	*52 31	45 20	2 49
	44 83	54 19	0 98
	30 95	68 97	0 08
	9 19	90 80	0 01

Composition of the solutions sat with respect to one another

$t^\circ$	water layer		alcohol layer	
	% alcohol	% $\text{MnSO}_4$	% alcohol	% $\text{MnSO}_4$
50	†5 68	34 95	†53 64	0 97
	†7 69	30 99	†45 83	2 19
	†8 70	29 20	†41 93	3 11
	†11 85	24 84	†35 15	5 95
35	†8 38	29 52	†42 38	3 07
	*9 24	28 61	*41 71	3 44
	10 75	26 33	36 89	5 19
	15 09	21 85	30 06	9 03
30	†7 60	32 40	†50 97	1 74
	*8 69	30 15	*45 20	2 49
	10 46	27 58	40 71	3 93
	11 86	25 75	37 54	5 20
	16 18	20 86	29 89	9 64

(Schreinemakers and Deuss)

†Metastable solutions

\*Solutions also sat with respect to  $\text{MnSO}_4, \text{H}_2\text{O}$

Solubility of  $\text{MnSO}_4 + 4\text{H}_2\text{O}$  in alcohol + Aq

g $\text{H}_2\text{O}$	g alcohol	$\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$
55 86	30 03	14 11
52 25	43 59	4 16
49 41	47 66	2 94
45 34	53 00	1 66
42 56	56 24	1 20

(Linebarger, Am Ch J 1892, 14 380)

Solubility of  $\text{MnSO}_4 + 5\text{H}_2\text{O}$  in alcohol + Aq

Composition of the solution sat with  $\text{MnSO}_4 + 5\text{H}_2\text{O}$

$t^\circ$	alcohol layer		water layer	
	% alcohol	% $\text{MnSO}_4$	% alcohol	% $\text{MnSO}_4$
10	37 06	5 44	13 78	25 25
15	44 56	2 79	9 25	29 79
17 6	47 11	2 22	8 53	30 88
21	53 55	1 10	6 10	35 05
25	53 09	1 23	6 81	33 72

Composition of solution sat with solid substance at  $25^\circ$

% $\text{H}_2\text{O}$	% alcohol	% $\text{MnSO}_4$	Solid phase
60 7	0	39 3	$\text{MnSO}_4 + 5\text{H}_2\text{O}$
*59 47	6 81	33 72	"
*45 68	53 09	1 23	"
42 05	57 39	0 56	"
23 30	76 70	0 0	$\text{MnSO}_4 + \text{H}_2\text{O}$

\*The solutions also sat with respect to one another

(Schreinemakers and Deuss)

\*The two liquids are sat with respect to one another

Composition of the two solutions sat with respect to one another at 25°

Water layer		Alcohol layer	
% alcohol	% MnSO <sub>4</sub>	% alcohol	% MnSO <sub>4</sub>
*6 81	*33 72	*53 09	1 23
8 48	31 51	49 76	1 83
15 02	22 61	32 75	8 01

\*Also sat with MnSO<sub>4</sub>, 5H<sub>2</sub>O  
(Schrenemakers and Deuss)

Insol in absolute ether between 5° and 7°, and no crystal H<sub>2</sub>O is removed thereby. Insol in boiling oil of turpentine, but 1 mol crystal H<sub>2</sub>O is removed from MnSO<sub>4</sub>+4H<sub>2</sub>O (Brandes, Pogg 20 568)

Insol in benzonitrile (Naumann, B 1914, 47 1370), ethyl acetate (Naumann, B 1910, 43 314), acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

100 g sat solution in glycol contain 0.5 g MnSO<sub>4</sub> (de Coninck, Bull Ac roy Belg 1905 359)

MnSO<sub>4</sub>+7H<sub>2</sub>O occurs as the min *Mallardite*

**Manganomanganic sulphate**, MnO, MnO<sub>2</sub>, 4SO<sub>3</sub>+9H<sub>2</sub>O

Deliquescent. Decomp by H<sub>2</sub>O. Sol in little dil H<sub>2</sub>SO<sub>4</sub>+Aq (Freymy, C R 82 475)

**Manganic sulphate**, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>

Extremely deliquescent. Sol in H<sub>2</sub>O with evolution of heat, and decomposition into a basic sulphate. Behaves similarly with dilute acids. Sol in traces in cold conc H<sub>2</sub>SO<sub>4</sub>. Insol in cold conc HNO<sub>3</sub>+Aq. Sol in conc HCl+Aq. Decomp by absolute alcohol (Carius, A 98 53)

**Manganyl sulphate**, MnO<sub>2</sub>, SO<sub>3</sub>

Sol in H<sub>2</sub>SO<sub>4</sub> but solution decomp if below 40-60° Baume. Solubility in 40° Baumé acid=15% 55°, 4-5%. Solution can be heated to 60-80° without decomp (Bad Anilin u Sodafabrik, C C 1905, II 1398)

**Manganous hydrogen sulphate**

MnSO<sub>4</sub> is sol in 20 pts boiling conc H<sub>2</sub>SO<sub>4</sub>, more sol in boiling H<sub>2</sub>SO<sub>4</sub>+Aq of 1.6 sp gr (Schultz)

MnH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, and +H<sub>2</sub>O. Sol in H<sub>2</sub>O with decomp (Schultz)

MnH<sub>3</sub>(SO<sub>4</sub>)<sub>4</sub>. Sol in H<sub>2</sub>O with decomp (Schultz)

**Manganic hydrogen sulphate**, Mn<sub>2</sub>H<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+8H<sub>2</sub>O

Deliquescent. Decomp by H<sub>2</sub>O. Sol in dil H<sub>2</sub>SO<sub>4</sub>+Aq (Francke, J pr (2) 36 251)

**Manganous hydrazine sulphate**, MnH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>

1 pt is sol in 60 pts H<sub>2</sub>O at 18°. Stable in the air at 100° (Curtius, J pr 1894, (2) 50 331)

**Manganous nickel potassium sulphate**,

MnSO<sub>4</sub>, NiSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>+12H<sub>2</sub>O. Sol in H<sub>2</sub>O (Vohl, A 94 57)

**Manganous potassium sulphate**, K<sub>2</sub>SO<sub>4</sub>, MnSO<sub>4</sub>+2H<sub>2</sub>O

+4H<sub>2</sub>O. Efflorescent (Pierre, A ch (3) 16 239)

2MnSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> (Mallet, C N 1899, 80 301)

**Manganic potassium sulphate**, K<sub>2</sub>Mn<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O

Decomp by dissolving in H<sub>2</sub>O (Mitscherlich)

**Manganomanganic potassium sulphate**,

Mn<sub>5</sub>(SO<sub>4</sub>)<sub>3</sub>, 5K<sub>2</sub>SO<sub>4</sub>=3Mn(SO<sub>4</sub>)<sub>2</sub>, 2MnSO<sub>4</sub>, 5K<sub>2</sub>SO<sub>4</sub>

Decomp by much H<sub>2</sub>O. Sol in dil or conc H<sub>2</sub>SO<sub>4</sub>. Insol in alcohol or ether (Francke, J pr (2) 36 166)

**Manganous potassium zinc sulphate**, MnSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O

Sol in H<sub>2</sub>O (Vohl)

**Manganous rubidium sulphate**, MnSO<sub>4</sub>,

Rb<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O

Sol in H<sub>2</sub>O (Tutton, Chem Soc 63 337). 1 l H<sub>2</sub>O dissolves 357 g anhydrous salt at 25° (Loeche, Am Ch J 1902, 27, 459)

+2H<sub>2</sub>O (Wyruboff, Bull Soc Min 1891, 14 242)

2MnSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub> (Wyruboff)

**Manganic rubidium sulphate**, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Rb<sub>2</sub>SO<sub>4</sub>+24H<sub>2</sub>O

Deliquescent (Christensen, Z anorg 1901, 27 333)

**Manganous sodium sulphate**, MnSO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>

+2H<sub>2</sub>O. Deliquescent in moist air (Geiger)

+4H<sub>2</sub>O. Sol in 12 pts boiling H<sub>2</sub>O (Geiger)

**Manganous sulphate ammonia**, MnSO<sub>4</sub>, 4NH<sub>3</sub>

Decomp by H<sub>2</sub>O (Rose Pogg 20 148)

**Manganous sulphate cupric oxide**, MnSO<sub>4</sub>, 2CuO+3H<sub>2</sub>O

(Mailhe, A ch 1902, (7) 27 392)

MnSO<sub>4</sub>, 3CuO+xH<sub>2</sub>O (Recoura, C R 1901, 132 1415)

MnSO<sub>4</sub>, 24CuO+xH<sub>2</sub>O (Recoura)

**Manganous sulphate hydrazine,  $\text{MnSO}_4 \cdot 2\text{N}_2\text{H}_4$** 

Very unstable

Somewhat sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Franzen, Z anorg 1908, 60 285)**Manganous sulphate hydroxylamine,  $\text{MnSO}_4 \cdot \text{NH}_2\text{OH} + 2\text{H}_2\text{O}$** Insol in  $\text{H}_2\text{O}$  (Feldt, B 1894, 27 405)**Mercurous sulphate, basic,  $2\text{Hg}_2\text{O} \cdot \text{SO}_3 + \text{H}_2\text{O}$** Sol in 25,000 pts  $\text{H}_2\text{O}$  at  $20^\circ$  (Gouy, C R 1900, 130 1401)**Mercurous sulphate,  $\text{Hg}_2\text{SO}_4$** Sol in 500 pts cold, and 300 pts hot  $\text{H}_2\text{O}$  (Wackenroder, A 41 319)Solubility in  $\text{H}_2\text{O}$  at  $18^\circ = 7.8 \times 10^{-4}$  g mol per liter (Wilsmore, Z phys Ch 1900, 35 305)1 l  $\text{H}_2\text{O}$  dissolves  $11.71 \times 10^{-4}$  g-mol  $\text{Hg}_2\text{SO}_4$  at  $25^\circ$  (Drucker, Z anorg 1901, 28 362)Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	In 100 pts of the solution	
	$\text{Hg}_2\text{SO}_4$	$\text{H}_2\text{SO}_4$
16.5	0.055	0.008
33	0.060	0.018
50	0.065	0.037
75	0.074	0.063
91	0.084	0.071
100	0.092	0.071

(Barre, A ch 1911, (8) 24 203)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ$  is 20% greater than at  $18^\circ$  and  $= 11.71 \times 10^{-4}$  g mol per l. By addition of increasing amts of  $\text{H}_2\text{SO}_4$  the solubility is somewhat, but not regularly, decreased,  $\text{K}_2\text{SO}_4$  lowers solubility less than  $\text{H}_2\text{SO}_4$  (Drucker, Z anorg 1901, 28 362)

Easily sol in dil  $\text{HNO}_3 + \text{Aq}$ , from which solution it is separated by dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Wackenroder, A 41 319)Abundantly sol in hot, less sol in cold dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Berzelius)Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

$\text{H}_2\text{SO}_4$ normality	g mol $\text{Hg}_2\text{SO}_4$ per litre
0.0400	$8.31 \times 10^{-4}$
0.1000	$8.78 \times 10^{-4}$
0.2000	$8.04 \times 10^{-4}$

(Drucker, Z anorg 1901, 28 362)

Partially decomp by hot  $\text{NH}_4$  salts +  $\text{Aq}$  (Mahlé, A ch (3) 5 179)5 times more sol in sat  $\text{CdSO}_4 + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Huett, Phys Rev 1907, 25. 16)Sat  $\text{ZnSO}_4$  or  $\text{CdSO}_4 + \text{Aq}$  attack much less

than pure  $\text{H}_2\text{O}$ , yet the solubility of  $\text{Hg}_2\text{SO}_4$  in these solutions is greater, i.e., 0.8 g in 1 l  $\text{ZnSO}_4 + \text{Aq}$  and 1.1 g in 1 l  $\text{CdSO}_4 + \text{Aq}$  at  $20^\circ$  (Gouy, C R 1900, 130 1402)

Solubility in 0.2N  $\text{K}_2\text{SO}_4 + \text{Aq} = 9.05 \times 10^{-4}$  g mol per l at  $25^\circ$  (Drucker, Z anorg 1901, 28 362)

Solubility of  $\text{Hg}_2\text{SO}_4$  in  $\text{K}_2\text{SO}_4 + \text{Aq}$ 

$t^\circ$	g per 100 g sat solution		
	$\text{K}_2\text{SO}_4$	$\text{Hg}_2\text{SO}_4$	free $\text{H}_2\text{SO}_4$
15	2.90	0.0475	0.0080
	5.70	0.0703	0.0093
	8.22	0.0912	0.0098
	8.77	0.0994	
	9.44	0.1080	0.0110
33	2.94	0.0677	0.0250
	5.68	0.1015	0.0350
	8.30	0.1364	0.0441
	10.70	0.1724	0.0438
	11.90	0.1902	0.0420
75	3.10	0.1344	0.1681
	5.75	0.2120	0.2135
	8.50	0.2951	0.2514
	13.20	0.4610	0.2503
	17.30	0.6440	0.2225

(Barre, A ch 1911, (8) 24 202)

About 3 times as sol in sat  $\text{ZnSO}_4 + \text{Aq}$  as in distilled  $\text{H}_2\text{O}$  (Wright, Phil Mag (5) 1885, 19 29)

**Mercuric sulphate, basic,  $2\text{HgO} \cdot \text{SO}_3$** 

(Mailhé, A ch 1902, (7) 27 394)

 $3\text{HgO} \cdot \text{SO}_3$  (Mineral turpeth)Sol in 2000 pts cold and 600 pts boiling  $\text{H}_2\text{O}$  (Fourcroy A ch 10 307)

Sol in 43,478 pts  $\text{H}_2\text{O}$  at  $16^\circ$  when pptd cold, and in 32,258 pts at  $16^\circ$  when pptd at  $100^\circ$  (Cameron, Z anorg 19 144)

Sol in warm dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Rosc)

Solubility in  $\text{H}_2\text{O}$  is increased by addition of  $\text{H}_2\text{SO}_4$  up to an acid content of 4.3 mol  $\text{SO}_3$  to 93.7 mols  $\text{H}_2\text{O}$  (Holtzman, Z phys Ch 1895, 17 665)

Sol in warm conc  $\text{HCl}$  or  $\text{HBr} + \text{Aq}$  (Ditte)Sol in alkali chlorides +  $\text{Aq}$  (Mailhé)

Sol in dil  $\text{HNO}_3$  or in  $\text{HCl} + \text{Aq}$ . More easily sol in the warm acids (Ry, Chem Soc 1897, 71 1099)

$3\text{HgO} \cdot 2\text{SO}_3 + 2\text{H}_2\text{O}$  (Holtzman, Z phys Ch 1895, 17 659)

$4\text{HgO} \cdot 3\text{SO}_3$  (Hopkins Sill Am J 18 364)

**Mercuric sulphate,  $\text{HgSO}_4$** 

Decomp by  $\text{H}_2\text{O}$  into  $3\text{HgO} \cdot \text{SO}_3$ , and a sol acid salt. Sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Decomp by all acids (Berzelius)

Sol in warm conc HCl or HBr + Aq, very sl sol in boiling conc HI + Aq (Ditte, A ch (5) **17** 124)

Very sl sol in hot conc HF (Ditte, A ch 1879, (5) **17** 125)

Sol in HCN + Aq (Mohr)

Sol with decomp in NaCl + Aq (Miahle) Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, **20** 829)

Insol in conc alcohol

Insol in acetone (Naumann, B 1904, **37** 4329), methyl acetate (Naumann, B 1909, **42** 3790), ethyl acetate (Naumann, B 1910, **43** 314)

Insol in benzonitrile (Naumann, B 1914, **47** 1370)

Insol in pyridine (Schroeder, Dissert **1901**)

+H<sub>2</sub>O Decomp by H<sub>2</sub>O (Eisfeldt, Pharm Centr **1853** 812)

**Mercuriomercuric sulphate**, Hg<sub>2</sub>O, 2HgO, SO<sub>3</sub>

Insol in cold H<sub>2</sub>O, not decomp by boiling H<sub>2</sub>O Decomp by HCl + Aq (Brooke, Pogg **66** 63)

Hg<sub>2</sub>SO<sub>4</sub>, HgSO<sub>4</sub> (Baskerville, J Am Chem Soc 1897, **19** 875)

**Mercuric hydrogen sulphate**, HgH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>

(Braham, C N **42** 163)

**Mercuric potassium sulphate**, 3HgSO<sub>4</sub>,

K<sub>2</sub>SO<sub>4</sub> + 2H<sub>2</sub>O

Sol in H<sub>2</sub>O (Hirzel, J B **1850** 332)

**Mercuric sulphate chloride ammonium chloride**, 2HgSO<sub>4</sub>, HgCl<sub>2</sub>, 2NH<sub>4</sub>Cl

Decomp with H<sub>2</sub>O Ether dissolves out HgCl<sub>2</sub> (Kosmann, A ch (3) **27** 238)

**Mercuric sulphate cyanide**, HgSO<sub>4</sub>, Hg(CN)<sub>2</sub> + 5H<sub>2</sub>O

Decomp by conc or warm acids (Rupp, Arch Pharm 1912, **250** 280)

**Mercuric sulphate hydrazine**, HgSO<sub>4</sub>, N<sub>2</sub>H<sub>4</sub>

Ppt (Hofmann and Marburg, A 1899, **305** 216)

**Mercuric sulphate hydrobromide**, HgSO<sub>4</sub>, 2HBr

Sol in H<sub>2</sub>O without separation of basic sulphate (Ditte, A ch (5) **17** 122)

3HgO, SO<sub>3</sub>, 6HBr Sol in H<sub>2</sub>O (Ditte)

**Mercuric sulphate hydrochloride**, HgSO<sub>4</sub>, HCl

Not attacked by HCl Sl sol in HNO<sub>3</sub> (Baskerville, J Am Chem Soc 1901, **23** 895)

HgSO<sub>4</sub>, 2HCl Sol in H<sub>2</sub>O without separation of a basic salt Very sol in warm H<sub>2</sub>SO<sub>4</sub>, solidifying on cooling if very conc, or crystallising if dil (Ditte)

Very deliquescent

Very sol in H<sub>2</sub>O (Baskerville, J Am Chem Soc 1901, **23** 895)

+H<sub>2</sub>O (Baskerville, J Am Chem Soc 1901, **23** 895)

3HgO, SO<sub>3</sub>, 6HCl Sol in H<sub>2</sub>O (Ditte)

**Mercuric sulphate hydroxylamine**, HgSO<sub>4</sub>, 2NH<sub>2</sub>OH + H<sub>2</sub>O

Decomp by cold H<sub>2</sub>O (Adams, Am Ch J 1902, **28** 209)

**Mercuric sulphate iodate iodide**, 6(3HgO, 2SO<sub>3</sub>), 6HgI<sub>2</sub>, Hg(IO<sub>3</sub>)<sub>2</sub>

Decomp by H<sub>2</sub>O and acids (Bruckner, M 1907, **28** 961)

**Mercuric sulphate iodide, basic**, 3HgO, 2SO<sub>3</sub>, HgI<sub>2</sub>

3(3HgO, 2SO<sub>3</sub>), 2HgI<sub>2</sub> + 10H<sub>2</sub>O

2(3HgO, 2SO<sub>3</sub>), HgI<sub>2</sub> + 10H<sub>2</sub>O Very sol in hot conc HNO<sub>3</sub>

3HgO, 2SO<sub>3</sub>, HgSO<sub>4</sub>, HgI<sub>2</sub> + 10H<sub>2</sub>O (Ditte, C R 1905, **140** 1167)

**Mercuric sulphate iodide**, HgSO<sub>4</sub>, HgI<sub>2</sub>

Decomp by H<sub>2</sub>O, not by alcohol or ether (Riegel, J B pr Pharm **11** 396)

3HgSO<sub>4</sub>, HgI<sub>2</sub> Decomp by cold or hot H<sub>2</sub>O Sol in H<sub>2</sub>SO<sub>4</sub> + Aq (Ditte, C R 1905, **140** 1165)

4HgSO<sub>4</sub>, HgI<sub>2</sub> + 15H<sub>2</sub>O, and +18H<sub>2</sub>O Decomp by cold or hot H<sub>2</sub>O Sol in H<sub>2</sub>SO<sub>4</sub> (Ditte)

**Mercuric sulphate phosphide**

See *Dimercuriphosphonium mercuric sulphate*

**Mercuric sulphate sulphide, basic**, 2HgO, SO<sub>3</sub>, HgS

Somewhat sol in HCl, H<sub>2</sub>SO<sub>4</sub> and HNO<sub>3</sub> (Jacobson, Pogg 1846, **68** 412)

4HgO, 3SO<sub>3</sub>, 2HgS + 4H<sub>2</sub>O Sl sol in H<sub>2</sub>SO<sub>4</sub> (Estrup, Z anorg 1909, **62** 169)

**Mercuric sulphate sulphide**, 2HgSO<sub>4</sub>, HgS

Sl sol in hot HCl, H<sub>2</sub>SO<sub>4</sub>, or HNO<sub>3</sub> + Aq Easily sol in hot aqua regia (Jacobson, Pogg **68** 410)

2HgSO<sub>4</sub>, HgS (Palm, C C **1863** 122)

HgSO<sub>4</sub>, 2HgS (Barfoed, J B **1864** 282)

Sol in aqua regia (Deniges, Bull Soc 1915, (4) **17** 355)

HgSO<sub>4</sub>, 3HgS Insol in H<sub>2</sub>O Easily sol in aqua regia, decomp by HNO<sub>3</sub> into—

3HgSO<sub>4</sub>, HgS Insol in all acids except aqua regia (Spring, A **199** 116)

**Molybdenum sesquisulphate** (?)

*Basic* Insol in H<sub>2</sub>O

*Neutral* Decomp by H<sub>2</sub>O into acid and basic salts

*Acid* Sol in H<sub>2</sub>O (Berzelius)



**Molybdenum disulphate (?)**Sol in  $\text{H}_2\text{O}$ **Molybdenum sulphate,  $\text{Mo}_2\text{O}_5, 2\text{SO}_3$** 

Very slowly sol in cold, more quickly sol in hot  $\text{H}_2\text{O}$  (Bailhache, C R 1901, **132** 476)  
 $7\text{MoO}_3, 2\text{MoO}_3, 7\text{SO}_3 + \text{Aq}$  (Péchar, C R 1901, **132** 630)

**Molybdic sulphate,  $\text{MoO}_3, \text{SO}_3$** Deliquescent Sol in  $\text{H}_2\text{O}$  (Schultz-Sellack, B 4 14)

$\text{MoO}_3, 3\text{SO}_3 + 2\text{H}_2\text{O}$  Deliquescent Partially sol in  $\text{H}_2\text{O}$  (Anderson, Berz J B **22** 161)

Does not exist (Schultz-Sellack)

**Molybdenum sulphate ammonia,** $5\text{NH}_3, \text{MoO}_2\text{SO}_3, 7\text{MoO}_3 + 8\text{H}_2\text{O}$  $3\text{NH}_3, \text{MoO}_2\text{SO}_3, 7\text{MoO}_3 + 10\text{H}_2\text{O}$ 

Both very sol in water but less sol in  $\text{H}_2\text{O}$  containing ammonium salts (Péchar, C R 1901, **132** 630)

**Neodymium sulphate, basic,  $\text{Nd}_2\text{O}_3, \text{SO}_3$** Insol in  $\text{H}_2\text{O}$ Nearly insol in dil acids (Wohler, B 1913, **46** 1730)Insol in  $\text{H}_2\text{O}$  (Matignon, C R 1902, **134** 658)**Neodymium sulphate,  $\text{Nd}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$** Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	pts $\text{Nd}_2(\text{SO}_4)_3$
0	9 50
16	7 05
30	5 04
50	3 72
80	2 70
100	2 21

(Muthmann and Rolig, B 1898, **31** 1728)**Neodymium hydrogen sulphate,  $\text{Nd}(\text{SO}_4\text{H})_3$** (Brauner, Z anorg 1904, **38** 331)**Neodymium potassium sulphate**

Cryst modification more sol in cold than in hot  $\text{H}_2\text{O}$  (Boudouard, C R 1898, **126** 901)

**Nickel sulphate, basic**Very sl sol in  $\text{H}_2\text{O}$  (Berzelius)

$6\text{NiO}, 5\text{SO}_3 + 4\text{H}_2\text{O}$  (Athanasesco, C R **103** 271)

$7\text{NiO}, 7\text{H}_2\text{O}, \text{SO}_3 + 3\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$  (Habermann, M **5** 432)

$5\text{NiO}, \text{SO}_3, 5\text{NiO}, 2\text{SO}_3$ , and  $5\text{NiO}, 3\text{SO}_3$  (Pickering, Chem Soc 1907, **91** 1985)

 $6\text{NiO} \text{ SO}_3$  (Stromholm C C **1906**, 1 1222)**Nickel sulphate,  $\text{NiSO}_4$** 100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{NiSO}_4$  at  $t^\circ$ 

2 16° 20° 23° 31°  
 30 4 37 4 39 7 41 45 3 pts  $\text{NiSO}_4$

41° 50° 53° 60° 70°  
 49 1 52 54 4 57 2 61 9 pts  $\text{NiSO}_4$

(Tobler A **95** 193)

100 pts of sat solution contain at 11 14° 28 84 at 18 20° 30 77 pts anhydrous salt (v Hauer W A B **53** 2 221)

100 pts  $\text{H}_2\text{O}$  at 112 5° dissolve 185 71 pts  $\text{NiSO}_4$  (Griffiths)

$\text{NiSO}_4 + 7\text{H}_2\text{O}$  is sol in 3 pts  $\text{H}_2\text{O}$  at 12 5° (Tup puth)

100 pts  $\text{H}_2\text{O}$  at 15 5° dissolve 75 6 pts  $\text{NiSO}_4 + 7\text{H}_2\text{O}$

Sat  $\text{NiSO}_4 + \text{Aq}$  contains at

-3° +2° 5° 11° 17° 54°  
 21 7 22 7 23 1 25 2 26 6 33 6%  $\text{NiSO}_4$

68° 74° 92° 97° 110° 117° 119°  
 38 2 38 7 42 4 44 2 46 5 48 8 49 4%  $\text{NiSO}_4$

(Étard, A ch 1894, (7) 2 552)

See also below under hydrated salts

Sp gr of  $\text{NiSO}_4 + \text{Aq}$  containing g  $\text{NiSO}_4 + 7\text{H}_2\text{O}$  in 1000 g  $\text{H}_2\text{O}$  at 23 5°

140 5 g (= 1/2 mol) 281 421 5 562  
 1 073 1 136 1 190 1 238

602 5 843 983 5 1124  
 1 280 1 317 1 349 1 378

Containing  $\text{NiSO}_4$  (anhydrous)

77 5 g (= 1/2 mol) 155 232 5 310 387 5 465  
 1 079 1 153 1 224 1 292 1 358 1 421

(Gerlach, Z anal **28** 468)

Sp gr of  $\text{NiSO}_4 + \text{Aq}$  at 0° S = pts  $\text{NiSO}_4$  in 100 pts solution,  $\text{S}_1$  = mols  $\text{NiSO}_4$  in 100 mols solution

S	$\text{S}_1$	Sp gr
4 2930	0 581	1 0522
3 9591	0 476	1 0431
3 2845	0 392	1 0357
2 5043	0 297	1 0271
1 6131	0 189	1 0173
0 8327	0 097	1 0089

(Charpy, A ch (6) **29** 26)

Sp gr of  $\text{NiSO}_4 + \text{Aq}$  at room temp containing

10 62 18 19 25 35%  $\text{NiSO}_4$   
 1 0925 1 1977 1 3137

(Wagner, W Ann 1883, **18** 272)Sp gr of  $\text{NiSO}_4 + \text{Aq}$  at 25°

Concentration of $\text{NiSO}_4 + \text{Aq}$	Sp gr
1-normal	1 0773
1/2- "	1 0391
1/4- "	1 0198
1/8- "	1 0017

(Wagner, Z phys Ch 1890, **5** 39)

For solubility of  $\text{NiSO}_4 + \text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$ , see under  $\text{NiSO}_4 + 7\text{H}_2\text{O}$  and  $\text{NiNa}_2(\text{SO}_4)_2$   
 100 pts sat  $\text{NiSO}_4 + \text{ZnSO}_4 + \text{Aq}$  at 18–20° contain 35.45 pts of the two salts (v Hauer)  
 Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)  
 $\text{HC}_2\text{H}_3\text{O}_2$  precipitates it completely from aqueous solution (Persoz)  
 100 pts absolute methyl alcohol dissolve 0.5 pt  $\text{NiSO}_4$  at 18° (de Bruyn, Z phys Ch 10 783)

Solubility of  $\text{NiSO}_4 \cdot 3\text{CH}_3\text{O} + 3\text{H}_2\text{O}$  in methyl alcohol at 14°

P = % anhydrous  $\text{NiSO}_4$  in the sat solutions

Alcohol % by wt	P	In 1000 mol of the solution		
		Mol $\text{NiSO}_4$	Mol $\text{CH}_3\text{O}$	Mol $\text{H}_2\text{O}$
100	3.72	7.75	969	23.2
97.5	0.77	1.65	950	48.5
95	0.455	0.96	908	91
92.5	0.50	1.0	871	128
90	0.70	1.6	830	168
89	1.01	2.0	814	184
88	1.25	2.4	800	198
87	1.48	2.9	781	216
86	1.73	3.2	767	230
85	1.93	3.6	755	241

(de Bruyn, R t c 1903, 22 418)

This salt is more sol in ethyl alcohol than in methyl alcohol

See also under hydrated salts

For solubility of  $\text{NiSO}_4$  in ethyl alcohol, see under hydrated salts

100 g sat solution in glycol contain 9.7 g  $\text{NiSO}_4$  at ord temp (de Coninck, Bull Ac Roy Belg 1905 359)

Insol in methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate, (Naumann, B 1904, 37, 3602)

Very sl sol in acetone (Krug and M'Elroy)

Insol in acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

+ $\text{H}_2\text{O}$  Very sl sol in abs methyl alcohol After standing in contact with it for 8–9 months, the solution contains 1.34%  $\text{NiSO}_4$  (de Bruyn R t c 1903, 22 414)

+ $2\text{H}_2\text{O}$  Cryst from sat  $\text{NiSO}_4 + \text{Aq}$  at 131° (Steele and Johnson)

+ $4\text{H}_2\text{O}$  Solubility in methyl alcohol + Aq at 10° Time = 24 hrs P = % anhydrous salt in the sat solutions

Alcohol of 100% 80% 50% 20% water  
 P 7.38 0.66 1.43 14.8 25.1

(de Bruyn, R t c 1903, 22 414)

+ $6\text{H}_2\text{O}$  Two modifications  $\alpha$ -blue, tetragonal,  $\beta$ -green, monoclinic

Solubility of  $\alpha$ - $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°

Salt used	t°	g $\text{NiSO}_4$ in 100 g $\text{H}_2\text{O}$	Salt remaining
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	32.3	43.57	$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)
	33.0	43.35	
$\text{NiSO}_4 + 7\text{H}_2\text{O}$	34.0	43.84	
	35.6	43.79	
$\text{NiSO}_4 + 6\text{H}_2\text{O}$	44.7	48.05	
$\text{NiSO}_4 + 7\text{H}_2\text{O}$	44.7	47.97	
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	50.0	50.15	
	51.0	50.66	
	52.0	52.34	
	53.0	52.34	

(Steele and Johnson)

Solubility of  $\beta$ - $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°

Salt used	t°	g $\text{NiSO}_4$ per 100 g $\text{H}_2\text{O}$	Salt remaining
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	54.5	52.50	$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (green)
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	57.0	53.40	
$\text{NiSO}_4 + 7\text{H}_2\text{O}$			
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	60.0	54.84	
$\text{NiSO}_4 + 7\text{H}_2\text{O}$			
$\text{NiSO}_4 + 7\text{H}_2\text{O}$	69.0	58.38	
	70.0	59.44	
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	73.0	60.72	
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	80.0	63.17	
$\text{NiSO}_4 + 7\text{H}_2\text{O}$			
$\text{NiSO}_4 + 7\text{H}_2\text{O}$	89.0	67.90	
	99.0	76.71	

(Steele and Johnson, Chem Soc 1904, 85 118)

Tr point from  $\alpha$ - to  $\beta$ - salt = 53.3° (Steele and Johnson)

100 pts absolute methyl alcohol dissolve 31.6 pts  $\text{NiSO}_4 + 6\text{H}_2\text{O}$  at 17°, 100 pts 93.5% methyl alcohol dissolve 7.8 pts  $\text{NiSO}_4 + 6\text{H}_2\text{O}$  at 18°, 100 pts 50% methyl alcohol dissolve 1.9 pts  $\text{NiSO}_4 + 6\text{H}_2\text{O}$  at 18° (de Bruyn, Z phys Ch 10 786)

$\alpha$ -Salt Solubility in methyl alcohol + Aq at 14° Time = 5 to 6 hrs

Alcohol % by wt	% $\text{NiSO}_4$	In 1000 mol of the solution		
		Mol $\text{NiSO}_4$	Mol $\text{CH}_3\text{O}$	Mol $\text{H}_2\text{O}$
100	12.4	26	794	180
97.5	10.6	22.3	808	170
95	6.5	14	817	169
92.5	3.06	5.9	838	156
90	1.18	2.3	821	177
85	0.315	0.57	757	242
80	0.25	0.4	688	312
60	0.46	0.8	453	546
40	2.43	3.5	265	732
20	14.7	21	105	874
0 (water)	26.0	39	0	961

(de Bruyn, R t c 1903, 22 412)

$\beta$  salt Solubility in methyl alcohol + Aq at 14° Time = 24 hrs

Alcohol % by wt	% NiSO <sub>4</sub>	In 1000 mol of the solution		
		Mol NiSO <sub>4</sub>	Mol CH <sub>3</sub> O	Mol H <sub>2</sub> O
100	15 7	33 8	763	203
97 5	12 4	26	781	193
95	10 0	20 3	784	196
92 5	5 61	11 1	800	189
90	2 35	4 5	810	185
89	1 79			
88	1 29			
87	0 97			
86	0 735			
85	0 61	1 3	755	244
80	0 415	0 7	682	317
60	0 75	1 3	453	546
40	3 11	4 0	264	732
20	14 1	21 0	105	874
0 (water)	27 2	40 0	0	960

(de Bruyn )

+7H<sub>2</sub>O

Solubility in 100 pts H<sub>2</sub>O at t°, using  
NiSO<sub>4</sub>+7H<sub>2</sub>O

t°	Pts NiSO <sub>4</sub>	t°	Pts NiSO <sub>4</sub>	t°	Pts NiSO <sub>4</sub>
0	29 3	33	45 5	66	63 6
1	29 7	34	46 0	67	64 1
2	30 1	35	46 5	68	64 7
3	30 5	36	47 0	69	65 3
4	31 0	37	47 5	70	65 9
5	31 5	38	48 0	71	66 5
6	32 0	39	48 5	73	67 0
7	32 5	40	49 0	72	67 6
8	33 0	41	49 6	74	68 2
9	33 5	42	50 1	75	68 8
10	34 0	43	50 6	76	69 3
11	34 5	44	51 2	77	69 9
12	35 0	45	51 7	78	70 5
13	35 5	46	52 3	79	71 1
14	36 0	47	52 8	80	71 7
15	36 5	48	53 4	81	72 3
16	37 0	49	53 9	82	72 9
17	37 5	50	54 5	83	73 5
18	38 0	51	55 0	84	74 1
19	38 5	52	55 6	85	74 6
20	39 0	53	56 1	86	75 2
21	39 5	54	56 7	87	75 8
22	40 0	55	57 3	88	76 4
23	40 5	56	57 9	89	77 0
24	41 0	57	58 4	90	77 6
25	41 5	58	59 0	91	78 2
26	42 0	59	59 6	92	78 8
27	42 5	60	60 2	93	79 4
28	43 0	61	60 7	94	80 1
29	43 5	62	61 3	95	80 7
30	44 0	63	61 9	96	81 3
31	44 5	64	62 4	97	81 9
32	45 0	65	63 0	98	82 5

Solubility in 100 pts H<sub>2</sub>O at t° —Continued

t°	Pts NiSO <sub>4</sub>	t°	Pts NiSO <sub>4</sub>	t°	Pts NiSO <sub>4</sub>
99	83 1	103	85 6	107	88 1
100	83 7	104	86 2	108	88 7
101	84 3	105	86 8	108 4	88 7
102	84 9	106	87 5		

(Mulder, calculated from his own and Tobler's determinations, Scheik Verhandel 1864 70 )

Solubility in H<sub>2</sub>O at t°

Salt used	t°	g NiSO <sub>4</sub> in 100 g H <sub>2</sub> O	Salt remaining
NiSO <sub>4</sub> +7H <sub>2</sub> O	-5	25 74	NiSO <sub>4</sub> +7H <sub>2</sub> O
"	0	27 22	"
"	9	31 55	"
"	15	34 19	"
"	22 6	37 90	"
"	22 8	38 88	"
"	30 0	42 46	"
NiSO <sub>4</sub> +6H <sub>2</sub> O	30 0	42 47	"
NiSO <sub>4</sub> +7H <sub>2</sub> O	32 3	44 02	"
"	33 0	45 74	"
"	34 0	45 5	"

(Steele and Johnson, Chem Soc 1904, 85 116 )

M-pt of NiSO<sub>4</sub>+7H<sub>2</sub>O = 98-100° (Tilden, Chem Soc 45 409 )

Tr point from  $\alpha$ -6H<sub>2</sub>O salt to 7H<sub>2</sub>O salt = 31 5° (Steele and Johnson )

Exists also in an unstable, more soluble modification (Fedorow, C C 1903, II 95 )

Solubility of NiSO<sub>4</sub>·7H<sub>2</sub>O + Na<sub>2</sub>SO<sub>4</sub>·10H<sub>2</sub>O in 100 g H<sub>2</sub>O at t°

t	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
0	22 46	10 09
5	25 28	15 245
10	28 26	20 64

(Koppel, Z phys Ch 1905, 52 401 )  
See also under NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>

100 pts absolute methyl alcohol dissolve 46 pts NiSO<sub>4</sub>+7H<sub>2</sub>O at 17°, 100 pts absolute methyl alcohol dissolve 24 7 pts NiSO<sub>4</sub>+7H<sub>2</sub>O at 4°, 100 pts 93 5% methyl alcohol dissolve 10 1 pts NiSO<sub>4</sub>+7H<sub>2</sub>O at 4°, 100 pts 50% methyl alcohol dissolve 2 pts NiSO<sub>4</sub>+7H<sub>2</sub>O at 4° (de Bruyn, Z phys Ch 10 786 )

Solubility in methyl alcohol+Aq at 14°  
Time, 5 to 6 hrs

Alcohol % by wt	NiSO <sub>4</sub>	In 1000 mol of solution		
		Mol NiSO <sub>4</sub>	Mol CH <sub>3</sub> O	Mol H <sub>2</sub> O
100	16 8	35 7	714	250
97 5	13 9	29	734	237
95	11 6	23 6	742	234 5
92 5	8 12	16 2	760	224
90	5 78	11 2	758	231
85	1 52	3	744	253
84	1 06			
83	0 985			
82	0 83			
81	0 665			
80	0 653	1 2	687	312
60	0 805	1 3	453	546
45	1 73			
40	2 78	4	264	732
35	4 55			
30	6 33			
20	13 7	20	105	875
0 (water)	26 4	39 5	0	960 5

(de Bruyn, R t c 1903, **22** 411)

100 g absolute ethyl alcohol dissolve 1.3 g NiSO<sub>4</sub>+7H<sub>2</sub>O at 4°, and 2 g at 17° (de Bruyn, Z phys Ch **10** 786)  
Min *Morenosite*

#### Nickel hydrazine sulphate, NiH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>

1 pt is sol in 275.5 pts H<sub>2</sub>O at 18° SI sol in hot H<sub>2</sub>O Sol in HNO<sub>3</sub> with decomp, insol in HCl Sol in NH<sub>4</sub>OH+Aq (Curtius, J pr 1894, (2) **50** 331)

#### Nickel potassium sulphate, NiSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O

Sol in 8.9 pts H<sub>2</sub>O (Tupputi)

100 pts H<sub>2</sub>O dissolve at

0° 10° 14° 20° 30°  
5.3 8.9 10.5 13.8 18.6 pts anhydrous salt,

36° 49° 55° 60° 75°

20.4 27.7 32.4 35.4 45.6 pts anhydrous salt  
(Tobler, A **95** 193)

Saturated solution contains at

20° 40° 60° 80°

8.7 12.3 17.6 22.0% anhydrous salt

(v Hauer, J pr **74** 433)

1 l H<sub>2</sub>O dissolves 68.8 g anhydrous salt at 25° (Locke, Am Ch J 1902, **27** 459)

#### Nickel potassium zinc sulphate, NiSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O

Sol in H<sub>2</sub>O (Vohl, A **94** 51)

#### Nickel rubidium sulphate, NiSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O

Sol in H<sub>2</sub>O (Tutton, Chem Soc **63** 337)  
1 l H<sub>2</sub>O dissolves 59.8 g anhydrous salt at 25° (Locke, Am Ch J 1902, **27** 459)

#### Nickel sodium sulphate, NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O

Solubility of NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> 4H<sub>2</sub>O in 100 g H<sub>2</sub>O at t°

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
20	29 31	26 87
25	27 33	25 33
30	24 64	22 58
35	23 66	21 67
40	21 88	20 65

(Koppel, Z phys Ch 1905, **52** 401)

Solubility of NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> 4H<sub>2</sub>O+NiSO<sub>4</sub> 7H<sub>2</sub>O in 100 g H<sub>2</sub>O at t°

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>	t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
18 5	30 70	25 805	30	34 98	19 825
20	31 59	25 355	35	36 01	16 435
25	33 11	23 07	40	37 935	14 295

(Koppel)

Solubility of NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> 4H<sub>2</sub>O+Na<sub>2</sub>SO<sub>4</sub> 10H<sub>2</sub>O in 100 g H<sub>2</sub>O at t°

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
18 5	26 14	29 455
20	24 07	31 365
25	18 81	37 13
30	9 87	44 25

(Koppel)

Solubility of NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> 4H<sub>2</sub>O+Na<sub>2</sub>SO<sub>4</sub> (anhydrous) in 100 g H<sub>2</sub>O at t°

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
35	7 13	49 595
40	7 245	49 03

(Koppel)

#### Nickel thallium sulphate, NiSO<sub>4</sub>, Tl<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O

Easily sol in H<sub>2</sub>O Can be recryst from little H<sub>2</sub>O without decomp (Werther, J pr **92** 132)

1 l H<sub>2</sub>O dissolves 46.1 g anhydrous salt at 25° (Locke, Am Ch J 1902, **27** 459)

#### Nickel zinc sulphate, NiSO<sub>4</sub>, ZnSO<sub>4</sub>+13H<sub>2</sub>O

Sol in 3-4 pts cold H<sub>2</sub>O Insol in alcohol (Tupputi, **1811**)  
Completely sol in NH<sub>4</sub>OH+Aq  
2NiSO<sub>4</sub>, 2ZnSO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub> (Étard, C R **87** 602)

**Nickel sulphate ammonia,  $\text{NiSO}_4 \cdot 6\text{NH}_3$** 

Sol in  $\text{H}_2\text{O}$  with separation of hydroxide (Rose, Pogg **20** 151)

$\text{NiSO}_4 \cdot 5\text{NH}_3 + 3\frac{1}{2}\text{H}_2\text{O}$  Deliquescent (André, C R **106** 936)

$\text{NiSO}_4 \cdot 4\text{NH}_3 + 2\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$   
Can be recrystallized out of little  $\text{H}_2\text{O}$  Insol even in dil alcohol (Erdmann)

**Nickel sulphate cupric oxide,  $\text{NiSO}_4 \cdot 2\text{CuO} + 6\text{H}_2\text{O}$** 

(Mailhe, Bull Soc 1902, (3) **27** 172)  
 $2\text{NiSO}_4 \cdot 3\text{CuO} + 10\text{H}_2\text{O}$ , and  $+12\text{H}_2\text{O}$  (Mailhe)

$5\text{NiSO}_4 \cdot 16\text{CuO} + x\text{H}_2\text{O}$  (Recoura, C R 1901, **132** 1415)

$\text{NiSO}_4 \cdot 20\text{CuO} + x\text{H}_2\text{O}$  (Recoura)

**Nickel sulphate, hydrazine,  $\text{NiSO}_4 \cdot 3\text{N}_2\text{H}_4$** 

Ppt (Curtius, J pr 1894, (2) **50** 343)

**Nickel sulphate hydroxylamine,  $\text{NiSO}_4 \cdot 6\text{NH}_2\text{OH}$** 

Decomp by  $\text{H}_2\text{O}$  (Uhlenhut, A 1899, **307** 334)

**Nitrosyl sulphate,  $\text{H}(\text{NO})\text{SO}_4$** 

See Nitrosulphonic acid

**Osmious sulphate**

Easily sol in  $\text{H}_2\text{O}$  and alcohol

**Osmic sulphate**

Sol in  $\text{H}_2\text{O}$  (Berzelius)

**Palladous sulphate, basic,  $\text{PdSO}_4 \cdot 7\text{PdO} + 6\text{H}_2\text{O}$ , and  $10\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HCl} + \text{Aq}$  (Kane)

**Palladous sulphate,  $\text{PdSO}_4 \cdot 2\text{H}_2\text{O}$** 

Deliquescent in moist air, very sol in  $\text{H}_2\text{O}$ , but decomp by much  $\text{H}_2\text{O}$ , with separation of a basic salt (Kane)

**Phosphoryl sulphate,  $(\text{PO})_2(\text{SO}_4)_2$  (?)**

Possible composition of Weber's (B **20** 86)  $\text{P}_2\text{O}_5$ ,  $3\text{SO}_3$  (?)

$3\text{P}_2\text{O}_5 \cdot 2\text{SO}_3$  Immediately decomp by  $\text{H}_2\text{O}$  (Adie, C N 1891, **63** 102)

**Platmic sulphate,  $\text{Pt}(\text{SO}_4)_2$** 

Deliquescent Sol in  $\text{H}_2\text{O}$ , alcohol, or ether, also in  $\text{H}_3\text{PO}_4$ ,  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$  (Berzelius)

$\text{H}_2\text{PtO}_4 \cdot 2\text{SO}_4$  Sol in  $\text{H}_2\text{O}$  (Blondel, A ch 1905, (8) **6** 109)

$\text{PtO}_2 \cdot \text{SO}_3 + 4\text{H}_2\text{O}$  Ppt Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{SO}_4$

$\text{PtSO}_4(\text{OH})_2 \cdot 4\text{Pt}(\text{OH})_4 + 3\text{H}_2\text{O}$  Ppt (Prost, Bull Soc (2) **46** 156)

$\text{Pt}_5\text{SO}_4\text{O}_{13} + 16\text{H}_2\text{O}$  As above (Prost)

**Platinum hydroxylamine sulphate,  $\text{Pt}(\text{NH}_2\text{OH})_4\text{SO}_4$** 

Only sl sol in  $\text{H}_2\text{O}$ , sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Uhlenhut, A 1900, **311** 123)

**Platmic potassium sulphate, basic**

Insol in boiling  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  Easily sol in boiling  $\text{HCl} + \text{Aq}$  Sl decomp by aqua regia (E Davy)

$\text{Pt}_{10}(\text{SO}_4)_2\text{O}_{10} \cdot 3\text{K}_2\text{SO}_4 + 34\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Prost, Bull Soc (2) **46** 156)

$\text{Pt}_{18}(\text{SO}_4)_2\text{O}_{12} \cdot 5\text{K}_2\text{SO}_4 + 34\text{H}_2\text{O}$  As above (Prost)

**Platinum rubidium sulphate,  $\text{Pt}_6\text{Rb}_6(\text{SO}_4)_4 + 17\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Prost, Bull Soc (2) **46** 156)

**Platinum sulphate sulphocarbamide,  $\text{PtSO}_4 \cdot 4\text{CS}(\text{NH}_2)_2$** 

Insol in  $\text{H}_2\text{O}$  Sol in conc  $\text{H}_2\text{SO}_4$  without decomp (Kurnakow J pr 1894, (2) **50**, 489)

**Potassium sulphate,  $\text{K}_2\text{SO}_4$** 

Not hygroscopic in the ordinary sense of the word 100 pts  $\text{K}_2\text{SO}_4$  over  $\text{H}_2\text{O}$  at  $14-20^\circ$  absorb 58 pts  $\text{H}_2\text{O}$  in 22 days, and finally deliquesce completely (Mulder)

12 pts  $\text{K}_2\text{SO}_4$  mixed with 100 pts  $\text{H}_2\text{O}$  lower the temp  $3.3^\circ$  (Rudorff, B **2** 68)

100 pts  $\text{H}_2\text{O}$  dissolve with absorption of heat at  $0^\circ$

8 36 pts  $\text{K}_2\text{SO}_4$  (Gay-Lussac)

8 46 " (Mulder)

8 5 " (Gerardin)

7 31 " (Moller, Pogg **117** 386)

7 3-7 9 " (Nordenskiöld, Pogg **136** 314)

100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 8 36 pts  $\text{K}_2\text{SO}_4$  at  $12.72^\circ$   
10 57 pts at  $49.08^\circ$  16 91 pts at  $63.90^\circ$  19 29 pts  
at  $101.50^\circ$  26 33 pts (Gay Lussac A ch (2) **11** 311)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{K}_2\text{SO}_4$	$t^\circ$	Pts $\text{K}_2\text{SO}_4$
0	7 8	47 0	16 0
15 65	10 3	70 2	20 3
28 1	12 8	98 0	23 9

(Nordenskiöld Pogg **136** 341)

100 pts sat  $\text{K}_2\text{SO}_4$  at  $101.7^\circ$  contain 17 5 pts  $\text{K}_2\text{SO}_4$  or 100 pts  $\text{H}_2\text{O}$  at  $101.25^\circ$  dissolve 21 212 pts  $\text{K}_2\text{SO}_4$  (Griffiths)

100 pts  $\text{H}_2\text{O}$  at  $102.8^\circ$  dissolve 29 pts  $\text{K}_2\text{SO}_4$  (Penny) at  $15^\circ$  7 3 6 25 pts (Ure's Dict.) at  $100^\circ$  20 pts (Ure's Dict.) at  $100^\circ$  24 2 pts (Wenzel)

Sol in 9 081 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach) in 16 pts at  $15^\circ$  and 5 pts at  $100^\circ$  in 18 pts cold and 5 pts boiling  $\text{H}_2\text{O}$  in 12 pts cold and 5 pts boiling  $\text{H}_2\text{O}$  (M R and P) in 12 pts  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abt)

$\text{K}_2\text{SO}_4$  sat at  $15^\circ$  has sp gr = 1.0774 and contains 10 055 pts  $\text{K}_2\text{SO}_4$  in 100 pts  $\text{H}_2\text{O}$  (Michel and Krafft A ch (3) **41** 478)

100 pts  $\text{H}_2\text{O}$  dissolve 9 26 pts  $\text{K}_2\text{SO}_4$  at  $15.6^\circ$ , and sat solution has sp gr = 1.177 (Page and Keightley, Cherr Soc (2) **10** 566)

Solubility in 100 pts H<sub>2</sub>O at t°

t°	Pts K <sub>2</sub> SO <sub>4</sub>	t°	Pts K <sub>2</sub> SO <sub>4</sub>	t°	Pts K <sub>2</sub> SO <sub>4</sub>
0	8 5	35	13 1	70	19 8
1	8 6	36	13 3	71	20 0
2	8 7	37	13 4	72	20 2
3	8 8	38	13 6	73	20 4
4	9 0	39	13 8	74	20 6
5	9 1	40	14 0	75	20 8
6	9 2	41	14 2	76	21 0
7	9 3	42	14 3	77	21 2
8	9 4	43	14 5	78	21 4
9	9 5	44	14 7	79	21 6
10	9 7	45	14 9	80	21 8
11	9 8	46	15 1	81	22 0
12	9 9	47	15 3	82	22 2
13	10 0	48	15 5	83	22 4
14	10 2	49	15 6	84	22 6
15	10 3	50	15 8	85	22 8
16	10 4	51	16 0	86	23 0
17	10 5	52	16 2	87	23 2
18	10 7	53	16 4	88	23 4
19	10 8	54	16 6	89	23 6
20	10 9	55	16 8	90	23 9
21	11 1	56	17 0	91	24 1
22	11 2	57	17 2	92	24 3
23	11 3	58	17 4	93	24 5
24	11 5	59	17 6	94	24 7
25	11 6	60	17 8	95	25 0
26	11 7	61	18 0	96	25 2
27	11 9	62	18 2	97	25 5
28	12 0	63	18 4	98	25 7
29	12 2	64	18 6	99	25 9
30	12 3	65	18 8	100	26 2
31	12 5	66	19 0	101	26 4
32	12 6	67	19 2	102	26 6
33	12 8	68	19 4	102 25	26 75
34	13 0	69	19 6		

(Mulder, calculated from his own and other experiments, Scheik Verhandel **1864** 50)

If solubility S = pts anhydrous salt in 100 pts of solution, S = 7.5 + 0.1070t from 0° to 163°. Solubility from 163° to 220° is constant at 25 (Étard, C R **106** 208)

Solubility of K<sub>2</sub>SO<sub>4</sub> in 100 pts H<sub>2</sub>O at t°

t°	Pts K <sub>2</sub> SO <sub>4</sub>	t	Pts K <sub>2</sub> SO <sub>4</sub>	t°	Pts K <sub>2</sub> SO <sub>4</sub>
16	9 76	39	14 21	120	26 5
20	10 30	54	17 39	143	28 8
28	12 59	98	23 91	170	32 9
36	13 28				

(Tilden and Shenstone, Phil Trans **1884** 23)

Solubility of K<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O 100 pts H<sub>2</sub>O dissolve at

4 3° 18 4° 69 9°  
8 16 10 8 19 7 pts K<sub>2</sub>SO<sub>4</sub>

(Andreae, J pr (2) **29** 456)

100 ccm H<sub>2</sub>O dissolve 12 04 g K<sub>2</sub>SO<sub>4</sub> at 25° (Trevor, Z phys Ch **7** 468)

Sat K<sub>2</sub>SO<sub>4</sub> + Aq contains at

21° 23° 60° 99° 130°  
10 1 10 3 14 5 19 1 21 1% K<sub>2</sub>SO<sub>4</sub>,

130° 152° 175° 195° 220°  
21 3 22 8 24 5 23 8 24 6% K<sub>2</sub>SO<sub>4</sub>  
(Étard, A ch **1894**, (7) **2** 549)

Solubility of K<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O at t°

G K<sub>2</sub>SO<sub>4</sub> per 100 g H<sub>2</sub>O

t°	K <sub>2</sub> SO <sub>4</sub>	Sp gr	t°	K <sub>2</sub> SO <sub>4</sub>	Sp gr
0 40	7 47	1 0589	58 95	18 01	1 1089
15 70	10 37	1 0770	74 85	20 64	1 1157
31 45	13 34	1 0921	89 70	22 80	1 1194
42 75	15 51	1 1010	101 1*	24 21	1 1207

\* = b - pt

(Berkeley, Phil Trans Roy Soc **1904**, **203** A, 189)

100 g H<sub>2</sub>O dissolve 0 133 gram-equivalent K<sub>2</sub>SO<sub>4</sub> at 25° (Van't Hoff and Meyerhoffer, Z phys Ch **1904**, **49** 315)

1 l sat K<sub>2</sub>SO<sub>4</sub> + Aq at 25° contains 0 617 mols K<sub>2</sub>SO<sub>4</sub> (Herz Z anorg **1911**, **73** 274)

Solubility of K<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O at t°

t°	% K <sub>2</sub> SO <sub>4</sub>
4 78	7 82
30 05	11 43
54 20	14 77
68 90	16 40

(Le Blanc and Schmandt, Z phys Ch **1911**, **77** 614)

100 g H<sub>2</sub>O dissolve 12 10 g K<sub>2</sub>SO<sub>4</sub> at 25° (Amadori, Rend Acc Linc **1912**, (5) **21** II 667)

Solubility of K<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O at various pressures Figures denote pts K<sub>2</sub>SO<sub>4</sub> contained in 100 pts sat K<sub>2</sub>SO<sub>4</sub> + Aq at t° and A pressure in atmospheres

A	0°	15°	15 5°	16 2°
1	6 81	9 14	9 24	9 35
20	7 14		9 44	9 54
30	7 14			

(Moller, Pogg **117** 386)

Sat K<sub>2</sub>SO<sub>4</sub> + Aq boils at 101 5°, and contains 26 33 pts K<sub>2</sub>SO<sub>4</sub> to 100 pts H<sub>2</sub>O (Gay-Lussac), at 101 7°, and contains 21 2 pts K<sub>2</sub>SO<sub>4</sub> to 100 pts H<sub>2</sub>O (Griffiths), at 102 25°, and contains 26 75 pts K<sub>2</sub>SO<sub>4</sub> to 100 pts H<sub>2</sub>O (Mulder), boils at 103° (Kremers)

Crust forms at 101 7°, and solution contains 25 3 pts K<sub>2</sub>SO<sub>4</sub> to 100 pts H<sub>2</sub>O, highest

temp observed, 102 1° (Gerlach, Z anal 26 426)

B-pt of  $K_2SO_4$ +Aq containing pts  $K_2SO_4$  to 100 pts  $H_2O$

B pt	Pts $K_2SO_4$	B pt	Pts $K_2SO_4$
100 5°	7	102°	30 0
101 0	14 5	102 1	31 6
101 5	22 1		

(Gerlach, Z anal 26 430)

Sp gr of  $K_2SO_4$  at 19 5°

% $K_2SO_4$	Sp gr	% $K_2SO_4$	Sp gr
2 401	1 0193	9 264	1 0783
4 744	1 0385	10 945	1 0909
6 988	1 0568		

(Kremers Pogg 95 120)

Sp gr and B pt of  $K_2SO_4$ +Aq at 12 5°

Pts $K_2SO_4$ to 100 pts $H_2O$	Sp gr	B pt	Pts $K_2SO_4$ to 100 pts $H_2O$	Sp gr	B pt
1	1 0079	100 38°	6	1 0456	101 12
2	1 0151	100 63°	7	1 0524	101 25°
3	1 0231	100 75°	8	1 0599	101 25°
4	1 0305	100 88°	9	1 0676	101 38°
5	1 0391	101°	10	1 0735	101 5°

(Brandes and Gruner 1827)

$K_2SO_4$ +Aq sat at 8° has 1 072 sp gr (Anthon, A 24. 211)

$K_2SO_4$ +Aq saturated at 12° contains 10 38%  $K_2SO_4$  and has sp gr 1 0716 (Struve, Zeit Ch (2) 5 323), saturated at 15° contains 11 01%  $K_2SO_4$  and has sp gr 1 0831 (Gerlach), saturated at 18 75° contains 10 74%  $K_2SO_4$  and has sp gr 1 0798 (Kars-ten)

Sp gr of  $K_2SO_4$ +Aq at 15°

% $K_2SO_4$	Sp gr	% $K_2SO_4$	Sp gr	% $K_2SO_4$	Sp gr
1	1 0082	5	1 0410	8	1 0664
2	1 0163	6	1 0495	9	1 0750
3	1 0245	7	1 0579	9 92	1 0830
4	1 0328				

(Gerlach, Z anal 8 287)

Sp gr of  $K_2SO_4$ +Aq at 18°

% $K_2SO_4$	Sp gr
5	1 0395
10	1 0815

(Kohlrausch, W Ann 1879 1)

Sp gr of  $K_2SO_4$ +Aq at 15°/15° a=pts  $K_2SO_4$  in 100 pts of the solution, b=pts  $K_2SO_4$  in 100 pts  $H_2O$

a	b	Sp gr
1	1 010	1 00808
3	3 093	1 02447
5	5 263	1 04091
7	7 527	1 05776
9	9 890	1 07499
9 92	11 013	1 08305

(Gerlach, Z anal 28 493)

Sp gr of  $K_2SO_4$ +Aq at 20° containing 0 5 mol  $K_2SO_4$  to 100 mols  $H_2O$ =1 03758, containing 1 mol  $K_2SO_4$  to 100 mols  $H_2O$ =1 06744 (Nicol, Phil Mag (5) 16 122)

Sp gr of  $K_2SO_4$ +Aq at 25°

Concentration of $K_2SO_4$ +Aq	Sp gr
1-normal	1 0664
$1/2$ "	1 0338
$1/4$ "	1 0170
$1/8$ "	1 0084

(Wagner, Z phys Ch 1890, 5 37)

$K_2SO_4$ +Aq containing 67%  $K_2SO_4$  has sp gr 20°/20°=1 0549 (Le Blanc and Rohland, Z phys Ch 1896, 19 278)

Sp gr of  $K_2SO_4$ +Aq at 20 1°, when p=per cent strength of solution, d=observed density, w=volume conc in gr per cc ( $\frac{pd}{100}=w$ )

p	d	w
9 83	1 0800	0 10615
8 172	1 0657	0 08708
6 779	1 0539	0 07144
5 021	1 0394	0 05218
3 127	1 0238	0 03202
2 508	1 0186	0 02554
1 448	1 0100	0 01463
1 079	1 0070	0 01087
1 047	1 0066	0 01053
0 455	1 0018	0 00456

(Barnes, J phys Chem 1898, 2 543)

Sp gr of  $K_2SO_4$ +Aq at 18°

$\frac{1}{2}$ $K_2SO_4$ g equiv per l	Sp gr at 18
0 8327	1 0567
0 7975	1 0539
0 6688	1 0456
0 5029	1 0344
0 5016	1 0340
0 2508	1 0173
0 01001	1 0006

(McKay, Elektrochem Zeit 1899, 6 115)

Sp gr of sat  $K_2SO_4$ +Aq at  $t^\circ$ 

$t^\circ$	g $K_2SO_4$ sol in 100 g $H_2O$	Sp gr
0	7 35	1 058
10	9 22	1 069
20	11 11	1 081
30	12 97	1 089
40	14 76	1 097
50	16 50	1 106
60	18 17	1 114
70	19 75	1 121

(Tscherna], J Russ phys Chem Soc 1912,  
44 1565)Sol in conc acids, not pptd by glacial  
 $HC_2H_3O_2$  Insol in  $KOH$ +Aq of 1 35 sp gr  
(Liebig, A 11 262)Solubility of  $K_2SO_4$  in  $H_2SO_4$ +Aq at  $18^\circ$ .

Mols per 100 mols solution		Solid phase
K $SO_4$	$H_2SO_4$	
1 10	0	$K_2SO_4$
1 59	0 95	"
2 49	2 70	"
2 75	3 17	$K_2SO_4, KHSO_4$
2 75	3 74	"
2 83	5 08	"
2 80	5 79	$K_2SO_4, 3KHSO_4$
2 61	5 61	$K_2SO_4, 6KHSO_4$
2 25	6 19	" + $KHSO_4$
1 08	7 94	$KHSO_4$
0 77	9 2	"
0 44	22 7	"

(Stortenbecker, R t c 1902, 21 407)

Solubility in  $H_2SO_4$ +Aq at  $0^\circ$ 

1000 g of the solution contain		Solid phase
Mols $H_2SO_4$	Mols K $SO_4$	
0 37	0 59	K $SO_4$
0 75	0 55	"
1 08	0 64	"
1 13	0 74	K $SO_4$ +K H( $SO_4$ ) <sub>2</sub>
1 44	0 73	K <sub>2</sub> H( $SO_4$ )
1 66	0 71	"
1 66	0 69	"
1 89	0 66	K <sub>2</sub> H( $SO_4$ ) + K <sub>2</sub>
1 88	0 69	"
2 15	0 59	Ka+Kb
2 12	0 61	"
2 29	0 54	Kb
2 30	0 53	Kb+KHSO <sub>4</sub>
2 33		"
2 48	0 43	KHSO <sub>4</sub>
3 08	0 28	"
4 45	0 12	"
5 27	0 09	"

These results show that at  $0^\circ$  there existbetween  $K_2H(SO_4)_2$  and  $KHSO_4$ , two acid  
sulphates, Ka and Kb Ka is probably  
 $K_2SO_4, 3KHSO_4$  and Kb is probably  $K_2SO_4,$   
 $6KHSO_4$ 

(D'Ans, Z anorg 1909, 63 228)

3 1 mols  $K_2SO_4$  are sol in absolute  $H_2SO_4$   
at  $25^\circ$  (Bergius, Z phys Ch 1910, 73 353)Solubility in  $H_2SO_4$ +Aq at  $25^\circ$ 

Millimols $H_2SO_4$ in 10 ccm	Millimols $K_2SO_4$ in 10 ccm
	6 17
3 97	8 92
7 57	10 82
14 35	14 86

(Herz, Z anorg 1912, 73 276)

Solubility in  $H_2SO_4$ +Aq at  $25^\circ$ 

In 1000 g of the solution		Solid phase
Mols $SO_3$	Mols K $SO_4$	
6 42	0 171	$KHSO_4$
6 60	0 190	"
6 91	0 266	$KHSO_4 + K_2H_2(SO_4)_2, H_2O$
7 26	0 182	"
7 62	0 157	"
7 88	0 167	"
8 00	0 201	"
8 10	0 250	$KH_2(SO_4)_2, H_2O$
8 15	0 352	"
8 16	0 364	$KH_2(SO_4)_2, H_2O + KH_2(SO_4)_2$
8 29	0 341	"
8 33	0 322	"
8 45	0 325	"
8 62	0 316	"
8 57	0 384	$KH_2(SO_4)_2$
8 71	0 412	"
8 82	0 553	$KH_2(SO_4)_2$
8 65	0 880	$KH_2(SO_4)_2 + KHS O_7$
8 63	0 899	$KHS O_7$ (metastable solution)
8 70	0 882	"
8 96	0 561	"
9 80	0 365	"
9 78	0 430	"
9 80	0 665	$KHS O_7$
9 66	0 904	"
9 66	0 937	"

(D'Ans, Z anorg 1913, 80 239)

Pptd from  $K_2SO_4$ +Aq by  $NH_4OH$ +Aq  
(Sullivan)



Solubility of  $K_2SO_4$  in  $NH_4OH + Aq$  at  $20^\circ$ 

G $NH_3$ in 100 ccm $H_2O$	G $K_2SO_4$ in 100 ccm $H_2O$
0	10 804
6 08	4 100
15 37	0 828
24 69	0 140
31 02	0 042

(Girard, Bull Soc (2) 43 522)

1 l sat solution in  $H_2O$  contains 105.7 g  $K_2SO_4$  at  $20^\circ$ , in  $NH_4OH + Aq$  (5.2%  $NH_3$ ), 45.2 g (Konowalow, J Russ Phys Chem Soc 1894, 31 985)

Solubility of  $K_2SO_4$  in  $KOH + Aq$  at  $25^\circ$ 

In 1000 g of the solution

Mols $K_2SO_4$	Mols $(KOH)_2$
0 617	0 0
0 433	0 258
0 280	0 433
0 137	1 13
0 035	2 86
0 009	3 42
~ ~	4 809

einer, Z anorg 1910, 67 438)

Sol in sat  $NH_4Cl + Aq$  without pptn (See  $NH_4Cl$ )

Sl sol in sat  $KCl + Aq$  without pptn  
100 g sat  $KCl + Aq$  at  $25^\circ$  dissolve 0.0167 g equiv  $K_2SO_4$  at  $25^\circ$  (Van't Hoff and Meyerhoffer Z phys Ch 1904 49 315)

Sl sol in sat  $KNO_3 + Aq$  without causing pptn

1 l of the solution contains 50.7 g  $K_2SO_4 + 216.5$  g  $KNO_3 = 267.2$  g mixed salts at  $15^\circ$   
Sp gr  $K_2SO_4 + KNO_3 + Aq = 1.165$

1 l of the solution contains 47.66 g  $K_2SO_4 + 308.5$  g  $KNO_3 = 356.2$  g mixed salts at  $25^\circ$   
Sp gr of  $K_2SO_4 + KNO_3 + Aq = 1.210$  (Euler, Z phys Ch 1904, 49 313)

See also under  $KNO_3$

Sol in sat  $NaNO_3 + Aq$  without causing pptn at first, but soon  $KNO_3$  is pptd (Karsten) (See  $NaNO_3$ )

Sol in  $(NH_4)_2SO_4 + Aq$  with pptn of  $(NH_4)_2SO_4$  (Rudorff, B 6 485) (See  $(NH_4)_2SO_4$ )

More sol in aqueous solutions of other salts, as  $Na_2SO_4$ ,  $MgSO_4$ ,  $CuSO_4$ , etc., than in pure  $H_2O$  (Pfaff, A 99 227)

Sol in sat  $Na_2SO_4 + Aq$ ,  $MgSO_4 + Aq$ ,  $NaCl + Aq$  (See  $MgSO_4$  and  $NaCl$ )

Solubility of  $K_2SO_4$  in  $Na_2SO_4 + Aq$ 

Temp = $34^\circ$		Temp = $60^\circ$	
% $Na_2SO_4$	% $K_2SO_4$	% $Na_2SO_4$	% $K_2SO_4$
0	11.9	0	15.3
7.1	10.7	6.6	13.9
31.4	4.3	27.1	8.2
33.1	0	31.3	0

(Nacken, B A B 1910 1016)

100 g  $H_2O$  sat with both  $K_2SO_4$  and  $Li_2SO_4$  dissolve

4.74 g  $Li_2SO_4 + 10.3$  g  $K_2SO_4$  at  $15^\circ$   
11.5 g " + 16.4 g " "  $62^\circ$   
18.52 g " + 26.2 g " "  $100^\circ$

(Rabe, Z anorg 1902, 31 156)

Sl sol in sat  $ZnSO_4$  or  $CuSO_4 + Aq$  with separation of double salt

100 pts  $H_2O$  dissolve 8.5 + 0.12 pts  $K_2SO_4$ . On addition of a K salt,  $K_2SO_4$  is pptd. The amount of  $K_2SO_4$  remaining in solution plus the amt of K in the salt added is a constant (Blarez, C R 112 939)

Solubility of  $K_2SO_4 + Th(SO_4)_2$  at  $16^\circ$ Solid phase,  $Th(SO_4)_2$ 

Pts per 100 pts $H_2O$		Pts per 100 pts $H_2O$	
$K_2SO_4$	$Th(SO_4)_2$	$K_2SO_4$	$Th(SO_4)_2$
0 000	1 390	1 487	0 870
0 424	1 667	1 633	0 635
1 004	2 193	1 844	0 370
1 152	3 191	2 512	0 128
1 224	2 514	3 092	0 070
1 283	2 222	4 050	0 027
1 348	1 706	4 825	0 003
1 378	1 637		

(Barre, C R 1911, 150 1555)

Difficultly sol in 20%  $KCl + Aq$  (Stromeyer)

Solubility in K acetate + Aq at  $25^\circ$ 

Composition of the solution

% K acetate	% $K_2SO_4$	H O
6 11	6 65	87.24
8 68	5 09	86.23
11 29	3 99	84.72
15 59	2 35	82.66
20 12	1 23	78.65
29 95	0 39	69.66

The solid phase in these solutions is  $K_2SO_4$  (Fox, Chem Soc 1909, 95 58)

100 g hydroxylamine dissolve 3.5 g  $K_2SO_4$  at  $17-18^\circ$  (de Bruyn, Z phys Ch 1892, 10 782)

Easily sol in liquid HF (Franklin, Z anorg 1905 46 2)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Neither dissolved nor attacked by liquid  $\text{NO}_2$  (Frankland, Chem Soc 1901, 79 1361)

Insol in absolute alcohol

Insol in alcohol, the sp gr of which is 0 905 (Anthon)

Solubility in dil alcohol increases with the temp

100 pts alcohol of 0 939 sp gr (53% by vol, 45% by weight) dissolve at

4° 8° 60°  
0 16 0 21 0 92 pts  $\text{K}_2\text{SO}_4$

(Gerardin, A ch (4) 5 147)

100 pts of the sat solution at 15° in alcohol of

10 20 30 40% by weight,  
contain 3 9 1 46 0 56 0 21 pts  $\text{K}_2\text{SO}_4$

(Schiff, A 118 362)

Solubility in acetic acid + Aq at 25°

Concentration of the acetic acid Mol/Liter	Solubility of $\text{K}_2\text{SO}_4$ Mol/Liter
0 000	0 6714
0 070	0 6619
0 137	0 6559
0 328	0 6350
0 578	0 6097
1 151	0 5556
2 183	0 4743

(Rothmund and Wilmore, Z phys Ch 1902, 40 620)

Solubility in phenol + Aq at 25°

Concentration of the phenol Mol/Liter	Solubility of $\text{K}_2\text{SO}_4$ Mol/Liter
0 000	0 6714
0 016	0 6650
0 021	0 6614
0 032	0 6598
0 040	0 6555
0 047	0 6522
0 064	0 6502
0 076	0 6494
0 127	0 6310
0 152	0 6251
0 236	0 6042
0 252	0 5956
0 308	0 5834
0 409	0 5572
0 464	0 5480
0 486	0 5425
0 495	0 5389
0 498 (saturated)	0 5377

(Rothmund and Wilmore, Z phys Ch 1902, 40 619)

100 g 95% formic acid dissolve 36 5 g  $\text{K}_2\text{SO}_4$  at 21° (Aschan, Ch Ztg 1913, 37 1117)

Solubility in organic substances + Aq at 25°

Organic substance	Composition of the solutions		
	% organic substance	% $\text{K}_2\text{SO}_4$	% H <sub>2</sub> O
Alcohol	1 35	9 17	89 48
	4 80	6 90	88 30
	7 80	4 96	87 24
	9 70	4 32	85 98
	12 34	3 57	84 09
	14 51	2 71	82 78
	15 26	2 66	82 08
	20 50	1 83	77 67
	26 91	0 97	72 12
	35 97	0 41	63 62
	43 90	0 22	55 88
	69 26	0 016	30 72
Pyridine	4 23	7 95	87 82
	13 90	4 77	81 33
	24 51	2 75	72 74
	34 19	1 47	64 34
	46 29	0 45	53 26
	55 93	0 12	43 95
	75 90	0 006	24 09
Ethylene glycol	3 16	9 67	87 17
	9 89	7 69	82 53
	18 47	5 74	75 79
	32 11	3 57	64 32
	49 03	1 83	49 14
Chloral hydrate	6 44	9 13	84 43
	9 09	8 41	82 50
	12 38	7 79	79 83
	13 20	7 31	79 49
	22 07	5 88	72 05
	33 15	4 54	62 31
	44 40	3 36	52 24
	47 30	2 92	49 78
	62 82	2 00	35 18
	70 28	1 75	27 97
Glycerol	80 36	1 40	18 24
	85 26	1 08	13 66
	8 96	8 87	82 17
	13 36	7 69	78 95
	20 34	6 47	73 19
	24 15	5 83	70 02
	33 73	4 44	61 83
	40 40	3 65	55 95
	43 52	3 38	53 10
	50 18	2 69	47 13
Mannitol	57 22	2 07	40 71
	67 94	1 53	30 53
	78 18	0 98	20 84
	98 28	0 73	0 99
	3 20	10 32	86 48
	5 82	10 07	84 11
	8 35	9 61	82 04
	11 26	9 19	79 55
	14 30	8 66	77 04
	17 22	8 35	74 43

Solubility in organic substances + Aq at 25° —

*Continued*

Organic substance	Composition of the solutions		
	% organic substance	% K <sub>2</sub> SO <sub>4</sub>	% H <sub>2</sub> O
Sucrose	9 56	9 65	80 79
	18 55	8 65	72 80
	28 16	7 42	64 42
	37 24	6 35	56 41
	47 55	5 21	47 24
	57 00	4 24	38 76
Acetone	4 92	7 20	87 88
	10 06	5 02	84 92
	16 23	2 96	80 81
	24 31	1 50	74 19
	37 19	0 47	62 34
	46 29	0 20	53 51
	62 40	0 03	37 57

(Fox and Gage, Chem Soc 1910, **97** 381)Sol in 76 pts glycerine of 1.225 sp gr at ordinary temp (Vogel, N Repert **16** 557)Insol in acetone (Krug and M'Elroy, Eidman, C C **1899**, II 1014)Insol in CS<sub>2</sub> (Arctowski, Z anorg 1894, **6** 257), benzonitrile (Naumann, B 1914, **47** 1370), methyl acetate (Naumann, B 1909 **42** 3790) ethyl acetate (Naumann104 g K<sub>2</sub>SO<sub>4</sub> + 219 0

5°, or 100 g sat solution con-

O<sub>4</sub> + 66.74 g sugar (Kohler,and 1897, **47** 447)

Glycerite

+ ½ H<sub>2</sub>O 100 pts H<sub>2</sub>O dissolve 9.82 pts (Ogier, C R **82** 1055)**Tripotassium hydrogen sulphate**, K<sub>3</sub>H(SO<sub>4</sub>)<sub>2</sub>Sol in H<sub>2</sub>O**Potassium hydrogen sulphate**, KHSO<sub>4</sub>1.07 pts KHSO<sub>4</sub> (= 1 pt K<sub>2</sub>S<sub>2</sub>O<sub>7</sub>) dissolveat 0° in 2.95 pts H<sub>2</sub>O

" 20° " 2.08 "

" 40° " 1.59 "

" 100° " 0.88 "

(Kremers, Pogg **92** 497)Sp gr of KHSO<sub>4</sub> + Aq at 15° containing5 10 15 % KHSO<sub>4</sub>,

1.0354 1.0726 1.1116

20 25 27% KHSO<sub>4</sub>

1.1516 1.1920 1.2110

(Kohlrausch, W Ann **1879** 1)Sat solution boils at 105.5° (Griffiths), **108** (Kremers)Alcohol dissolves out H<sub>2</sub>SO<sub>4</sub>K<sub>2</sub>SO<sub>4</sub> crystallises from dilute solutions100 g 95% formic acid dissolve 14.6 g KHSO<sub>4</sub> at 19.3° (Aschan, Ch Ztg 1913, **37** 1117)Insol in methyl acetate (Naumann B 1909, **42**, 3790)Min *Mismitie*+ 5½ H<sub>2</sub>O Deliquescent (Senderens, Bull Soc (3) **2** 278)**Potassium dihydrogen sulphate**, K<sub>2</sub>H<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>Sol in H<sub>2</sub>O (Phillips, Phil Mag **1** 429)Composition is 4K<sub>2</sub>O, 7SO<sub>3</sub> + 3H<sub>2</sub>O, according to Berthelot (A ch (4) **30** 442)**Potassium trihydrogen sulphate**, KH<sub>3</sub>(SO<sub>4</sub>)<sub>2</sub>Sol in H<sub>2</sub>O with rise of temperature (Schultz, Pogg **133** 137)+ 1½ H<sub>2</sub>O (Lescœur, C R **78** 1044)**Potassium disulphate (pyrosulphate)**, K<sub>2</sub>S<sub>2</sub>O<sub>7</sub>When dissolved in exactly the necessary amount of hot H<sub>2</sub>O for solution, it crystallises on cooling without decomp. Decomp by excess of H<sub>2</sub>O (Jacquelin, A ch **70** 311)Insol in methyl acetate (Naumann, B 1909 **42** 3790)**Potassium hydrogen disulphate**, KHS<sub>2</sub>O<sub>7</sub>Sol in fuming H<sub>2</sub>SO<sub>4</sub> without decomposition**Potassium octosulphate**, K<sub>2</sub>S<sub>8</sub>O<sub>25</sub>Decomp by H<sub>2</sub>O (Weber)**Potassium praseodymium sulphate**, 3K<sub>2</sub>SO<sub>4</sub>,Pr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> + H<sub>2</sub>OSl sol in H<sub>2</sub>OSol in conc HCl and HNO<sub>3</sub> (Von Scheele Z anorg 1898, **18** 358)**Potassium rhodium sulphate**, 3K<sub>2</sub>SO<sub>4</sub>,Rh<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>Does not exist (Eidman, C R **107** 234)K<sub>2</sub>SO<sub>4</sub>, Rh<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> + 24H<sub>2</sub>O Very sol in H<sub>2</sub>O (Piccini, Z anorg 1901, **27** 66)**Potassium samarium sulphate**, 9K<sub>2</sub>SO<sub>4</sub>,2Sm<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> + 3H<sub>2</sub>OSl sol in H<sub>2</sub>OSl sol in sat K<sub>2</sub>SO<sub>4</sub> + Aq1 l sat K<sub>2</sub>SO<sub>4</sub> + Aq dissolves 0.5 g Sm<sub>2</sub>O<sub>3</sub> (Cleve, Bull Soc (2) **43** 166)**Potassium scandium sulphate**, 3K<sub>2</sub>SO<sub>4</sub>,Sc<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>Very slowly sol in cold, more easily sol in warm H<sub>2</sub>O Insol in sat K<sub>2</sub>SO<sub>4</sub> + AqSol in H<sub>2</sub>O and in dil K<sub>2</sub>SO<sub>4</sub> + Aq (Meyer, Z anorg 1914, **86** 279)2K<sub>2</sub>SO<sub>4</sub>, Sc<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> Sol in K<sub>2</sub>SO<sub>4</sub> + Aq (Cleve)

Does not exist (Nilson)

**Potassium sodium sulphate**, 3K<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>100 pts H<sub>2</sub>O dissolve 40.8 pts at 103.5° (Penny, Phil Mag (4) **10** 401)5K<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub> 100 pts H<sub>2</sub>O at 100° dissolve 25 pts, at 12.7°, 10.1 pts, at 4.4°, 9.2 pts (Gladstone, Chem Soc **6** 111)

**Potassium strontium sulphate,  $K_2Sr_2(SO_4)_2$** Decomp by  $(NH_4)_2CO_3 + Aq$  (Rose Pogg 93 604) $K_2SO_4, SrSO_4$  This is the only double salt formed from these two components between  $0^\circ$  and  $100^\circ$ 100 pts of the sat solution in equilibrium with  $SrSO_4$  and the double salt contain at17.5° 50° 75° 100°  
1.27 188 271 3.9 pts  $K_2SO_4$ 

(Barre, C R 1909, 149 292)

**Potassium tellurium sulphate,  $KHSO_4, 2TeO_2, SO_3 + 2H_2O$** 

(Metzner, A ch 1898, (7) 15 203)

**Potassium terbium sulphate**Easily sol in  $H_2O$  Sl sol in  $K_2SO_4 + Aq$  Delafontaine, Zeit Chem (2) 2 230)**Potassium thallic sulphate,  $KTI(SO_4)_2 + 4H_2O$** Decomp by  $H_2O$  (Fortini, Gazz ch t 1905, 35 (2) 453) $2K_2O, TI_2O_3, 4SO_3$  Insol in  $H_2O$  Very difficultly sol in warm dil  $H_2SO_4 + Aq$  Strecker, A 135 207)**Potassium thorium sulphate,  $K_2SO_4, Th(SO_4)_2 + 4H_2O$** Sol in hot  $H_2O$  containing a few drops HCl (Barre, A ch 1911, (8) 24 227) $2K_2SO_4, Th(SO_4)_2 + 2H_2O$  Slowly sol in old, easily and abundantly in hot  $H_2O$ , and is gradually decomp by boiling Easily sol in acids Insol in alcohol (Berzelius) $3.5K_2SO_4, Th(SO_4)_2$  Insol in  $K_2SO_4 + Aq$  if con contrations above 4.5% (Barre) $4K_2SO_4, Th(SO_4)_2 + 2H_2O$  (Chydenius)**Potassium tin (stannous) sulphate,  $K_2SO_4, SnSO_4$** 

(Marignac)

**Potassium tin (stannic) sulphate,  $K_2Sn(SO_4)_2$** Easily sol in  $H_2O$  with decomp

Sol in HCl (Weinland, Z anorg 1907, 54 250)

**Potassium tin (stannous) sulphate chloride,  $4K_2SO_4, 4SnSO_4, SnCl_2$** Can be recrystallised from  $H_2O$  (Marignac, Ann Min (5) 12 62)**Potassium titanium sulphate,  $K_2SO_4, Ti(SO_4)_2 + 3H_2O$** Difficultly sol in  $H_2O$  or  $HCl + Aq$  Decomp by much  $H_2O$  (Wallace, Pogg 102 453)**Potassium titanyl sulphate,  $2K_2SO_4, 3TiO, SO_4 + 10H_2O$** Very sol in  $H_2O$  with decomp Insol in conc  $H_2SO_4$  (Rosenheim, Z anorg 1901, 26 251) $K_2SO_4, TiO_2SO_4 + 7H_2O$  Very hygroscopic and sol in  $H_2O$  (Mazzuchelli and Pontanelli, C C 1909, II 420) $K_2SO_4, (TiO)SO_4$  (Spence, C C 1901, II 747)**Potassium uranous sulphate,  $K_2SO_4, U(SO_4)_2 + H_2O$** Very sl sol in  $H_2O$  (Rammelsberg)**Potassium uranyl sulphate,  $K_2SO_4, (UO_2)SO_4 + 2H_2O$** Sol in 9 pts  $H_2O$  at  $22^\circ$  and in 0.51 pt at  $100^\circ$  Insol in alcohol (Ebelmen, A ch (3) 5 211)100 pts of aqueous solution sat at  $25^\circ$  contain 10.5 pts salt, at  $70.5^\circ$  contain 23.93 pts salt (Rimbach, B 1904, 37. 478) $+ 3H_2O$  (de Coninck, Chem Soc 1905, 88 (2) 394) $2K_2SO_4, (UO_2)SO_4 + 2H_2O$  Decomp by  $H_2O$ Cannot be cryst from rather conc  $H_2SO_4$ , as it is completely decomp by it (Rimbach, B 1905, 38 1572) $K_2O, 2UO_3, 3SO_3$  Ppt Identical with  $UO_2, OK, SO_3H$  of Scheller, (A 1867, 144 238) (Kohlschutter, A, 1900, 311. 11) $2K_2SO_4, 3(UO_2)SO_4 + H_2O$  Sol in  $H_2O$  Insol in alcohol (Berzelius)

Does not exist (Ebelmen)

**Potassium vanadium sulphate,  $K_2O, V_2O_5, 2SO_3 + 6H_2O = K(VO_2)SO_4 + 3H_2O$** 

(Friedheim, B 24 1183)

 $= KVO_3, K_2SO_4, V_2O_5, 2SO_3 + 9H_2O$  of Munzing (Berlin, Dissert 1889). $K_2SO_4, VSO_4 + 6H_2O$  Sol in  $H_2O$  (Piccini, Z anorg 1902, 32 61) $K_2V_2(SO_4)_4 + 24H_2O$  100 pts  $H_2O$  dissolve 198.4 pts salt at  $10^\circ$  Sp gr of sat solution at  $4^\circ/20^\circ = 1.782$  (Piccini, Z anorg 1897, 13 446)**Potassium vanadyl sulphate,** $K_2SO_4, (VO)_2(SO_4)_2$ Very slowly sol in  $H_2O$ , still less sol in dil alcohol (Gerland) $K_2SO_4, VOSO_4 + 3H_2O$  Easily sol in  $H_2O$  Sol in alcohol + conc  $H_2SO_4$  (Koppcl, Z anorg 1903, 35 178) $K_2SO_4, 2VOSO_4$  Very hygroscopic Very sol in  $H_2O$  but goes into solution slowly (Koppcl and Behrendt, B 1901, 34 3935)Easily sol in  $H_2O$  (Koppcl, Z anorg 1903, 35 174)**Potassium yttrium sulphate,  $4K_2SO_4, Y_2(SO_4)_3$** Sol in 16 pts cold  $H_2O$ , and in 10 pts sat  $K_2SO_4 + Aq$ , and more abundantly if the latter solution contains ammonium salts or free acid (Berlin) $3K_2SO_4, 2Y_2(SO_4)_3$  100 ccm cold sat

$K_2SO_4 + Aq$  dissolve an amount of this salt corresponding to 4.685 g  $Y_2O_3$  (Cleve)

**Potassium zinc sulphate,  $K_2SO_4, ZnSO_4 + 6H_2O$**

Sol in 5 pts cold  $H_2O$  (Bucholz N J Pharm 9 2 26)

100 pts  $H_2O$  dissolve at

0° 10° 15° 25° 36°

12.6 13.7 22.5 28.8 39.9 pts hydrous salt,

45° 50° 58° 65° 70°

51.2 54.0 67.6 81.3 87.9 pts hydrous salt

(Tobler, A 95 193)

100 pts  $H_2O$  at 15° dissolve 14.8 pts  $K_2SO_4, ZnSO_4 + 6H_2O$ , sp gr of sat  $H_2O$  solution at 15° = 1.0939 (Schiff, A 109 326)

1 l  $H_2O$  dissolves 131.9 g anhydrous salt at 25° (Locke, Am Ch J 1902, 27 459)

**Potassium zirconium sulphate,  $2K_2O, 6ZrO_2, 7SO_3 + 9H_2O$**

Decomp by  $H_2O$

$3K_2O, 3ZrO_2, 7SO_3 + 9H_2O$  Insol in  $H_2O$   
 $Zr_2O_3(KSO_4)_2 + 8H_2O$  Ppt (Rosenheim, B 1905, 38 815)

**Potassium sulphate vanadate**

Very difficultly sol in  $H_2O$  Insol in alcohol (Berzelius)

**Potassium sulphate antimony trifluoride**

See Antimony trifluoride potassium sulphate

**Praseodymium sulphate, basic,  $(PrO)_2SO_4$**

Insol in  $H_2O$  (Matignon, C R 1902, 134 660)

Insol in  $H_2O$  Nearly insol in dil acids (Wöhler, B 1913, 46 1730)

**Praseodymium sulphate,  $Pr_2(SO_4)_3$**

Sol in  $H_2O$ , very hygroscopic 23.64 pts are sol in 100 pts  $H_2O$  at 0° and 17.7 pts at 20° (von Scheele, Z anorg 1898, 18 357-358)

+5 $H_2O$  Sol in  $H_2O$  (von Scheele, Z anorg 1898, 18 357)

Difficultly sol in  $H_2O$  (Kraus, Zeit Kryst 1901, 34 400)

1.50 pts  $Pr_2(SO_4)_3$  are sol in 100 pts  $H_2O$  at 85°, 1.45 pts at 90°, and 1.02 pts at 95° (Muthmann and Rolig, B 1898, 31 1729)

+8 $H_2O$  (Kraus, Zeit Kryst 1901, 34 406)

Sol in  $H_2O$  (von Scheele, Z anorg 1898, 18 357)

**Solubility in  $H_2O$  at t°**

t	Pts $Pr_2(SO_4)_3$
0	19.79
18	14.10
35	10.31
55	7.09
75	4.13

(Muthmann and Rolig, B 1898, 31 1727)

+15½ $H_2O$  Sol in  $H_2O$  (von Scheele Z anorg 1898, 18 357)

**Praseodymium hydrogen sulphate,  $Pr(SO_4)H$**

(Brauner, Z anorg 1904, 38 330)

Solubility in boiling conc  $H_2SO_4$  100 g of the solution contain 1.02 g of the acid sulphate (Matignon, C R 1902, 134 659)

**Radium sulphate**

Less sol in  $H_2O$  than corresponding Ba comp (Curie, Dissert 1903)

**Rhodium sulphate,  $Rh_2(SO_4)_3 + 12H_2O$**

Easily sol in  $H_2O$  (Berzelius)

Sl sol in, but not decomp by  $H_2O$  when not more than 16 pts  $H_2O$  are present to 1 pt salt. Decomp by hot  $H_2O$  to—

$Rh_2(SO_4)_3, Rh_2O_3$  Insol in  $H_2O$  (Leidich C R 107 234)

**Rhodium rubidium sulphate,  $Rh_2(SO_4)_3, Rb_2SO_4 + 24H_2O$**

Sol in  $H_2O$ , m-pt, 108-109° (Piccini Z anorg 1901, 37 65)

**Rhodium thallium sulphate,  $Rh_2(SO_4)_3, Tl_2SO_4 + 24H_2O$**

Very sol  $H_2O$  (Piccini, Z anorg 1901 37 69)

**Rhodium sodium sulphate,  $Rh_2Na_2(SO_4)_4$**

Insol in  $H_2SO_4$  or aqua regia (Seuber and Kobbe, B 23 2560)

**Rubidium sulphate,  $Rb_2SO_4$**

100 pts  $H_2O$  dissolve 42.4 pts at 10° (Bunsen)

100 cc  $H_2O$  at 17-18° dissolve 44.7 g  $Rb_2SO_4$  (Tutton, Chem Soc 1894, 65 632)

Sat  $Rb_2SO_4 + Aq$  contains at

3° 20°  
27.4 32.5%  $Rb_2SO_4$ ,

37° [97° 170°  
37.3 43.9 49.2%  $Rb_2SO_4$   
(Étard, A ch 1894, (7) 2 550)

Solubility of  $\text{Rb}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ 

$t^\circ$	g $\text{Rb}_2\text{SO}_4$ per 100 g		$t^\circ$	g $\text{Rb}_2\text{SO}_4$ per 100 g	
	$\text{H}_2\text{O}$	solution		$\text{H}_2\text{O}$	solution
0	36.4	27.3	60	67.4	40.3
10	42.6	29.9	70	71.4	41.7
20	48.2	32.5	80	75.0	42.9
30	53.5	34.9	90	78.7	44.0
40	58.5	36.9	100	81.8	45.0
50	63.1	38.7	102.4*	82.6	45.2

\* B-pt at 742.4 mm

(Berkeley, calc by Seidell, Solubilities, 2nd Ed., p 587)

Sp gr of  $\text{Rb}_2\text{SO}_4 + \text{Aq}$  sat at  $10^\circ = 1.2978$   
(Erdmann, Arch Pharm 1894, 232.16)G-equiv salt per l. at  $18^\circ = 0.501$  1.01Sp gr  $6^\circ/6^\circ$  1.05587 1.11047"  $18^\circ/18^\circ$  1.05496 1.10896"  $30^\circ/30^\circ$  1.05433 1.10810G-equiv salt per l at  $18^\circ = 2.043$  3.168Sp gr  $6^\circ/6^\circ$  1.21888 1.33276"  $18^\circ/18^\circ$  1.21613 1.32912"  $30^\circ/30^\circ$  1.21443 1.32750

(Clausen, W Ann 1914, (4) 44.1071)

10 ccm of sat  $\text{Rb}_2\text{SO}_4 + \text{absolute } \text{H}_2\text{SO}_4$   
contain approx 5.881 g  $\text{Rb}_2\text{SO}_4$  (Bergius,  
Z phys Ch 1910, 72.355)Insol in methyl acetate (Naumann, B  
1909, 42.3790), acetone (Naumann, B 1904,  
37.4329, Erdmann, C C 1899, II 1014)**Rubidium pyrosulphate,  $\text{Rb}_2\text{S}_2\text{O}_7$** Decomp by  $\text{H}_2\text{O}$ **Rubidium octosulphate,  $\text{Rb}_2\text{S}_8\text{O}_{25}$** Decomp by  $\text{H}_2\text{O}$  (Weber, B 17.2497)**Rubidium hydrogen sulphate,  $\text{RbHSO}_4$** Sol in  $\text{H}_2\text{O}$ **Rubidium tin (stannic) sulphate,  $\text{Rb}_2\text{Sn}(\text{SO}_4)_3$** Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{HCl}$  (Wein-  
land, Z anorg 1907, 54.250)**Rubidium thallic sulphate,  $\text{RbTl}(\text{SO}_4)_2$** 

(Marshall, C C 1902, II 1089)

+  $4\text{H}_2\text{O}$  (Fortini, Gazz ch it 1905, 35  
(2) 455)**Rubidium thorium sulphate,  $\text{Rb}_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2 + 2\text{H}_2\text{O}$** Sl sol in  $\text{H}_2\text{O}$  (Manuelli, Gazz ch it  
1903, 32 (2) 523)**Rubidium titanium sulphate,  $\text{Rb}_2\text{SO}_4 \cdot \text{Ti}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  acidified with  $\text{H}_2\text{SO}_4$ . De-  
comp in neutral aq solution (Piccini, Z  
anorg 1898, 17.359)Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl}$  Insol in  
 $\text{H}_2\text{SO}_4$  Decomp by boiling with conc  
 $\text{H}_2\text{SO}_4$  (Stahler, B 1905, 38.2623)**Rubidium uranyl sulphate,  $\text{Rb}_2(\text{UO}_2)(\text{SO}_4)_2 + 2\text{H}_2\text{O}$** Somewhat less sol in  $\text{H}_2\text{O}$  than K salt  
(Rimbach, B 1904, 37.479)**Rubidium vanadium sulphate,  $\text{Rb}_2\text{V}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$** 0.177 gram mols of anhydrous salt are  
sol in 1 l  $\text{H}_2\text{O}$  (Locke, Am Ch J 1901,  
26.175)Insol in  $\text{H}_2\text{O}$ Insol in  $\text{H}_2\text{SO}_4$  Decomp by boiling with  
conc  $\text{H}_2\text{SO}_4$ Sol in  $\text{HCl}$  (Stahler, B 1905, 38.3980)100 pts  $\text{H}_2\text{O}$  dissolve 2.56 pts salt at  $10^\circ$ Sp gr of solution at  $4^\circ/20^\circ = 1.915$  (Pic-  
cini, Z anorg 1897, 13.446)**Rubidium zinc sulphate,  $\text{Rb}_2\text{SO}_4 \cdot \text{ZnSO}_4 + 6\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  (Bunsen and Kopp, Pogg  
113.337)1 l  $\text{H}_2\text{O}$  dissolves 101 g anhydrous salt  
at  $25^\circ$  (Locke, Am Ch J 1902, 27.459)**Rubidium zirconium sulphate,  $\text{Zr}_2\text{O}_3 \cdot (\text{RbSO}_4)_2 + 15\text{H}_2\text{O}$** 

Ppt (Rosenheim, B 1905, 38.815)

**Ruthenic sulphate,  $\text{Ru}(\text{SO}_4)_2$** Deliquescent, and easily sol in  $\text{H}_2\text{O}$   
(Claus, A 59.246)**Samarium sulphate, basic,  $(\text{SmO})_2\text{SO}_4$** Insol in  $\text{H}_2\text{O}$  and in cold dil  $\text{H}_2\text{SO}_4$   
(Matignon, C R 1905, 141.1231)**Samarium sulphate,  $\text{Sm}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$** Difficultly sol in  $\text{H}_2\text{O}$ Much less sol than  $\text{D}_{12}(\text{SO}_4)_3 + 8\text{H}_2\text{O}$   
(Cleve)2.05 pts anhydrous salt are sol in 100 pts  
 $\text{H}_2\text{O}$  at  $25^\circ$  (Keyes and James, J Am  
Chem Soc 1914, 36.635)100 g  $\text{Sm}_2(\text{SO}_4)_3 + \text{Aq}$  sat at  $25^\circ$  contain  
3.426 g anhyd  $\text{Sm}_2(\text{SO}_4)_3$  (Wirth, Z anorg  
1912, 76.174)Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ n = equiv g of  $\text{H}_2\text{SO}_4$  in 1 l of solventc = g  $\text{Sm}_2\text{O}_3$  in 100 g of solutionc<sub>1</sub> = g  $\text{Sm}_2(\text{SO}_4)_3$  in 100 g of solution

n	c	c <sub>1</sub>	n	c	c <sub>1</sub>
0	2.029	3.426	2.16	1.43	2.416
0.1	2.038	3.441	6.175	0.416	0.7025
0.505	1.985	3.352	12.6	0.0656	0.1107
1.1	1.821	3.075			

(Wirth, Z anorg 1912, 76.174)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

Solid phase	
	$\text{Sm}_2(\text{SO}_4)_3$
J 7 / 4 9 5 8 7 8 8 2 2 2 3 2 5 46 3 40 3 77 5 77 2 77 3 76 8	$\text{Sm}_2(\text{SO}_4)_3, (\text{NH}_4)_2\text{SO}_4, 7\text{H}_2\text{O}$
	$(\text{NH}_4)_2\text{SO}_4$

and James, J Am Chem Soc 1914,  
36 637)Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

Pts $\text{Na}_2\text{SO}_4$ per 100 pts $\text{H}_2\text{O}$	Pts $\text{Sm}_2(\text{SO}_4)_3$ per 100 pts $\text{H}_2\text{O}$	Solid phase
0 1	2 0	$\text{Sm}_2(\text{SO}_4)_3$
0 5	0 11	"
1 9	0 03	$2\text{Sm}_2(\text{SO}_4)_3, 3\text{Na}_2\text{SO}_4 + 6\text{H}_2\text{O}$
6 44	0 016	"
7 00	0 008	"
9 02	0 016	"
10 51	0 012	"
11 48	0 012	"
13 58	0 010	"
14 71	0 010	"
14 47	0 009	"
20 02	0 012	"
23 42	0 012	"
23 68	0 018	"
25 93	0 015	"
27 40	0 011	"

These results seem to indicate that there is only one double salt formed by the union of  $\text{Sm}_2(\text{SO}_4)_3$  with  $\text{Na}_2\text{SO}_4$ . Formula of this salt is  $2\text{Sm}_2(\text{SO}_4)_3, 3\text{Na}_2\text{SO}_4, 6\text{H}_2\text{O}$

(Keyes and James, J Am Chem Soc 1914,  
36 635)**Samarium hydrogen sulphate,  $\text{Sm}(\text{HSO}_4)_3$** Sl sol in  $\text{H}_2\text{O}$  (Matignon, C R 1905,  
141 1230)

Ppt (Brauner, Z anorg 1904, 38 331)

**Samarium sodium sulphate,  $\text{Sm}_2(\text{SO}_4)_3$ ,** $\text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ Sl sol in sat  $\text{Na}_2\text{SO}_4 + \text{Aq}$  (Cleve, Bull  
Soc (2) 43 166) $2\text{Sm}_2(\text{SO}_4)_3, 3\text{Na}_2\text{SO}_4 + 6\text{H}_2\text{O}$  Only double  
salt formed at  $25^\circ$  (Keyes and James, J  
Am Chem Soc 1914, 36 365)**Scandium sulphate, basic,  $\text{Sc}_2\text{O}(\text{SO}_4)_2$** 

(Crookes, Roy Soc Proc 1908, 80 A, 518)

**Scandium sulphate,  $\text{Sc}_2(\text{SO}_4)_3$** *Anhydrous* Easily sol in  $\text{H}_2\text{O}$  $+2\text{H}_2\text{O}$  $+5\text{H}_2\text{O}$ , 54.61 g of pentahydrate are sol  
in 100 cc  $\text{H}_2\text{O}$  at  $25^\circ$  (Wirth, Z anorg 1914,  
87 10)Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

$\text{H}_2\text{SO}_4 + \text{Aq}$	g $\text{Sc}_2(\text{SO}_4)_3$ in 100 g of the solution
0 00	28 52
0 5-n	29 29
1 0-n	19 87
4 86-n	8 363
9 73-n	1 315

In 22.35-n  $\text{H}_2\text{SO}_4$  the solid phase is  
 $\text{Sc}_2(\text{SO}_4)_3, 3\text{H}_2\text{SO}_4$  and 100 g sat solution  
contain 0.484 g  $\text{Sc}_2(\text{SO}_4)_3$ 

(Wirth, Z anorg 1914, 87 10)

 $+6\text{H}_2\text{O}$  Extremely sol in  $\text{H}_2\text{O}$ , but not  
deliquescent**Scandium hydrogen sulphate,  $\text{Sc}_2(\text{SO}_4)_3 +$   
 $3\text{H}_2\text{O}$** 

(Wirth)

**Scandium sodium sulphate,  $\text{Sc}_2(\text{SO}_4)_3$ ,** $3\text{Na}_2\text{SO}_4 + 12\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  (Cleve) $+10\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  and in excess of  
 $\text{Na}_2\text{SO}_4 + \text{Aq}$  (Meyers, Z anorg 1914, 86  
279)**Silver (argentoargentic) sulphate,  $\text{Ag}_2\text{SO}_4$ ,** $\text{Ag}_2\text{SO}_4 + \text{H}_2\text{O}$ Gradually sol in conc, but not attacked  
by dil.  $\text{HNO}_3 + \text{Aq}$  Not attacked by hot  
conc  $\text{H}_2\text{SO}_4$  (Lea, Sill Am J 144 322)**Silver sulphate,  $\text{Ag}_2\text{SO}_4$** Sol in 200 pts cold and less than 100 pts boiling  
 $\text{H}_2\text{O}$  (Wittstein)Sol in 88 pts boiling  $\text{H}_2\text{O}$  in 87.25  
pts boiling  $\text{H}_2\text{O}$  (Wenzel) in 11 at  $100^\circ$   
(Kremers)100 pts  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 11.0 pts  $\text{Ag}_2\text{SO}_4$   
(Ure & Di et.)Sol in 160 pts  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abl)11  $\text{H}_2\text{O}$  dissolves  $2.57 \times 10^{-2}$  g-mol  $\text{Ag}_2\text{SO}_4$   
at  $25^\circ$  (Drucker, Z anorg 1901, 28 362)11  $\text{H}_2\text{O}$  dissolves 7.707 g  $\text{Ag}_2\text{SO}_4$  at  $17^\circ$   
(Euler, Z phys Ch 1904, 49 314)11  $\text{H}_2\text{O}$  dissolves 0.0267 mol  $\text{Ag}_2\text{SO}_4$  at  
 $25^\circ$  (Rothmund, Z phys Ch 1909, 69 539)11  $\text{H}_2\text{O}$  dissolves 8.35 g  $\text{Ag}_2\text{SO}_4$  at  $25^\circ$

(Hill and Simmons, Z phys Ch 1909, 67 603)

1 l H<sub>2</sub>O dissolves 8 344 g Ag<sub>2</sub>SO<sub>4</sub> at 25°  
Sp gr of solution = 1 0052 (Harkins, J Am Chem Soc 1911, 33 1812)

### Solubility in H<sub>2</sub>O at t°

t°	Pts Ag <sub>2</sub> SO <sub>4</sub> in 100 pts of the solution
14 5	0 730
33	0 909
51 5	1 062
75	1 237
100	1 393

(Barre, A ch 1911, (8) 24 211)

More sol in H<sub>2</sub>SO<sub>4</sub>+Aq than in pure H<sub>2</sub>O  
Still more sol in HNO<sub>3</sub>+Aq and still more in conc H<sub>2</sub>SO<sub>4</sub>, from which it is pptd by H<sub>2</sub>O (Schnaubart)

### Solubility in H<sub>2</sub>SO<sub>4</sub>+Aq at 25°

$\frac{1}{2}$ H <sub>2</sub> SO <sub>4</sub> +Aq Normality	Solubility of Ag <sub>2</sub> SO <sub>4</sub> g mol per litre
0 02	2 60×10 <sup>-2</sup>
0 04	2 64×10 <sup>-2</sup>
0 10	2 71×10 <sup>-2</sup>
0 20	2 75×10 <sup>-2</sup>

(Drucker, Z anorg 1901, 28 362)

Solubility of Ag<sub>2</sub>SO<sub>4</sub> in acids+Aq at 25°

C = concentration of acid in acid+Aq in milliequivalents per l

S = Solubility of Ag<sub>2</sub>SO<sub>4</sub> in acid+Aq in milliequivalents per l

Acid	C	S
HNO <sub>3</sub>	0 0	53 98
	15 89	59 86
	31 78	65 32
	63 57	75 90
H <sub>2</sub> SO <sub>4</sub>	0 0	53 98
	29 02	54 88
	58 02	55 64
	105 26	56 82

(Swan, J Am Chem Soc 1911, 33 1814)

### Solubility in HNO<sub>3</sub>+Aq at 25°

Normality HNO <sub>3</sub>	Sp gr of the solution	Ag <sub>2</sub> SO <sub>4</sub> dissolved per l
0 000	1 0054	8 350
1 0046	1 061	34 086
2 0452	1 1069	49 010
4 017	1 1871	71 166
4 209	1 1956	73 212
5 564	1 2456	84 609
8 487	1 3326	94 671
10 034	1 3676	90 806

(Hill and Simmons, Z phys Ch 1909, 67 603)

Sol in NH<sub>4</sub>OH, and (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq

100 pts H<sub>2</sub>O dissolve 0 58 pt at 18° 100 pts (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq (15%) dissolve 0 85 pt Ag<sub>2</sub>SO<sub>4</sub> at 18° Other sulphates have little effect (Eder, J pr (2) 17 44)

Determinations of the solubility of Ag<sub>2</sub>SO<sub>4</sub> in (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> at temp between 16 5° and 100° show that no double salt is formed by these two sulphates (Etard, A ch 1911, (8) 24 221)

### Solubility of Ag<sub>2</sub>SO<sub>4</sub> in (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq

G per 100 g H<sub>2</sub>O

(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	Ag <sub>2</sub> SO <sub>4</sub>	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	Ag <sub>2</sub> SO <sub>4</sub>
Temp = 33°		Temp = 51°	
8 85	1 101	8 90	1 362
15 90	1 331	16 27	1 680
22 22	1 500	22 43	1 887
27 25	1 585	32 10	2 061
30 80	1 619	35 38	2 095
35 88	1 627	39 03	2 082
39 46	1 600	42 37	2 055
43 22	1 557	45 05	2 026
Temp = 75°		Temp = 100°	
8 80	1 758	9 23	2 221
15 23	2 155	15 00	2 626
22 30	2 490	22 01	3 075
28 25	2 734	27 00	3 325
32 00	2 823	34 90	3 663
35 82	2 889	38 70	3 772
41 16	2 929	44 15	3 854
46 46	2 902	47 63	3 867

(Barre, A ch 1911, (8) 24 149, 202, 210)

### Solubility of Ag<sub>2</sub>SO<sub>4</sub> in K<sub>2</sub>SO<sub>4</sub>+Aq

G per 100 g H<sub>2</sub>O

K <sub>2</sub> SO <sub>4</sub>	Ag <sub>2</sub> SO <sub>4</sub>	K <sub>2</sub> SO <sub>4</sub>	Ag <sub>2</sub> SO <sub>4</sub>
Temp = 33°		Temp = 51°	
3 22	0 863	3 20	1 023
5 62	0 940	5 61	1 127
8 37	1 046	8 40	1 247
10 41	1 117	10 55	1 340
11 80	1 177	13 16	1 450
		14 37	1 524
Temp = 75°		Temp = 100	
3 12	1 273	3 23	1 488
5 73	1 406	5 60	1 675
8 43	1 554	8 45	1 890
10 55	1 665	11 30	2 115
13 17	1 806	15 07	2 410
17 06	2 021	18 58	2 677

(Barre, A ch 1911, (8) 24 149, 202, 210)



Solubility in  $K_2SO_4 + Aq$  at  $25^\circ$ 

$\frac{1}{2}K_2SO_4 + Aq$ Normality	Solubility of $Ag_2SO_4$ g mol per litre
0.02	$2.46 \times 10^{-2}$
0.04	$2.36 \times 10^{-2}$
0.10	$2.31 \times 10^{-2}$
0.20	$2.32 \times 10^{-2}$

(Drucker, Z anorg 1901, 28 362)

Solubility in  $Na_2SO_4 + Aq$  at  $t^\circ$ 

$t^\circ$	$Ag_2SO_4$ in 100 pts $H_2O$	$Na_2SO_4$ in 100 pts $H_2O$
14.5	0.741 0.904 1.003	5.278 10.103 13.045
33	0.972 1.150 1.320 1.448 1.548 1.570 1.549 1.462 1.199 0.932	5.345 10.056 15.185 20.093 25.412 29.556 34.732 39.447 44.693 46.976
51	1.173 1.377 1.572 1.705 1.787 1.802 1.727 1.540 1.188 0.882	5.407 10.116 15.146 20.247 25.196 29.230 34.625 39.302 42.914 44.464
75	1.458 1.697 1.934 2.075 2.161 2.138 1.910 1.603 1.156	5.368 9.813 15.260 19.978 25.556 29.662 35.278 38.944 41.365
100	1.651 2.012 2.312 2.351 2.260 2.012 1.687 1.158	5.336 10.153 15.532 25.451 29.714 34.718 38.635 40.160

Up to  $33^\circ$ , the solubility of  $Ag_2SO_4$  in  $Na_2SO_4 + Aq$  increases with the concentration of  $Na_2SO_4$ , above  $33^\circ$  the solubility of  $Ag_2SO_4$  rises to a maximum at a certain concentration of  $Na_2SO_4$  dependent on the temp. The

solubility curves for various temp all end at a concentration of 40%  $Na_2SO_4$ , that is, the mixed crystals formed at this concentration are equally sol at all temp

(Barre, C R 1910, 150 1323)

Solubility in  $Na_2SO_4 + Aq$  at  $t^\circ$ 

$t^\circ$	100 pts $H_2O$ dissolve	
	$Na_2SO_4$	$Ag_2SO_4$
18	0.0 0.25 0.51 0.74 1.00 1.48 2.01 2.50 3.04 4.00 4.99 10.10 13.04	0.766 0.712 0.682 0.675 0.665 0.670 0.673 0.689 0.703 0.736 0.768 0.932 1.028
33	0.0 0.25 0.51 0.75 0.98 1.50 2.01 2.48 3.00	0.917 0.861 0.835 0.825 0.816 0.820 0.832 0.849 0.867
51	0.00 0.25 0.49 0.68 1.02 1.51 1.90 2.46 2.92 3.95	1.081 1.032 1.010 0.000 0.995 1.002 1.017 1.034 1.053 1.103
75	0.00 0.20 0.47 0.80 0.98 1.52 1.96 2.50 2.98 4.08	1.267 1.215 1.208 1.206 1.210 1.222 1.238 1.269 1.296 1.366
100	0.00 0.50 1.01 1.44 1.94 3.02	1.404 1.341 1.363 1.382 1.418 1.494

(Barre, A ch 1911, (8) 24 215)

## Solubility in salts + Aq at 25°

C = concentration of salt in salt + Aq in milliequivalents per l

$d_1 = \text{sp gr } 25^\circ/4^\circ \text{ of salt + Aq}$

S = solubility of  $\text{Ag}_2\text{SO}_4$  in salt + Aq expressed in milliequivalents per l

$d_2 = \text{sp gr } 25^\circ/4^\circ \text{ of } \text{Ag}_2\text{SO}_4 + \text{salt} + \text{Aq}$

Salt	C	$d_1$	S	$d_2$
none			53 52	
$\text{KNO}_3$	24 914 49 774 99 870	0 9986 1 0002 1 0034	57 70 61 13 67 93	1 0072 1 0092 1 0034
$\text{Mg}(\text{NO}_3)_2$	24 764 49 595 99 460	0 9985 0 9999 1 0026	59 44 64 32 72 70	1 0073 1 0094 1 0133
$\text{AgNO}_3$	24 961 49 86 99 61	1 0007 1 0044 1 0112	39 09 28 45 16 96	1 0065 1 0084 1 0137
$\text{K}_2\text{SO}_4$	25 024 50 044 100 0 200 03	0 9989 1 0006 1 0041 1 0110	50 66 49 35 48 04 48 30	1 0064 1 0079 1 0112 1 0180
$\text{MgSO}_4$	20 22 50 069 100 04 200 05	0 9984 1 0002 1 0032 1 0092	52 21 50 93 49 95 49 60	1 0061 1 0079 1 0105 1 0164

(Harkins, J Am Chem Soc 1911, **33** 1813)

Solubility of  $\text{Ag}_2\text{SO}_4$  in salts + Aq at 25°

C = concentration of salt in salt + Aq in milliequivalents per l

S = solubility of  $\text{Ag}_2\text{SO}_4$  in salt + Aq in milliequivalents per l

Salt	C	S
$\text{KHSO}_4$	0 0 52 64 105 26	53 98 52 18 51 76
$\text{K}_2\text{SO}_4$	0 0 27 18 54 34	53 98 50 90 49 30

(Swan, J Am Chem Soc 1911, **33** 1814)

Decomp by alkali thiosulphates + Aq (Herschell)

100 ccm  $\text{Ag}_2\text{SO}_4 + \text{Ag}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  sat at 17° contain 3 95 g  $\text{Ag}_2\text{SO}_4$  and 8 30 g  $\text{Ag}_2\text{C}_2\text{H}_3\text{O}_2$  and solution has sp gr = 1 0094 (Euler, C C 1904, I 1316)

Insol in liquid  $\text{NH}_3$  (Franklin, Am. Ch J 1898 **20** 829)

## Solubility in organic compds + Aq at 25°

Solvent	Mol $\text{Ag}_2\text{SO}_4$ sol in 1 litre
Water	0 0267
0 5-N Methyl alcohol	0 0249
" Ethyl alcohol	0 0228
" Propyl alcohol	0 0218
" Tert amyl alcohol	0 0204
" Acetone	0 0220
" Ether	0 0206
" Formaldehyde	0 0227
" Glycol	0 0259
" Glycerine	0 0263
" Mannitol	0 0297
" Glucose	0 0283
" Sucrose	0 0270
" Urea	0 0303
" Dimethylpyrone	0 0216
" Urethane	0 0227
" Formamide	0 0270
" Acetamide	0 0253
" Acetonitrile	0 0525
" Glycocoll	0 0433
" Acetic acid	0 0252
" Phenol	0 0379
" Chloral	0 0233
" Methylal	0 0205
" Methyl acetate	0 0212

(Rothmund, Z phys Ch 1909, **69** 539)

Insol in methyl acetate (Bezold, Dissert 1906, Naumann, B 1909, **42** 3790), ethyl acetate (Naumann, B 1904, **37** 3601), liquid methylamine (Franklin, J Am Chem Soc 1906, **28** 1420), acetone (Naumann, B 1904, **37** 4329, Eidmann, C C 1899, II 1014)

Very sol in a hot mixture of  $\text{H}_2\text{SO}_4$  and monobrombenzene, less sol in cold (Couper, A ch (3) **52** 311)

Silver hydrogen sulphate,  $\text{AgHSO}_4$ 

Decomp by  $\text{H}_2\text{O}$ , sol in  $\text{H}_2\text{SO}_4$  (Stas)  $\text{Ag}_2\text{O}, 3\text{H}_2\text{O}, 4\text{SO}_3 + 2\text{H}_2\text{O} = \text{Ag}_2\text{H}_4(\text{SO}_4)_2 + \text{H}_2\text{O}$  As above (Schultz, Pogg **133** 137)  $2\text{Ag}_2\text{O}, 3\text{H}_2\text{O}, 5\text{SO}_3 + 2\text{H}_2\text{O} = \text{Ag}_4\text{H}_4(\text{SO}_4)_5 + 2\text{H}_2\text{O}$  As above (Schultz)

Silver pyrosulphate,  $\text{Ag}_2\text{S}_2\text{O}_7$ 

Decomp by  $\text{H}_2\text{O}$  (Weber, B **17** 2497)

Silver thallic sulphate,  $\text{AgTl}(\text{SO}_4)_2$ 

(Lepsius, Chem Ztg **1890** 1327)

Silver tin (stannic) sulphate,  $\text{Ag}_2\text{Sn}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ 

Ppt Decomp by  $\text{H}_2\text{O}$  Sol in HCl (Weinland, Z anorg 1907, **54** 250)

Silver sulphate acetylde,  $\text{Ag}_2\text{SO}_4, 2\text{Ag}_2\text{C}_2$ 

(Plimpton, Proc Chem Soc 1892, **8** 109)

**Silver sulphate ammonia,  $\text{Ag}_2\text{SO}_4 \cdot 2\text{NH}_3$** 

Completely sol in  $\text{H}_2\text{O}$  (Rose, Pogg 20 153)

$\text{Ag}_2\text{SO}_4 \cdot 4\text{NH}_3$  Easily sol in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp (Mitscherlich)

**Silver sulphate mercuric oxide,  $\text{Ag}_2\text{SO}_4 \cdot \text{HgO}$** 

Insol in  $\text{H}_2\text{O}$ , but decomp even in the cold  
Sol in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  (Finci, Gazz ch it 1911, 41 (2) 548)

**Silver sulphate sulphide,  $\text{Ag}_2\text{SO}_4 \cdot \text{Ag}_2\text{S}$** 

Decomp by hot  $\text{H}_2\text{O}$  or cold  $\text{HCl} + \text{Aq}$   
Sol in boiling  $\text{HNO}_3 + \text{Aq}$  (Poleck and Thümmel, B 16 2435)

**Sodium sulphate,  $\text{Na}_2\text{SO}_4$** **Anhydrous**

1 pt  $\text{Na}_2\text{SO}_4$  is sol in 7 367 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach)  
in 5 52 pts  $\text{H}_2\text{O}$  at  $13.3^\circ$  (Foggendorf) in 10 pts  $\text{H}_2\text{O}$  at  $13^\circ$  and in 3 pts  $\text{H}_2\text{O}$  at  $62.2^\circ$  (Wenzel)

100 pts  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 5 155 pts  $\text{Na}_2\text{SO}_4$  (Pfaff A 99 226) at  $100.6^\circ$  dissolve 45 985 pts  $\text{Na}_2\text{SO}_4$  (Griffiths)

See below for further data

+7 $\text{H}_2\text{O}$  Efflorescent Insol in alcohol

See below for further data

+10 $\text{H}_2\text{O}$

$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol in  $\text{H}_2\text{O}$  with absorption of heat, 20 pts  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  mixed with 100 pts  $\text{H}_2\text{O}$  at  $12.5^\circ$  lower the temperature  $6.8^\circ$  (Rüdorff, B 2 68)

Sol in 2 33 pts  $\text{H}_2\text{O}$  at  $19^\circ$  or 100 pts  $\text{H}_2\text{O}$  at  $19^\circ$  dissolve 42 3 pts  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  (Schiff A 109 326)

100 pts  $\text{H}_2\text{O}$  dissolve a pts  $\text{Na}_2\text{SO}_4$  and b pts  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	a	b	$t^\circ$	a	b
0	5 02	12 17	33 88	50 04	312 11
11 67	10 12	26 38	40 15	48 78	291 44
13 30	11 74	31 33	45 04	47 81	276 91
17 91	16 73	48 28	50 40	46 82	262 35
25 05	28 11	99 48	59 79	45 42	
28 76	37 35	161 53	70 61	44 35	
30 75	43 05	215 77	84 42	42 96	
31 84	47 37	270 22	103 17	42 65	
32 73	50 65	322 12			

(Gay Lussac A ch (2) 11 312)

Maximum solubility is at  $33^\circ$  from experiment and theoretical considerations. At this temp  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is converted into  $\text{Na}_2\text{SO}_4$  (Kopp A 34 271)

100 pts  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve pts  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$

$t^\circ$	Pts $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	$t^\circ$	Pts $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	$t^\circ$	Pts $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
2 5	11 39	37 50	294 04	75	241 68
7 5	16 38	43 75	261 04	81 25	217 20
12 5	29 03	50	285 06	87 50	220 65
18 75	70 78	56 25	248 11	93 75	225 46
25	143 38	62 5	222 22	100	241 69
31 25	479 97	68 75	242 88		

(Brandes and Furnhaber 1824)

1 pt  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol in 6 1 pts  $\text{H}_2\text{O}$  at  $7.5^\circ$  3 44 pts at  $12.5^\circ$  2 41 pts at  $18.75^\circ$  and 1 724 pts at  $20^\circ$  (Karsten.)

1 pt  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol in 2 86 pts cold and 0 8 pt boiling  $\text{H}_2\text{O}$  (Bergmann) in 3 pts cold and 0 5 pt boiling  $\text{H}_2\text{O}$  (Wittstein) in 4 pts cold and 1 pt boiling  $\text{H}_2\text{O}$  (Fourcroy) in 3 pts  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abl)

100 pts  $\text{H}_2\text{O}$  dissolve 12 494 pts  $\text{Na}_2\text{SO}_4$  or 35 492 pts  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  at  $15^\circ$  and sp gr of solution = 1 10847 (Michel and Krafft A ch (3) 41 478)

100 pts  $\text{H}_2\text{O}$  dissolve 39 4 pts cryst salt at  $15.5^\circ$  80 pts cryst salt at  $100^\circ$  (Ure's Dict)

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{Na}_2\text{SO}_4$  at  $t^\circ$

$t^\circ$	Pts $\text{Na}_2\text{SO}_4$	$t^\circ$	Pts $\text{Na}_2\text{SO}_4$
0	4 53	24 1	25 92
17 9	16 28	33	50 81

(Diacon, J B 1866 61)

Solubility of  $\text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at various pressures and temp Pts  $\text{Na}_2\text{SO}_4$  contained in 100 pts sat  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at A pressure in atmos and  $t^\circ$  are given

A	$0^\circ$	$15^\circ$	$15.4^\circ$	A	$15^\circ$
1	4 40	11 32	11 4	30	10 05
20	4 53	10 78	10 74	40	10 33

(Möller, Pogg 117 386)

The solubility of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  increases with the temperature from  $0$  to  $34^\circ$ . At  $34^\circ$  and above, it is converted into the anhydrous salt, the solubility of which is least at  $103.17^\circ$ , which is the boiling point of the saturated solution, and increases by cooling from that temp down to  $18-17^\circ$ . Below the latter temperature the anhydrous salt cannot exist in the presence of  $\text{H}_2\text{O}$ , but is converted into  $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$ , or  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ . The solubility of  $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$  increases with the temperature from  $0-26^\circ$ , and at  $27^\circ$  it is converted into the anhydrous salt.

Thus there are two different rates of solubility for  $\text{Na}_2\text{SO}_4$  for temperatures from  $0-18^\circ$ , three different rates from  $18-26^\circ$ , two from  $26-34^\circ$ , and only one above  $34^\circ$ .

1 By heating  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  to fusion and raising the heat until the liquid boils, placing in a closed vessel and cooling, the greater part of the anhydrous salt, which separates out on heating, redissolves on cooling, and the amount increases as the temp falls until  $18^\circ$  is reached. Below  $18^\circ$   $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$  is formed. Saturated  $\text{Na}_2\text{SO}_4 + \text{Aq}$  thus obtained contains for 100 pts HO at

$18^\circ$   $20^\circ$   $25^\circ$   $26^\circ$   
53 25 52 76 51 53 51 31 pts  $\text{Na}_2\text{SO}_4$ ,

$30^\circ$   $33^\circ$   $34^\circ$   $36^\circ$   
50 37 49 71 49 53 49 27 pts  $\text{Na}_2\text{SO}_4$

2 By allowing the boiling saturated solution free from undissolved salt to cool to  $0^\circ$

with exclusion of air until crystals of  $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$  are formed, then removing the greater part of the mother liquor with a warm pipette, and warming the rest of the mother liquor with the excess of crystals, the crystals dissolve in increasing quantity between  $0^\circ$  and  $26-27^\circ$ , so that at  $27^\circ$  the solution contains 56 pts  $\text{Na}_2\text{SO}_4$  to 100 pts  $\text{H}_2\text{O}$ . The remaining undissolved crystals of  $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$  begin to melt very slowly at  $27^\circ$ , more quickly at higher temperatures, and cause the separation of anhydrous crusts, and thus the strength of the solution is gradually lowered to the normal. Saturated solutions prepared in this way contain for 100 pts  $\text{H}_2\text{O}$  at

	$0^\circ$	$10^\circ$	$13^\circ$
	19 62	30 49	34 27 pts $\text{Na}_2\text{SO}_4$ ,
or 44 89	78 9	92 9 pts $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$	
	$15^\circ$	$16^\circ$	$17^\circ$
	37 43	38 73	39 99 pts $\text{Na}_2\text{SO}_4$ ,
or 105 8	117 4	111 0 pts $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$ ,	
	$18^\circ$	$19^\circ$	$20^\circ$
	41 63	43 35	44 73 pts $\text{Na}_2\text{SO}_4$ ,
or 124 6	133 0	140 0 pts $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$ ,	
	$25^\circ$	$26^\circ$	
	52 94	54 97 pts $\text{Na}_2\text{SO}_4$	
or 188 5	202 6 pts $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$		

3 Solutions obtained by shaking  $\text{H}_2\text{O}$  with  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  contain for 100 pts  $\text{H}_2\text{O}$  at

	$0^\circ$	$10^\circ$	$15^\circ$
	5 02	9 00	13 20 pts $\text{Na}_2\text{SO}_4$ ,
or 12 16	23 04	35 96 pts $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ,	
	$18^\circ$	$20^\circ$	$25^\circ$
	16 80	19 40	28 00 pts $\text{Na}_2\text{SO}_4$ ,
or 48 41	58 85	98 48 pts $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ,	
	$26^\circ$	$30^\circ$	
	30 00	40 00 pts $\text{Na}_2\text{SO}_4$ ,	
or 109 81	184 1 pts $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ,		
	$33^\circ$	$34^\circ$	
	50 76	55 0 pts $\text{Na}_2\text{SO}_4$	
or 323 1	412 2 pts $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$		

At  $34^\circ$ ,  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  begins to melt in its crystal  $\text{H}_2\text{O}$ . As long as there is a considerable quantity of unchanged crystals present, the solution contains 55 pts  $\text{Na}_2\text{SO}_4$  for 100 pts  $\text{H}_2\text{O}$ , but as the hydrous salt decreases in amount and becomes converted into the anhydrous salt, the solution becomes weaker and contains only 49.53 pts  $\text{Na}_2\text{SO}_4$  for 100 pts  $\text{H}_2\text{O}$  after warming for 6 or 8 hours at  $34^\circ$ . In the same way temporary solutions can be obtained at  $36-40^\circ$  with 55-56 pts  $\text{Na}_2\text{SO}_4$  to 100 pts  $\text{H}_2\text{O}$ , but this amount sinks to the normal even more quickly than at  $34^\circ$ .

$\text{Na}_2\text{SO}_4$  dehydrated at  $100-150^\circ$ , after the addition of  $1\frac{1}{2}-1\frac{1}{2}$  pts  $\text{H}_2\text{O}$ , gives a solution between  $0^\circ$  and  $32^\circ$  of the same strength as  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ , but at  $34^\circ$  a solution with

55 pts  $\text{Na}_2\text{SO}_4$  to 100 pts  $\text{H}_2\text{O}$  cannot be obtained, but one with 49.53 pts is formed (Lowel, A. ch (3) 49.32)

4 Solubility of anhydrous salt Above  $34^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolve at

$35^\circ$	$40^\circ$	$45^\circ$	$50^\circ$	$55^\circ$	
50 2	48 8	47 7	46 7	45 9 pts	$\text{Na}_2\text{SO}_4$ ,
$60^\circ$	$65^\circ$	$70^\circ$	$75^\circ$	$80^\circ$	
45 3	44 8	44 4	44 0	43 7 pts	$\text{Na}_2\text{SO}_4$ ,
$85^\circ$	$90^\circ$	$95^\circ$	$100^\circ$	$103 5^\circ$	
43 3	43 1	42 8	42 5	42 2 pts.	$\text{Na}_2\text{SO}_4$

(Mulder)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{Na}_2\text{SO}_4$	$t^\circ$	Pts $\text{Na}_2\text{SO}_4$	$t^\circ$	Pts $\text{Na}_2\text{SO}_4$
0	4 8	35	50 2	70	44 4
1	5 1	36	49 9	71	44 3
2	5 4	37	49 6	72	44 2
3	5 7	38	49 3	73	44 2
4	6 0	39	49 1	74	44 1
5	6 4	40	48 8	75	44 0
6	6 8	41	48 5	76	44 0
7	7 3	42	48 3	77	43 9
8	7 8	43	48 1	78	43 8
9	8 4	44	47 9	79	43 7
10	9 0	45	47 7	80	43 7
11	9 7	46	47 5	81	43 6
12	10 5	47	47 3	82	43 5
13	11 4	48	47 1	83	43 5
14	12 4	49	46 9	84	43 4
15	13 4	50	46 7	85	43 3
16	14 5	51	46 6	86	43 3
17	15 7	52	46 4	87	43 2
18	16 9	53	46 2	88	43 2
19	18 2	54	46 1	89	43 1
20	19 5	55	45 9	90	43 1
21	20 9	56	45 8	91	43 0
22	22 5	57	45 7	92	43 0
23	24 1	58	45 6	93	42 9
24	25 9	59	45 4	94	42 9
25	27 9	60	45 3	95	42 8
26	30 1	61	45 2	96	42 7
27	32 4	62	45 1	97	42 6
28	35 0	63	45 0	98	42 6
29	37 8	64	44 9	99	42 5
30	40 9	65	44 8	100	42 5
31	44 2	66	44 7	101	42 4
32	47 8	67	44 6	102	42 3
32 75	50 65	68	44 5	103	42 2
33	50 6	69	44 5	103 5	42 2
34	50 4				

(Mulder, Scheik Verhandel 1864. 123)

100 pts dissolve at

$0^\circ$	$34^\circ$	$100^\circ$	$120^\circ$
5	78 8(?)	42 7	41 95 pts $\text{Na}_2\text{SO}_4$ ,

$140^\circ$	$160^\circ$	$180^\circ$	$230^\circ$
42 0	42 9	44 25	46 4 pts $\text{Na}_2\text{SO}_4$

(Tilden and Shenstone, Lond R Soc Proc 35 345)

Solubility decreases above 230° (Étard, C R 113 854)

Sat  $\text{Na}_2\text{SO}_4 + \text{Aq}$  contains at

0° 7° 13° 24° 28° 30°  
4.1 6.2 9.9 19.3 25.2 29.5%  $\text{Na}_2\text{SO}_4$

49° 62° 83° 99° 134° 150°  
32.8 31.3 30.0 29.7 29.4 29.8%  $\text{Na}_2\text{SO}_4$

190° 240° 279° 320°  
29.9 30.0 24.5 17.8%  $\text{Na}_2\text{SO}_4$   
(Étard, A ch 1894, (7) 2 548)

Solubility of  $\text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at t°  
G per 100 g  $\text{H}_2\text{O}$

t°	$\text{Na}_2\text{SO}_4$	Sp gr	t°	$\text{Na}_2\text{SO}_4$	Sp gr
0 70	4 71	1 0432	33 5	49 39	1 3307
10 25	9 21	1 0802	38 15	48 47	1 3229
15 65	14 07	1 1150	44 85	47 49	1 3136
24 90	27 67	1 2067	60 10	45 22	1 2918
27 65	34 05	1 2459	75 05	43 59	1 2728
30 20	41 78	1 2894	89 85	42 67	1 2571
31 95	47 98	1 3230	101 9*	42 18	1 2450

\* B-pt

(Berkeley, Phil Trans Roy Soc 1904, 203 A, 189)

Transition point from  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  to  $\text{Na}_2\text{SO}_4 = 32.5^\circ$  (Berkeley), 32.883° (Richards and Churchill, Z phys Ch 1899, 28, 314)

100 g  $\text{Na}_2\text{SO}_4 + \text{Aq}$  sat at 15° contain 11.5 g anhydrous  $\text{Na}_2\text{SO}_4$ , 21.9 g at 25° (Schreinemakers, Arch Néer Sc 1910, (2) 15 81)

1 l  $\text{Na}_2\text{SO}_4 + \text{Aq}$  sat at 25° contains 1.881 mols  $\text{Na}_2\text{SO}_4$  (Herz, Z anorg 1911, 70 127)

Solubility in  $\text{H}_2\text{O}$  at t°

t°	Mol % $\text{Na}_2\text{SO}_4$
62	5 39
70	5 27
72	5 25
80	5 18
120	5 04
190	5 25
192	5 27
208	5 39
241	5 39
250	5 04
279	4 12
319	2 56
252	4 9
310	3 2
340	1 8
365	0 0

(Wuite, Z phys Ch 1913, 86 364)

Supersaturated solutions of  $\text{Na}_2\text{SO}_4$  are easily formed, when  $\text{Na}_2\text{SO}_4 + \text{Aq}$  sat at its b-pt is hermetically sealed, no crystals are deposited on cooling (Lowel). Supersat  $\text{Na}_2\text{SO}_4 + \text{Aq}$  may also be obtained by cooling hot sat  $\text{Na}_2\text{SO}_4 + \text{Aq}$  in flasks loosely stoppered with cotton wool (Schroeder, A 109 45), or by covering the containing vessel with a glass plate, watch-glass, card, etc., or by covering the liquid itself with a layer of oil, and then allowing to cool.

Hot  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 1 pt  $\text{H}_2\text{O}$  to 1 pt  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  does not crystallise on slowly cooling or on being quickly cooled by immersion in cold water, if it is contained in a barometer tube freed from air by boiling, or in an exhausted well-closed vessel, or in an open vessel with a layer of oil of turpentine on it (Gay-Lussac), or in a vessel containing air, either well stoppered or furnished with a loose cover (Schweigger), or in an open vessel under a bell jar full of air and closed at the bottom with a water joint, or in open bottles placed in a quiet situation, or in an open glass enclosed in a stoppered vessel, containing air and some KOH for drying, in this case  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  effloresces from the solution, and when washed down again does not cause instant crystallisation, but redissolves.

The crystallisation of a solution cooled in this way may often be brought about instantaneously, or often again after a short time, (1) by agitation, when the solution has been cooled in an open vessel, (2) by access of air caused by opening the vessel, the crystallisation taking place the more rapidly the larger the opening. In this case the crystallisation begins at the top, where the solution, the vessel, and the air come in contact, when a particle of dust falls in the liquid the crystallisation begins a little under the surface. When the solution has been cooled in vacuo, a bubble of air, hydrogen, carbonic acid, or nitrous oxide is sufficient to set up the crystallisation, (3) by contact with a solid body. The latter do not cause crystallisation when cooled in contact with the liquid, nor (excepting a crystal of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ) when they are moistened or warmed before contact with the solution.

Supersat  $\text{Na}_2\text{SO}_4 + \text{Aq}$  is brought to crystallisation by addition of a crystal of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ , or an isomorphous substance as  $\text{Na}_2\text{SeO}_4 + 10\text{H}_2\text{O}$ , or  $\text{Na}_2\text{CrO}_4 + 10\text{H}_2\text{O}$ . Other crystals, as  $\text{MgSO}_4 + 7\text{H}_2\text{O}$ , etc., have no action (Thomson, Chem Soc 35 199).

See also Hartley, Jones and Hutchinson, Chem Soc 1908, 93 825, on "Spontaneous crystallisation of sodium sulphate solutions," and de Coppet (A ch 1907, (8) 10 457) on same subject.

A more extended discussion of the phenomena and causes of supersaturation is not considered to be within the scope of this work.

$\text{Na}_2\text{SO}_4 + \text{Aq}$  sat at 15° has sp gr 1.10847 (Michel and Krafft) at 15° has sp gr 1.119 (Stolba) at 16°

has sp gr 1.1162 (Stolba) at 10° contains 29 pts  $\text{Na}_2\text{SO}_4$  to 100 pts  $\text{H}_2\text{O}$  (supersaturated?) and has sp gr 1.1259 (Karsten)

Sp gr of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 19.5°

% $\text{Na}_2\text{SO}_4$	Sp gr	% $\text{Na}_2\text{SO}_4$	Sp gr
2.894	1.0262	10.538	1.0977
5.589	1.0509	12.473	1.1162
7.995	1.0733		

(Kremers Pogg 95 120)

Sp gr of  $\text{Na}_2\text{SO}_4 + \text{Aq}$

% $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp gr	% $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp gr
1.262	1.005	13.744	1.055
2.522	1.010	14.975	1.080
3.780	1.015	16.203	1.085
5.035	1.020	17.426	1.070
6.288	1.025	18.645	1.075
7.538	1.030	19.860	1.080
8.786	1.035	21.071	1.085
10.030	1.040	22.277	1.090
11.272	1.045	23.478	1.095
12.510	1.050	24.674	1.100

(Schmidt Pogg 132 132)

Sp gr of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 19°

% $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp gr	% $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp gr
1	1.0040	16	1.0642
2	1.0079	17	1.0683
3	1.0118	18	1.0725
4	1.0158	19	1.0766
5	1.0198	20	1.0807
6	1.0232	21	1.0849
7	1.0278	22	1.0890
8	1.0318	23	1.0931
9	1.0358	24	1.0973
10	1.0398	25	1.1015
11	1.0439	26	1.1057
12	1.0479	27	1.1100
13	1.0520	28	1.1142
14	1.0560	29	1.1184
15	1.0601	30	1.1226

(Schiiff, A 110 70)

Sp gr of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 15°

%	Sp gr if $\text{Na}_2\text{SO}_4$	Sp gr if $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	%	Sp gr if $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	%	Sp gr if $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
1	1.0091	1.004	11	1.044	21	1.086
2	1.0182	1.008	12	1.047	22	1.090
3	1.0274	1.013	13	1.052	23	1.094
4	1.0365	1.016	14	1.056	24	1.098
5	1.0457	1.020	15	1.060	25	1.103
6	1.0550	1.024	16	1.064	26	1.107
7	1.0644	1.028	17	1.069	27	1.111
8	1.0737	1.032	18	1.073	28	1.116
9	1.0832	1.036	19	1.077	29	1.120
10	1.0927	1.040	20	1.082	30	1.125

(Gerlach, Z anal 8 287)

Sp gr of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 24.8° a=no of g, equivalent to  $\frac{1}{2}$  mol wt, dissolved in 1000 g  $\text{H}_2\text{O}$ , b=sp gr if a is  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol wt = 161, c=sp gr if a is  $\text{Na}_2\text{SO}_4$ ,  $\frac{1}{2}$  mol wt = 71

a	b	c	a	b	c
1	1.054	1.059	4	1.163	1.213
2	1.098	1.114	5	1.188	
3	1.134	1.165	6	1.209	

(Favre and Valson, C R 79 968)

Sp gr of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 18°

% $\text{Na}_2\text{SO}_4$	Sp gr	% $\text{Na}_2\text{SO}_4$	Sp gr
5	1.0450	15	1.1426
10	1.0915		

(Kohlrausch, W Ann 1879 1)

Sp gr of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 20° containing 0.5 mol  $\text{Na}_2\text{SO}_4$  to 100 mols  $\text{H}_2\text{O}$  = 1.03466, 1.0 mol  $\text{Na}_2\text{SO}_4$  to 100 mols  $\text{H}_2\text{O}$  = 1.06744 (Nicol, Phil Mag (5) 16 122)

Sp gr of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 25°

Concentration of $\text{Na}_2\text{SO}_4 + \text{Aq}$	Sp gr
1-normal	1.0606
$\frac{1}{2}$ " "	1.0309
$\frac{1}{4}$ " "	1.0156
$\frac{1}{8}$ " "	1.0079

(Wagner, Z phys Ch 1890, 5 39)

Sp gr at 16°/4° of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 9.4043%  $\text{Na}_2\text{SO}_4$  = 1.08655 (Schonrock, Z phys Ch 1893, 11 781)

$\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 25.51%  $\text{Na}_2\text{SO}_4$  has sp gr 20°/20° = 1.2527  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 10.14%  $\text{Na}_2\text{SO}_4$  has sp gr 20°/20° = 1.0938 (Le Blanc and Rohland, Z phys Ch 1896, 19 278)

Sp gr of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 17.5°, when p = per cent strength of solution, d = observed density, and w = volume conc in grs per cc ( $\frac{\text{pd}}{100} = w$ )

p	d	w
13.06	1.1226	0.14662
11.75	1.1094	0.13043
10.68	1.0990	0.11737
8.544	1.0784	0.09214
6.762	1.0615	0.07178
4.015	1.0358	0.04159
2.599	1.0225	0.02658
2.375	1.0204	0.02423
1.818	1.0154	0.01846
1.349	1.0109	0.01364
0.5204	1.0037	0.00522
0.2921	1.0014	0.00293

(Barnes, J phys Chem 1898, 2 543)

Sp gr of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $20^\circ$ 

Normality of $\text{Na}_2\text{SO}_4 + \text{Aq}$	% $\text{Na}_2\text{SO}_4$	Sp gr
0.97	12.36	1.1138
0.48	6.41	1.0570

(Forchheimer, Z phys Ch 1900, **34** 23)Sp gr of sat  $\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O} + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	wt of 1 ccm of the solution	100 g $\text{H}_2\text{O}$ dissolve g $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
0	1.040	12.16
5	1.058	
10	1.078	21.04
15	1.109	35.96
18	1.137	48.41
20	1.156	58.35
25	1.209	98.48
26	1.222	109.81
30	1.287	184.1
33	1.312	323.1
34	1.317	413.2
35	1.317	

(Tschernaj, J Russ Phys Chem Soc 1914, **46** 8)Sp gr and b pt of  $\text{Na}_2\text{SO}_4 + \text{Aq}$   $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing P pts  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  for every 100 pts  $\text{H}_2\text{O}$  has given sp gr and b pt

P	Sp gr	B pt	P	Sp gr	B pt
1	1.005	100.5°	16	1.064	101.25°
2	1.008	100.62	17	1.067	101.25
3	1.014	100.62	18	1.070	101.37
4	1.020	100.75	19	1.072	101.37
5	1.021	100.75	20	1.074	101.37
6	1.028	100.87	21	1.076	101.37
7	1.030	100.87	22	1.078	101.5
8	1.032	101.0	23	1.080	101.5
9	1.036	101.0	24	1.082	101.5
10	1.040	101.0	25	1.084	101.5
11	1.043	101.12	26	1.090	101.5
12	1.050	101.12	27	1.092	101.63
13	1.055	101.25	28	1.095	101.63
14	1.060	101.25	29	1.098	101.63
15	1.062	101.25	30	1.100	101.75

(Brandes and Gruner 1827)

Saturated solution boils at  $103.17^\circ$  (Löwel),  $103.5^\circ$  (Mulder),  $105^\circ$  (Kremers),  $100.5^\circ$  (Griffiths),  $100.8^\circ$  (Gerlach)Crust forms at  $102.9^\circ$ , highest temp,  $103.2^\circ$ , and solution contains 43.9 pts  $\text{Na}_2\text{SO}_4$  to 100 pts  $\text{H}_2\text{O}$  (Gerlach, Z anal **26** 426)B-pt of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing pts  $\text{Na}_2\text{SO}_4$  to 100 pts  $\text{H}_2\text{O}$ 

B pt	Pts $\text{Na}_2\text{SO}_4$	B pt	Pts $\text{Na}_2\text{SO}_4$
100.5°	9.5	102.5°	39.0
101.0	18.0	103.0	44.5
101.5	26.0	103.2	46.7
102.0	33.0		

(Gerlach, Z anal **26** 430)M-pt of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O} = 34^\circ$  (Tilden, Chem Soc **45** 409)Sol with decomp in  $\text{HCl} + \text{Aq}$ Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

1000 g of the solution contain		Solid phase
Mols $\text{H}_2\text{SO}_4$	Mols $\text{Na}_2\text{SO}_4$	
0.286	1.539	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O}$
0.338	1.671	"
0.338	1.742	"
0.884	2.256	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$
1.576	2.363	$\text{Na}_2\text{SO}_4 + \text{Na}_3\text{H}(\text{SO}_4)_2$
1.666	2.437	"
2.611	2.091	$\text{Na}_3\text{H}(\text{SO}_4)_2 + \text{Na}_3\text{H}(\text{SO}_4)_3, \text{H}_2\text{O}$

(D'Ans, Z anorg 1906, **49** 356)Solubility of  $\text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

1000 g of the solution contain		Solid phase
Mol $\text{Na}_2\text{SO}_4$	Mol $\text{H}_2\text{SO}_4$	
1.55	0.08	$\text{Na}_2\text{SO}_4$
1.59	0.147	"
1.85	0.60	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O}$
2.00	0.763	"
0.77	4.23	$\text{NaHSO}_4, \text{H}_2\text{O}$
0.47	4.96	"
0.32	6.61	$\text{Na}_2\text{HSO}_4$
0.305	6.87	"
0.07	7.18	$\text{Na}_3\text{H}(\text{SO}_4)_2$
0.79	8.78	"

(D'Ans, Z anorg 1909, **61** 92)10 ccm of sat  $\text{Na}_2\text{SO}_4 + \text{absolute } \text{H}_2\text{SO}_4$  contain approx 2.999 g  $\text{Na}_2\text{SO}_4$  (Bergius, Z phys Ch 1910, **72** 355)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ Solid Phase,  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ 

Millimols $\text{H}_2\text{SO}_4$ in 10 ccm	Millimols $\text{Na}_2\text{SO}_4$ in 10 ccm
5 10	18 81
7 79	22 38
	24 65

(Herz, Z anorg 1912, **73** 276 )Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

1000 g of the solution contain		Solid phase
Mols $\text{SO}_3$	Mols $\text{Na}_2\text{SO}_4$	
5 91	0 409	$\text{NaHSO}_4$
6 30	0 332	
6 64	0 297	$\text{NaHSO}_4 + \text{NaH}_2(\text{SO}_4)_2 \cdot \text{H}_2\text{O}$
6 90	0 173	$\text{NaH}_2(\text{SO}_4)_2 \cdot \text{H}_2\text{O}$
7 36	0 071	
7 74	0 047	
7 82	0 044	
8 12	0 037	
8 29	0 042	
8 40	0 046	
8 70	0 076	
8 86	0 156	
8 93	0 259	
8 93	0 269	
8 93	0 273	
8 84	0 527	
8 73	0 681	
8 70	0 808	$\text{NaH}_2(\text{SO}_4)_2 \cdot \text{H}_2\text{O}$
8 62	0 834	metastable solutions
8 62	0 844	
8 61	0 899	
8 87	0 445	$\text{NaH}_2(\text{SO}_4)_2 \cdot \text{H}_2\text{O} + \text{Na}_2\text{SO}_4$
		$4 \cdot 5\text{H}_2\text{SO}_4$
8 93	0 437	$\text{Na}_2\text{SO}_4 \cdot 4 \cdot 5\text{H}_2\text{SO}_4$
9 08	0 394	
9 36	0 425	$\text{Na}_2\text{SO}_4 \cdot 4 \cdot 5\text{H}_2\text{SO}_4 + \text{NaHS}_2\text{O}_7$
9 18	0 567	$\text{NaHS}_2\text{O}_7$
9 42	0 728	
9 48	0 760	
9 55	0 775	
9 48	0 953	$\text{NaHS}_2\text{O}_7 + ?$
9 85	0 787	?
9 98	0 908	?
(9 77)	(1 03)	Metastable
10 16	0 797	
10 78	0 302	?

(D'Ans, Z anorg 1913, **80** 236 )

Sl sol in conc  $\text{HC}_2\text{H}_3\text{O}_2$  (Ure's Dict )  
 Not pptd by addition of glacial  $\text{HC}_2\text{H}_3\text{O}_2$  to  
 $\text{Na}_2\text{SO}_4 + \text{Aq}$  (Persoz )

Solubility in  $\text{NaOH} + \text{Aq}$  at  $25^\circ$ 

1000 g of the solution contain		Solid phase
Mols ( $\text{NaOH}$ ) <sub>2</sub>	Mols $\text{Na}_2\text{SO}_4$	
0	1 54	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
0 074	1 41	
0 70	1 08	"
1 47	0 90	$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$
2 02	0 59	$\text{Na}_2\text{SO}_4$
2 82	0 24	"
3 52	0 126	"
5 83	0 013	"
6 62		$\text{NaOH} \cdot \text{H}_2\text{O}$

(D'Ans and Schreiner, Z anorg 1910, **67** 437 )Sol in sat  $\text{NH}_4\text{Cl} + \text{Aq}$ Rapidly and abundantly sol in sat  $\text{KCl} + \text{Aq}$  with pptn of  $\text{K}_2\text{SO}_4$  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol in sat  $\text{NaCl} + \text{Aq}$  without pptn. If effloresced  $\text{Na}_2\text{SO}_4$  is used, a ppt of  $\text{NaCl}$  is caused at first, and subsequently of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  (Karsten )Sol in boiling sat  $\text{NaCl} + \text{Aq}$  with pptn of  $\text{NaCl}$ , but from cold solutions the  $\text{Na}_2\text{SO}_4$  separates out first (Vauquelin )Less sol in  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (Hunt, Am J Sci (2) **25** 368 )Solubility in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ 

$t^\circ$	g $\text{NaCl}$ per 100 g $\text{H}_2\text{O}$	g $\text{Na}_2\text{SO}_4$ per 100 g $\text{H}_2\text{O}$
10	0 00	9 14
	4 28	6 42
	9 60	4 76
	15 65	3 99
	21 82	3 97
	28 13	4 15
	30 11	4 34
	32 27	4 59
	33 76	4 75
21 5	0 00	21 33
	9 05	15 48
	17 48	13 73
	20 41	13 62
	26 01	15 05
	26 53	14 44
	27 74	13 39
	31 25	10 64
	31 80	10 28
	32 10	8 43
	33 69	4 73
	34 08	2 77
	35 46	0 00
25	0 00	28 74
	2 74	26 57
	8 15	23 15
	19 86	20 52
	24 58	14 86
	31 21	9 95
	32 02	9 61



Solubility in NaCl+Aq at  $t^\circ$ —*Continued*

$t^\circ$	g NaCl per 100 g H <sub>2</sub> O	g Na <sub>2</sub> SO <sub>4</sub> per 100 g H <sub>2</sub> O
27	0 00 2 66 5 29 7 90 16 13 18 91 19 64 20 77 32 33	31 10 28 73 27 17 26 02 24 83 21 39 20 11 19 29 9 53
30	0 00 2 45 5 61 7 91 10 61 12 36 15 65 18 44 20 66 32 43	39 70 38 25 36 50 35 96 31 64 29 87 25 02 21 30 19 06 9 06
33	0 00 1 22 1 99 2 64 3 47 12 14 21 87 32 84 33 99 34 77	48 48 46 49 45 16 44 09 42 61 29 32 16 83 8 76 4 63 2 75
35	0 00 2 14 13 57 18 78 31 91 35 63	47 94 43 75 26 26 19 74 8 28 0 00

At 33° and above the values represent the solubility of Na<sub>2</sub>SO<sub>4</sub> in NaCl+Aq. At 10° the solid phase in contact with the solution is probably Na<sub>2</sub>SO<sub>4</sub>·7H<sub>2</sub>O. Between 17° and 33° the solid phase is either Na<sub>2</sub>SO<sub>4</sub>·10H<sub>2</sub>O or Na<sub>2</sub>SO<sub>4</sub>. An inversion of Na<sub>2</sub>SO<sub>4</sub>·10H<sub>2</sub>O to Na<sub>2</sub>SO<sub>4</sub> takes place at various temp below 33° depending on the amount of NaCl contained in the solution in contact with the solid sodium sulphate.

(Seidell, Am Ch J 1902, **27** 55)

## Solubility in NaCl+Aq at 15°

Composition of the sat solution		Solid Phase
% by wt Na <sub>2</sub> SO <sub>4</sub>	% by wt NaCl	
11 5	0	Na <sub>2</sub> SO <sub>4</sub> +10H <sub>2</sub> O
7 86	5 42	"
5 87	11 51	"
5 23	15 97	"
5 26	21 03	"
5 64	23 39	Na <sub>2</sub> SO <sub>4</sub> , 10H <sub>2</sub> O+NaCl
2 26	25 21	NaCl
0	26 3	"

(Schrenemakers and de Baat, Z phys Ch 1909, **67** 554)

Sol in sat NH<sub>4</sub>NO<sub>3</sub>+Aq (Margueritte, C R **38** 307)

Sol in sat KNO<sub>3</sub>+Aq with pptn after several hours (Karsten)

Na<sub>2</sub>SO<sub>4</sub>+10H<sub>2</sub>O is sol in sat NaNO<sub>3</sub>+Aq without pptn, but if effloresced Na<sub>2</sub>SO<sub>4</sub> is used, NaNO<sub>3</sub> is pptd at first, and subsequently Na<sub>2</sub>SO<sub>4</sub>+7H<sub>2</sub>O

The presence of CaSO<sub>4</sub> does not affect the solubility of Na<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O to any great extent (Barre, A ch 1911, (8) **24** 160)

More sol in K<sub>2</sub>SO<sub>4</sub>, CuSO<sub>4</sub>, MgSO<sub>4</sub>+Aq than in H<sub>2</sub>O (Pfaff, A **99** 226)

100 pts H<sub>2</sub>O dissolve 20.7 pts CuSO<sub>4</sub> and 15.9 pts Na<sub>2</sub>SO<sub>4</sub> (Rudorff, B **6** 484)

Sol in sat MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, CuSO<sub>4</sub>+Aq, but if more Na<sub>2</sub>SO<sub>4</sub> than can be dissolved is added to the CuSO<sub>4</sub>+Aq, a large quantity of a double sulphate separates out (Karsten)

The solubility of Na<sub>2</sub>SO<sub>4</sub> in K<sub>2</sub>SO<sub>4</sub>+Aq has been determined at 15°, 25°, 40°, 50°, 60°, 70° and 80°. From the results the conclusion is drawn that sodium and potassium sulphates form a double salt of the formula K<sub>2</sub>Na(SO<sub>4</sub>)<sub>2</sub> (Okada, Chem Soc 1915, **108** (2) 344)

See also under CuSO<sub>4</sub>, MgSO<sub>4</sub>, and K<sub>2</sub>SO<sub>4</sub>. Slowly but abundantly sol in sat ZnSO<sub>4</sub>+Aq, with separation of a double salt after a few days

Solubility of ZnSO<sub>4</sub>·7H<sub>2</sub>O+Na<sub>2</sub>SO<sub>4</sub>·10H<sub>2</sub>O in 100 g H<sub>2</sub>O at  $t^\circ$

$t$	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
0	40 305	7 905
5	42 285	9 515

(Koppel, Z phys Ch 1905, **52** 409)

See also under Na<sub>2</sub>Zn(SO<sub>4</sub>)<sub>4</sub>+4H<sub>2</sub>O

Solubility of  $\text{Na}_2\text{SO}_4 + \text{Th}(\text{SO}_4)_2$  at  $16^\circ$   
Solid phase  $\text{Th}(\text{SO}_4)_2$

Pts per 100 pts $\text{H}_2\text{O}$		Pts per 100 pts $\text{H}_2\text{O}$	
$\text{Na}_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$	$\text{Na}_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$
1 094	1 743	5 79	2 136
1 960	2 387	9 35	1 379
2 84	3 800	12 24	1 169
2 98	3 962	15 36	1 048
4 11	3 375		

(Barre, C R 1911, **150** 155)

Solubility in Na acetate + Aq at  $25^\circ$

Solid phase,  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$

Composition of the solutions

% Na acetate	% $\text{Na}_2\text{SO}_4$	% $\text{H}_2\text{O}$
0	21 9	78 10
4 10	17 72	78 18
7 71	16 48	75 81
12 58	13 50	73 92
16 26	11 50	72 24
20 63	8 10	71 27

(Fox, Chem Soc 1909, **95** 888)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, **20** 829)

Alcohol precipitates  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  from the cold saturated aqueous solution (Brandes and Firnhaber)

Insol in alcohol of from 0.817 to 0.90 sp gr (Kirwan)

1000 pts alcohol of 0.872 sp gr dissolve 0.7 pt  $\text{Na}_2\text{SO}_4$  at  $12.5^\circ$  of 0.905 sp gr dissolve 3.8 pts  $\text{Na}_2\text{SO}_4$  at  $12.5^\circ$

Insol in alcohol of 0.830.85 sp gr (Anthon)

From supersaturated solution in alcohol, crystals with  $7\text{H}_2\text{O}$  are formed (Schiff, A **106** 11)

100 pts 10% alcohol at  $15^\circ$  contain 14.35 pts  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ , 20% alcohol at  $15^\circ$  contain 5.6 pts  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ , 40% alcohol at  $15^\circ$  contain 1.3%  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  (Schiff, A **118** 365)

Very sol in abs alcohol at ord temp, somewhat more, though still exceedingly sparingly, sol in abs alcohol acidulated with  $\text{H}_2\text{SO}_4$  (Fresenius)

Alcohol does not affect crystal  $\text{H}_2\text{O}$  of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$

Solubility of  $\text{Na}_2\text{SO}_4$  in alcohol + Aq at  $t^\circ$

$t^\circ$	% alcohol	g per 100 g solution			solid phase
		$\text{H}_2\text{O}$	alcohol	$\text{Na}_2\text{SO}_4$	
15	0 7	88 7	0 0	11 3	$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
	9 2	85 1	8 6	6 3	"
	19 4	78 6	18 9	2 9	"
	39 7	60 0	39 5	0 5	"
	58 9	41 1	58 8	0 1	"
	72 0	28 0	72 0	0 0	"
	0 0	72 8	0 0	27 2	$\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$
	11 2	76 5	9 5	14 0	"
	20 6	74 3	19 2	6 5	"
	30 2	68 4	29 6	2 0	"
25	0 0	78 1	0 0	21 9	$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
	10 6	78 5	9 3	12 2	"
	24 0	72 8	22 9	4 3	"
	54 0	45 6	54 0	0 4	"
36	0 0	67 0	0 0	33 0	$\text{Na}_2\text{SO}_4$
	8 8	70 0	6 8	22 6	"
	12 8	71 2	10 5	18 3	"
	17 9	71 1	15 5	13 4	"
	18 1	71 0	15 7	13 3	"
	28 9	66 5	28 4	5 1	"
	48 7	50 9	48 3	0 8	"
45	0 0	67 6	0 0	32 4	"
	9 0	71 2	7 1	21 6	"
	14 5				
	20 6				
	31 6				

Between certain concentrations of alcohol, the liquid separates into two layers at  $25^\circ$ ,  $36^\circ$  and  $45^\circ$ , of the following composition

$t^\circ$	Upper Layer			Lower Layer		
	$\frac{g}{\text{H}_2\text{O}}$	$\frac{g}{\text{alcohol}}$	$\frac{g}{\text{Na}_2\text{SO}_4}$	$\frac{g}{\text{H}_2\text{O}}$	$\frac{g}{\text{alcohol}}$	$\frac{g}{\text{Na}_2\text{SO}_4}$
25	66 5	27 3	6 2	67 4	5 1	27 5
	68 1	23 9	8 0	68 5	6 0	25 5
	68 3	23 1	8 6	68 3	6 7	25 0
36	57 7	38 4	3 9	66 6	4 1	29 3
	65 0	28 3	6 7	68 8	5 9	25 3
	68 1	21 2	10 7	68 9	9 4	21 7
45	61 8	32 9	5 3			
	65 8	25 3	8 9	68 4	8 8	22 8
	66 0	24 0	10 0	68 6	10 1	21 3

(de Bruyn, Z phys Ch 1900, **32** 101)

## Solubility in alcohol+Aq at 25°

Composition of the sat solution			Solid phase
% by wt H <sub>2</sub> O	% by wt alcohol	% by wt Na <sub>2</sub> SO <sub>4</sub>	
63 41	34 84	1 75	Na <sub>2</sub> SO <sub>4</sub> , 10H <sub>2</sub> O
49 0	50 5	0 5	"
46 6	53 0	0 4	Na <sub>2</sub> SO <sub>4</sub> , 10H <sub>2</sub> O+Na <sub>2</sub> SO <sub>4</sub>
34 9	64 95	0 15	Na <sub>2</sub> SO <sub>4</sub>

Schreinemakers, Z phys Ch 1909, **67** 552 )

Solubility data for solution of NaCl in ethyl alcohol+Aq at 15°, 25°, and 30° are given by chreinemakers (Z phys Ch 1909, **67** 556)

## Solubility in propyl alcohol+Aq at 20°

propyl alcohol	g Na <sub>2</sub> SO <sub>4</sub> per 100 g solution	% propyl alcohol	g Na <sub>2</sub> SO <sub>4</sub> per 100 g solution
12 20	1 99	56 57	0 55
19 77	1 15	60 64	0 44
55 65	0 72	62 81	0 38

(Lanebarger, Am Ch J 1892, **14** 380 )

Sol in glycerine

Insol in acetone (Naumann, B 1904 **37** 4329, Eidmann, C C 1899 II, 1014), benzotrile (Naumann, B 1914, **47** 1370) methyl acetate (Naumann, B 1909, **42** 7790), ethyl acetate (Naumann, B 1910, **43** 314)

100 g H<sub>2</sub>O dissolve 183.7 g sugar+30.5 g Na<sub>2</sub>SO<sub>4</sub> at 31.25°, or 100 g sat solution contain 52.2 g sugar + 9.6 g Na<sub>2</sub>SO<sub>4</sub> (Kohler, Z Ver Zuckerind, 1897, **47** 447)

Min Anhydrous, *Thenardite* +10H<sub>2</sub>O, *Mirabilite*

**Sodium hydrogen sulphate, NaHSO<sub>4</sub>**

Not deliquescent Very sol in H<sub>2</sub>O with decomposition

Sol in 2 pts H<sub>2</sub>O at 0° (Link), 1 pt H<sub>2</sub>O at 100° (Schubarth) 100 pts H<sub>2</sub>O at 15.5° dissolve 92.72 pts Sol in 2 pts H<sub>2</sub>O at 18.75° (Abl), decomp by alcohol

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, **20** 829)

+H<sub>2</sub>O Deliquescent, and decomp by the H<sub>2</sub>O which it takes up

NaHS<sub>4</sub>(SO<sub>4</sub>)<sub>2</sub> Decomp by H<sub>2</sub>O (Schultz)

**Trisodium hydrogen sulphate, Na<sub>3</sub>H(SO<sub>4</sub>)<sub>2</sub>**

Sol in H<sub>2</sub>O with decomp

+H<sub>2</sub>O (Rose)

**Sodium pyrosulphate, Na<sub>2</sub>S<sub>2</sub>O<sub>7</sub>**

Sol in fuming H<sub>2</sub>SO<sub>4</sub> without decomp

**Sodium thallic sulphate, Na<sub>2</sub>SO<sub>4</sub>, Tl<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>**

Sol in H<sub>2</sub>O (Strecker, A **135** 207)

**Sodium thorium sulphate, Na<sub>2</sub>SO<sub>4</sub>, Th(SO<sub>4</sub>)<sub>2</sub> +6H<sub>2</sub>O**

Sol in H<sub>2</sub>O 100 pts cold sat Na<sub>2</sub>SO<sub>4</sub>+Aq dissolve 4 pts of this salt (Cleve)

See also under Na<sub>2</sub>SO<sub>4</sub>+ThSO<sub>4</sub>

**Sodium titanium sesquisulphate, Na<sub>2</sub>Ti<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> +5H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Spence, Chem Soc 1904, **86** (2) 412)

Insol in alcohol (Knecht, B 1903, **36** 169)

**Sodium titanyl sulphate, Na<sub>2</sub>TiO<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> +10H<sub>2</sub>O**

Hygroscopic (Mazzuchelli and Pantanelli, C C 1909, II 420)

**Sodium uranyl sulphate, Na<sub>2</sub>(UO<sub>2</sub>)(SO<sub>4</sub>)<sub>2</sub> +3H<sub>2</sub>O**

(de Coninck, C C 1905, I 919)

**Sodium vanadium sulphate, Na<sub>2</sub>V<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> +24H<sub>2</sub>O**

Very sol in H<sub>2</sub>O (Piccini, Z anorg 1897, **13** 444)

**Sodium vanadyl sulphate, Na<sub>2</sub>SO<sub>4</sub>, VOSO<sub>4</sub> +4H<sub>2</sub>O**

Easily sol in H<sub>2</sub>O and alcohol + conc H<sub>2</sub>SO<sub>4</sub> (Koppel, Z anorg 1903, **35** 177) Na<sub>2</sub>SO<sub>4</sub>, 2VOSO<sub>4</sub>+2½H<sub>2</sub>O Slowly sol in H<sub>2</sub>O

Can be cryst from H<sub>2</sub>SO<sub>4</sub> at 100° (Koppel)

**Sodium yttrium sulphate, Na<sub>2</sub>SO<sub>4</sub>, Y<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> +2H<sub>2</sub>O**

Quite sol in H<sub>2</sub>O (Cleve)

The only double salt capable of existing at 25° (James and Holden, J Am Chem Soc 1913, **35** 562)

**Sodium zinc sulphate, Na<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub> +4H<sub>2</sub>O**

Deliquescent in moist air

Decomp into constituents on dissolving in H<sub>2</sub>O (Graham, Phil Mag **18** 417)

Solubility of Na<sub>2</sub>Zn(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O in 100 g H<sub>2</sub>O at t°

t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
25	26 32	23 40
30	26 475	23 445
35	26 365	23 525
40	26 68	23 63

(Koppel, Z phys Ch 1905, **52** 409)

Solubility of  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{ZnSO}_4$   
 $7\text{H}_2\text{O}$  in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	grams $\text{ZnSO}_4$	grams $\text{Na}_2\text{SO}_4$	$t^\circ$	grams $\text{ZnSO}_4$	grams $\text{Na}_2\text{SO}_4$
10	45 79	11 24	25	56 155	7 215
15	48 81	10 175	30	60 55	6 34
20	52 34	8 625	35	65 25	5 64

(Koppel)

Solubility of  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{ZnSO}_4$   
 $6\text{H}_2\text{O}$  in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	grams $\text{ZnSO}_4$	grams $\text{Na}_2\text{SO}_4$
38	66 64	4 98
40	64 89	4 71

(Koppel)

Solubility of  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$   
 $10\text{H}_2\text{O}$  in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	grams $\text{ZnSO}_4$	grams $\text{Na}_2\text{SO}_4$
10	43 495	12 35
15	36 925	16 71
20	28 77	21 98
25	19 935	29 875
30	10 67	42 515

(Koppel)

Solubility of  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$   
 (anhydrous) in 100 g  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	grams $\text{ZnSO}_4$	grams $\text{Na}_2\text{SO}_4$
35	8 725	46 61
40	9 16	43 835

(Koppel)

**Sodium sulphate fluoride,  $\text{Na}_2\text{SO}_4$ ,  $\text{NaF}$**

Cryst from  $\text{H}_2\text{O}$  without decomp (Marignac, Ann Min (5) 15 236)

**Sodium sulphate antimony trifluoride**

See Antimony trifluoride sodium sulphate

**Strontium sulphate,  $\text{SrSO}_4$**

Very sl sol in cold, and still less in boiling  $\text{H}_2\text{O}$

1 l  $\text{H}_2\text{O}$  at 11–15° dissolves 0 066 g  $\text{SrSO}_4$  (Brandes and Silber), 0 145 g  $\text{SrSO}_4$  (Fresenius), 0 154–0 167 g  $\text{SrSO}_4$  (Marignac), 0 187 g  $\text{SrSO}_4$  (Kremers), 0 278 g  $\text{SrSO}_4$  (Andrews)

1 l boiling  $\text{H}_2\text{O}$  dissolves 0 104 g  $\text{SrSO}_4$  (Fresenius), 0 282 g  $\text{SrSO}_4$  (Brandes and Silber)

When a Sr salt is precipitated by  $\text{H}_2\text{SO}_4$ , 1 pt  $\text{SrSO}_4$  remains dissolved in 700 pts  $\text{H}_2\text{O}$  (Marignac)

Sol in about 8000 pts  $\text{H}_2\text{O}$  (Schweitzer, J B 1877 1054)

Calculated from electrical conductivity of the solution,  $\text{SrSO}_4$  is sol in 10,070 pts  $\text{H}_2\text{O}$  at 16 1° and 10,090 pts at 20 1° (Holleman, Z phys Ch 12 131)

1 l  $\text{H}_2\text{O}$  dissolves 107 mg  $\text{SrSO}_4$  at 18° and not much more at higher temp (Kohlrausch and Rose, Z phys Ch 12 241)

100 g  $\text{H}_2\text{O}$  dissolve

at  $t^\circ$  0°–5° 10°–12° 20° 30°  
 g  $\text{SrSO}_4$  0 0983 0 0994 0 1479 1 0600

at  $t^\circ$  50° 80° 90° 95–98°  
 g  $\text{SrSO}_4$  0 1629 0 1688 0 1727 0 1789

(Wolfmann, C C 1897, I 632)

1 l  $\text{H}_2\text{O}$  dissolves 114 mg  $\text{SrSO}_4$  at 18° (Kohlrausch, Z phys Ch 1904, 50 356), 114 3 mg at 18° (Kohlrausch, Z phys Ch 1908, 64 168)

Sol in 6895 pts cold, and 9638 pts boiling  $\text{H}_2\text{O}$ , in 11,000–12,000 pts  $\text{H}_2\text{O}$  containing  $\text{H}_2\text{SO}_4$ , in 474  $\text{HCl}$ +Aq containing 8 5%  $\text{HCl}$ , in 432 pts  $\text{HNO}_3$ +Aq containing 4 8%  $\text{N}_2\text{O}_5$ , in 7843 pts  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq containing 15 6%  $\text{HC}_2\text{H}_3\text{O}_2$  (Fresenius)

Or, 1 l cold  $\text{HCl}$ +Aq of 8 5% dissolves 2 11 g  $\text{SrSO}_4$ , 1 l cold  $\text{HNO}_3$ +Aq of 4 8%  $\text{N}_2\text{O}_5$  dissolves 2 31 g  $\text{SrSO}_4$ , 1 l cold  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq of 15 6%  $\text{HC}_2\text{H}_3\text{O}_2$  dissolves 0 1275 g  $\text{SrSO}_4$  (Fresenius)

Solubility of  $\text{SrSO}_4$  in  $\text{HCl}$ +Aq

No cc $\text{HCl}$ + Aq containing 1 mg equiv $\text{HCl}$	g per 100 cc solution	
	$\text{HCl}$	$\text{SrSO}_4$
0 2	18 23	0 161
0 5	7 29	0 207
1 0	3 65	0 188
2 0	1 82	0 126
10 0	0 36	0 048

(Banthusch, J pr 1884, (2) 29 54)

Solubility of  $\text{SrSO}_4$  in  $\text{HNO}_3$ +Aq

No cc $\text{HNO}_3$ + Aq containing 1 mg equiv $\text{HNO}_3$	g per 100 cc solution	
	$\text{HNO}_3$	$\text{SrSO}_4$
0 2	31 52	0 381
0 5	12 61	0 307
1 0	6 30	0 217
2 0	3 15	0 138
10 0	0 63	0 049

(Banthusch, J pr 1884, (2) 29 54)

Sol in conc  $\text{H}_2\text{SO}_4$  See under  $\text{SrH}_2(\text{SO}_4)_2$   
 Insol in  $\text{NH}_4\text{Cl}$ +Aq or conc  $(\text{NH}_4)_2\text{SO}_4$ +Aq (Rose)

Slowly but-completely sol in  $\text{NaCl}$ +Aq (Wackenroder)

$\text{H}_2\text{O}$  containing  $\text{Na}_2\text{SO}_4$  dissolves less  $\text{SrSO}_4$

than pure  $H_2O$ ,  $H_2O$  containing  $H_2SO_4$  still less (Andrews, Phil Mag Ann 7 406)

Insol in  $Na_2S_2O_3 + Aq$

Insol in boiling conc  $(NH_4)_2SO_4 + Aq$  (Rose, Pogg 110 292)

Sol in 16 949 pts  $(NH_4)_2SO_4 + Aq$  (1 4) (Fresenius, Z anal 32 195)

Pptn is hindered by alkali metaphosphates and citrates, but not by citric acid

Decomp at ord temp, and more rapidly on boiling by alkali carbonates + Aq

Sol in  $MgCl_2$  or  $KCl + Aq$ , solubility increasing with strength of solution, sol in  $NaCl$  or  $CaCl_2 + Aq$ , maximum solubility occurring when the solutions are of a medium concentration The numerical results are as follows

100 pts of the salt solutions containing given pts salt dissolve pts  $SrSO_4$

Salt	Pts salt	Pts $SrSO_4$
NaCl	22 17	0 1811
	15 54	0 2186
	8 44	0 1653
KCl	18 08	0 2513
	12 54	0 1933
	8 22	0 1925
$MgCl_2$	13 63	0 2419
	4 03	0 2057
	1 59	0 1986
CaCl	33 70	0 1706
	16 51	0 1853
	8 67	0 1756

(Virck, C C 1862 402)

Solubility in  $H_2O$ , and in solutions of the sulphates chlorides and nitrates of the alkalis and alkaline earths and in solutions of salts of the alkalis with strong organic acids has been determined No data in abstract (Wolfmann, Chem Soc 1898, (2) 74 220)

Solubility in  $H_2O$  is considerably decreased by the presence of  $K_2SO_4$  (Barre, A ch 1911, (8) 24 175)

Solubility of  $SrSO_4$  in  $Ca(NO_3)_2 + Aq$  at ord temp

G per 100 cc sat solution

$Ca(NO_3)_2$	$SrSO_4$	$Ca(NO_3)_2$	$SrSO_4$
0 5	0 0483	4	0 1489
1	0 0619	5	0 1689
2	0 1081	6	0 1955
3	0 1275		

(Raffo and Rossi, Gazz ch it 1915, 45 (1) 45)

Insol in liquid  $NH_3$  (Franklin, Am Ch J 1898, 20 829)

100 g 95% formic acid dissolve 0 02 g  $SrSO_4$  at 18 5° (Aschan, Chem Ztg 1913, 37 1117)

Insol in absolute alcohol, scarcely sol in dil alcohol

Insol in methyl acetate (Naumann, B 1909, 42 3790), acetone (Naumann, B 1904, 37 4329, Eidmann, C C 1899, II 1014)

Min Celestite

### Strontium hydrogen sulphate, $SrH_2(SO_4)_2$

100 pts  $H_2SO_4$  dissolve 2 2 pts  $SrSO_4$  (Lies-Bodart and Jacquemin), 100 pts  $H_2SO_4$  dissolve 5 68 pts (Struve, Z anal 9 34), 100 pts fuming  $H_2SO_4$  dissolve 9 77 pts (Struve)

1 g  $SrSO_4$  dissolves in 1256 g 91%  $H_2SO_4 + Aq$  (Varenne and Pauleau, C R 93 1016), boiling  $H_2SO_4$  dissolves about 15%  $SrSO_4$ , and still more at 100° (Schultz, Pogg 133 147)

Sol in 1519 pts 91%  $H_2SO_4$  (Varenne and Pauleau, C R 93 1016)

100 pts  $H_2SO_4$  (sp gr 1 843) dissolve 14 pts  $SrSO_4$  at 70° (Garside, C N 31 245)

Decomp by  $H_2O$

100 pts hot conc  $H_2SO_4$  dissolve about 9 0 pts  $SrSO_4$  (Rohland, Z anorg 1910, 66 206)

10 ccm of sat  $SrSO_4 +$  absolute  $H_2SO_4$  contain approx 2 17 g  $SrSO_4$  (Bergius, Z phys Ch 1910, 72 355)

+  $H_2O$  Decomp by  $H_2O$

### Strontium tin (stannic) sulphate, $SrSO_4$ , $Sn(SO_4)_2 + 3H_2O$

Decomp by  $H_2O$  Sol in  $HCl$  (Weinland and Kuhl, Z anorg 1907, 54 249)

### Strontium titanium sulphate, $SrSO_4$ , $Ti(SO_4)_2$

Ppt, decomp by  $H_2O$  giving titanous acid (Weinland and Kuhl, Z anorg 1907, 54 254)

### Tantalum sulphate, $3Ta_2O_5$ , $SO_3 + 9H_2O$

(Hermann, J pr 70 201)

### Tellurium sulphate, basic, $TeO_3$ , $SO_3$

Sol in cold dil  $H_2SO_4$  Decomp by hot  $H_2O$  (Klein, C R 99 326)

### Terbium sulphate, $Tr_2(SO_4)_3 + 8H_2O$

Sol in  $H_2O$

Sol in  $H_2O$ , pptd by alcohol (Urbun, C R 1908, 146 127)

### Thallous sulphate, $Tl_2SO_4$

1 pt dissolves at t° in pts  $H_2O$ , according to C = Crookes, L = Lamy

15°	18°	62°	100°	101 2°
21 1	20 8	8 7	5 4	5 22 pts $H_2O$
C	L	L	C	L

Solubility of  $\text{Ti}_2\text{SO}_4$  in  $\text{H}_2\text{O}$ 

$t^\circ$	% $\text{Ti}_2\text{SO}_4$	$t^\circ$	% $\text{Ti}_2\text{SO}_4$
0	2.63	60	9.85
10	3.57	70	11.31
20	4.64	80	12.75
30	5.80	90	14.19
40	7.06	99.7*	15.57
50	8.44		

B - pt at  $748 \text{ mm}$   
(Berkeley, Phil Trans Roy Soc 1904, **203**  
A, 189, calc by Landolt-Börnstein)

100 g  $\text{H}_2\text{O}$  dissolve 3.36 g  $\text{Ti}_2\text{SO}_4$  at  $6.5^\circ$ ,  
4.3 g at  $12^\circ$ , 19.14 g at  $100^\circ$  (Tutton, Proc  
Roy Soc 1907, **79** A, 351)

1 l  $\text{H}_2\text{O}$  dissolves 0.1928 equivalents  
 $\text{Ti}_2\text{SO}_4$  at  $20^\circ$ , or 48.59 g in 1 l of solution  
(Noyes, J Am Chem Soc 1911, **33** 1657)

1 l  $\text{H}_2\text{O}$  dissolves 0.1083 g equiv  $\text{Ti}_2\text{SO}_4$   
at  $25^\circ$ , or 27.28 g in 1 l of solution (Noyes)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

Strength of $\text{H}_2\text{SO}_4 + \text{Aq}$ g mols per l	g mols $\text{Ti}_2\text{SO}_4$ per l
0.0494	0.1172
0.0987	0.1249

(Noyes, J Am Chem Soc 1911, **33** 1662)

1 l  $\text{TiClO}_3 + \text{Aq}$  containing 0.1058 equiv-  
alents  $\text{TiClO}_3$ , dissolves 0.1366 equivalents  
 $\text{Ti}_2\text{SO}_4$  at  $20^\circ$  (Noyes)

See also  $\text{TiClO}_3$

Solubility in salts + Aq at  $25^\circ$ 

g mols per l	'g mols per l $\text{Ti}_2\text{SO}_4$ dissolved
0.0996 $\text{TiNO}_3$	0.08365
0.0497 $\text{Na}_2\text{SO}_4$	0.1080
0.1988 $\text{Na}_2\text{SO}_4$	0.1173
0.1010 $\text{NaHSO}_4$	0.1161

(Noyes)

**Thallous hydrogen sulphate,  $\text{TiHSO}_4$** 

Sl hydroscopic

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$

1000 g of the solution contain

Mols $\text{H}_2\text{SO}_4$	Mols $\text{Ti}_2\text{SO}_4$
4.55	0.56
4.79	0.55
4.89	0.59
4.92	0.66
4.78	0.75
4.26	1.01
4.03	1.08

(D'Ans, Z anorg 1910, **65** 232)

$\text{Ti}_2\text{SO}_4, \text{TiHSO}_4$  Sol in  $\text{H}_2\text{O}$  (Storten-  
becker, R t c 1902, **21** 90)

**Thallous pyrosulphate,  $\text{Ti}_2\text{S}_2\text{O}_7$** 

Decomp by  $\text{H}_2\text{O}$  (Weber, B **17** 2502)

**Thallous orthosulphate,  $\text{Ti}_2\text{S}_2\text{O}_8$** 

Decomp by  $\text{H}_2\text{O}$  (Weber, B **17** 2502)

**Thalic sulphate, basic,  $\text{Ti}_2\text{O}_3, 2\text{SO}_3 + 3\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$

+5 $\text{H}_2\text{O}$  As above (Willm, A ch (4) **5**  
5)

**Thalic sulphate,  $\text{Ti}_2(\text{SO}_4)_3 + 7\text{H}_2\text{O}$** 

Decomp by cold  $\text{H}_2\text{O}$  with separation of  
 $\text{TiO}(\text{OH})$  (Crookes)

**Thallothallic sulphate,  $2\text{Ti}_2\text{O}_3, 3\text{Ti}_2\text{O}_3, 12\text{SO}_3 + 25\text{H}_2\text{O}$** 

Gradually efflorescent (Willm)

$\text{Ti}_2(\text{SO}_4)_3$  (Lepsius, Chem Ztg **1890**  
1327)

$\text{TiH}(\text{SO}_4)_2$  (Lepsius)

**Thallous uranyl sulphate,  $\text{Ti}_2(\text{UO}_2)(\text{SO}_4)_2 + 3\text{H}_2\text{O}$** 

Sl sol in cold  $\text{H}_2\text{O}$

Easily forms supersat solutions (Kohn,  
Z anorg 1908, **59** 112)

**Thallium vanadium sulphate,  $\text{Ti}_2\text{V}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$** 

100 pts  $\text{H}_2\text{O}$  dissolve 11.06 pts salt at  $10^\circ$

Sp gr of solution at  $4^\circ/20^\circ = 2.342$

Very sol in hot  $\text{H}_2\text{O}$  (Piccini, Z anorg  
1897, **13** 446)

256 g anhydrous, or 433 g hydrated salt,  
or 0.573 g mols of anhydrous salt are sol in  
1 l  $\text{H}_2\text{O}$  at  $25^\circ$

Melts in crystal  $\text{H}_2\text{O}$  at  $48^\circ$  (Locke, Am  
Ch J 1901, **26** 175)

**Thallous zinc sulphate,  $\text{Ti}_2\text{Zn}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$** 

1 l  $\text{H}_2\text{O}$  dissolves 86 g anhydrous salt  
at  $25^\circ$  (Locke, Am Ch J 1902, **27** 459)

**Thallothallic sulphate bromide,  $\text{Ti}_2\text{Br}_2\text{SO}_4$** 

Very sol in cold  $\text{H}_2\text{O}$  Decomp by much  
 $\text{H}_2\text{O}$  (Meyer and Goldschmidt, B 1903, **36**  
242)

**Thorium sulphate, basic,  $3[\text{Th}(\text{SO}_4)_2 + 2\text{H}_2\text{O}]$ ,  
 $\text{Th}(\text{SO}_4)_2\text{O} + 2\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , very slowly attacked by dil  
acids (Demarcay)

1 hO $(\text{SO}_4)_2 + 2\text{H}_2\text{O}$  Stable in aq solution  
at  $100^\circ$  (Hauser, B 1910, **43** 2776)

+5 $\text{H}_2\text{O}$  Somewhat sol in hot conc  
 $\text{MgSO}_4 + \text{Aq}$  (Halla, Z anorg 1912, **79** 260)

**Thorium sulphate,  $\text{Th}(\text{SO}_4)_2$** 

Anhydrous Easily sol if brought into a  
large amount of  $\text{H}_2\text{O}$ , but very slowly sol if  
only a little  $\text{H}_2\text{O}$  is added to the salt

100 pts  $\text{H}_2\text{O}$  dissolve about 4.86 pts  $\text{Th}(\text{SO}_4)_2$  at  $0^\circ$  (Cleve)

When heated, a hydrous salt separates out, which redissolves on cooling (Cleve)

Solubility of anhydrous salt cannot be determined, as it begins to separate out  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$  before a saturated solution is reached. At  $0^\circ$ , 100 pts  $\text{H}_2\text{O}$  dissolved 22.97 pts  $\text{Th}(\text{SO}_4)_2$  in 15 minutes, at  $25^\circ$ , 27.00 pts  $\text{Th}(\text{SO}_4)_2$  were dissolved in 5 minutes (Roozeboom, Z phys Ch 5 198)

$+2\text{H}_2\text{O}$  Shows same behaviour as anhydrous salt. 100 pts  $\text{H}_2\text{O}$  dissolved 35.50 pts  $\text{Th}(\text{SO}_4)_2$  from this salt at  $1^\circ$ , but this is not the maximum solubility (Roozeboom)

$+4\text{H}_2\text{O}$  Pptd by alcohol from hot aqueous solution, also formed by heating  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$  in aqueous solution above  $60^\circ$

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$ . D=according to Demarcay (C R 96 1860), R=according to Roozeboom (Z phys Ch 5 202)

$t^\circ$	Pts $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts $\text{Th}(\text{SO}_4)_2$
17	9.41 D	50	2.54 R	70	1.09 R
35	4.50 D	55	1.94 D	75	1.32 D
40	4.04 R	60	1.634 R	95	0.71 D

$+6\text{H}_2\text{O}$  Behaves as the anhydrous salt, but action is much slower

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{Th}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$

$t^\circ$	Pts $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts $\text{Th}(\text{SO}_4)_2$
0	1.50	45	3.85
15	1.63	60	6.64
30	2.45		

(Roozeboom)

This determination gives too low figures, especially at the higher temperatures (Roozeboom)

$+8\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$

$t$	Pts $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts $\text{Th}(\text{SO}_4)_2$
0	1.00	25	1.85
15	1.38	44	3.71

(Roozeboom)

100 g  $\text{Th}(\text{SO}_4)_2 + \text{Aq}$  sat with  $\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$  at  $30^\circ$  contain 2.152 g anhydrous  $\text{Th}(\text{SO}_4)_2$  (Koppel and Holzkampf, Z anorg 1910, 67 274)

100 g  $\text{H}_2\text{O}$  dissolve 1.722 g at  $25^\circ$  (Barre, Bull Soc 1912, (4) 11)

$+9\text{H}_2\text{O}$  Pptd by alcohol from cold

aqueous solution. Sol in about 88 pts  $\text{H}_2\text{O}$  at  $0^\circ$  (Cleve). Extremely slowly sol in  $\text{H}_2\text{C}$

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$  calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$

$t^\circ$	Pts $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts $\text{Th}(\text{SO}_4)_2$
0	0.88	30	1.85	50	4.86
10	1.02	40	2.83	55	6.5±
20	1.25				

Above  $55^\circ$ ,  $\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$  separates out (Demarcay C R 96 1860, calculated by Roozeboom)

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$  calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$

$t^\circ$	Pts $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts $\text{Th}(\text{SO}_4)_2$
0	0.74	30	1.995	51	5.22
10	0.98	40	2.998	55	6.76
20	1.38				

Above  $60^\circ$ ,  $\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$  separates out (Roozeboom, Z phys Ch 5 201)

For further data, see Roozeboom (Z phys Ch 5 198), where there is a full discussion of the subject

100 g sat solution of  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $25^\circ$  contain 1.593 g anhyd. sal (Wirth, Z anorg 1912, 76 174)

Solubility of  $\text{Th}(\text{SO}_4)_2$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $t$

$t$	% $\text{H}_2\text{SO}_4$	% $\text{ThSO}_4$	Solid phase
30	0.000	2.152	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
	0.466	2.055	"
	0.72	2.085	"
	1.468	2.267	"
	2.983	2.311	"
	4.38	2.367	"
	4.97	2.323	"
	9.95	1.961	"
	15.03	1.484	"
	18.95	1.078	"
	23.64	0.7196	"
	32.68	0.3364	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$
	37.80	0.077	"
	43.28	0.0213	"
	45.69	0.0047	"
20	74.0	0.1208	"
	80.5	0.000	"
	5	1.722	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
	15	0.9752	"
Boiling temp	25	0.3838	"
	40	0.0103	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$
	5	0.7407	"
	10	0.4808	"
	15	0.3882	"

(Koppel and Holzkampf, Z anorg 1910, 6 274)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

Per 100 g of solution

g $\text{Th}(\text{SO}_4)_2$	g $\text{H}_2\text{SO}_4$
1 722	0 000
1 919	1 072
2 017	1 941
2 060	2 821
2 061	3 843
2 035	5 212
1 863	8 055
1 702	10 105

(Barre, Bull Soc 1912, (4) 11 647)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ 

Nahty $\text{SO}_4$	In 100 g of the liquid are dissolved		Solid phase
	g oxide	g anhydrous sulphate	
1	1 015	1 593	$\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$
16	1 14	1 831	"
32	0 9265	1 488	"
68	0 545	0 8751	"
68	0 2685	0 4312	"
68	0 0651	0 1045	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
89	0 0396	0 0636	"
15	0 0192	0 0308	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$

(Wirth, Z anorg 1912, 76 186)

Solubility of  $\text{Th}(\text{SO}_4)_2$  in  $\text{HCl} + \text{Aq}$  at  $30^\circ$ 

% $\text{HCl}$	% $\text{Th}(\text{SO}_4)_2$	Solid phase
0 0	2 15	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
4 55	3 541	"
6 95	3 431 =	"
12 14	2 811	"
15 71	2 360	"
18 33	2 199	"
20	2 13	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$
23 9	1 277	"

Koppel and Holzkampf, Z anorg 1910, 67 274)

Solubility of  $\text{Th}(\text{SO}_4)_2$  in  $\text{HNO}_3 + \text{Aq}$  at  $30^\circ$ 

% $\text{HNO}_3$	% $\text{Th}(\text{SO}_4)_2$	Solid phase
0 0	2 15	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
5 17	3 68	"
10 04	4 20	"
16 68	4 84	"
21 99	4 47	"
28 33	3 96	"
28 51	3 88	"
33 17	3 34	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$
38 82	2 51	"

Koppel and Holzkampf, Z anorg 1910, 67 274)

The presence of phosphoric acid increases the solubility of thorium sulphate in  $\text{HCl}$  and  $\text{HNO}_3$  (Koppel and Holzkampf, Z anorg 1910, 67 280)

For solubility of  $\text{Th}(\text{SO}_4)_2$  in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Li}_2\text{SO}_4$ , and  $\text{K}_2\text{SO}_4$ , see respective sulphates Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 830)

Thorium hydrogen sulphate,  $\text{ThH}_2(\text{SO}_4)_2$ 

Hydroscopic

Sol in excess of hot  $\text{H}_2\text{SO}_4$ , insol in cold  $\text{H}_2\text{SO}_4$  (Brauner, Z anorg 1904, 38 333)Thulium sulphate,  $\text{Tm}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ 

Insol in alcohol (James, J Am Chem Soc 1911, 33 1343)

Tin (stannic) sulphate, basic,  $(\text{SnO})\text{SO}_4 + \text{H}_2\text{O}$ Easily sol in cold  $\text{H}_2\text{O}$ , but quickly decomp with separation of stannic hydroxide (Ditte, C R 104 178)

$3\text{SnO}$ ,  $\text{SO}_3$  Easily sol in dil acids (Ditte, A ch 1882, (5) 27 159)  
 $+1\frac{1}{2}\text{H}_2\text{O}$  Not decomp by cold  $\text{H}_2\text{O}$  (Ditte)

Tin (stannous) sulphate,  $\text{SnSO}_4$ Sol in 5.3 pts  $\text{H}_2\text{O}$  at  $19^\circ$ , and 5.5 pts at  $100^\circ$  (Marignac) Solution soon decomposes with separation of a basic salt Sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Bouquet)

Insol in acetone (Naumann, B 1904, 37 4329)

Tin (stannic) sulphate,  $\text{Sn}(\text{SO}_4)_2 + 2\text{H}_2\text{O}$ Deliquescent Easily sol in  $\text{H}_2\text{O}$ , decomp by much  $\text{H}_2\text{O}$  Sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Slowly sol in  $\text{HCl} + \text{Aq}$  Decomp by absolute alcohol (Ditte, C R 104 178)Titanium sulphate,  $\text{Ti}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ Deliquescent, and sol in  $\text{H}_2\text{O}$  The aqueous solution is decomp on boiling (Glatzel, B 9 1833)Titanium sesquisulphate,  $\text{Ti}_2(\text{SO}_4)_3$ Very deliquescent, and easily sol in  $\text{H}_2\text{O}$  Aqueous solution is decomp by boiling (Ebelmen)Insol in  $\text{H}_2\text{O}$ , alcohol, ether and conc  $\text{H}_2\text{SO}_4$  Slowly sol in dil  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$  (Stahler, B 1905, 38 2624)

Not sol in alcohol (Knecht, B 1903, 36 169)  
 $+8\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Glatzel, B 9 1833)

Titanium hydrogen sesquisulphate,  $3\text{Ti}_2(\text{SO}_4)_3 + \text{H}_2\text{SO}_4 + 25\text{H}_2\text{O}$ Gradually sol in  $\text{H}_2\text{O}$  Insol in 60%  $\text{H}_2\text{SO}_4$ , alcohol, ether and glacial acetic acid (Stahler, B 1905, 38 2621)



**Titanyl sulphate, (TiO)SO<sub>4</sub>**

Decomp by H<sub>2</sub>O Slowly sol in cold, rapidly in warm HCl+Aq (Merz, J pr 99 157)

+2H<sub>2</sub>O Sol in H<sub>2</sub>O (Blondel, Bull Soc 1899, (3) 21 262)

2TiO<sub>2</sub>, 3SO<sub>3</sub>+3H<sub>2</sub>O Sol in H<sub>2</sub>O acidified with HCl (Blondel, Bull Soc 1899, (3) 21 262)

5TiO<sub>2</sub>, SO<sub>3</sub>+5H<sub>2</sub>O (Blondel)

7TiO<sub>2</sub>, 2SC<sub>3</sub>+xH<sub>2</sub>O (Blondel)

2TiO<sub>2</sub>, SO<sub>3</sub>+xH<sub>2</sub>O (Blondel)

**Uranous sulphate, basic, U(OH)<sub>2</sub>SO<sub>4</sub>+H<sub>2</sub>O**

Insol in H<sub>2</sub>O H<sub>2</sub>O dissolves out H<sub>2</sub>SO<sub>4</sub> (Ebelmen, A ch (3) 5 217)

+5H<sub>2</sub>O Sol in alcohol  
Pptd by ether (Rosenheim, Z anorg 1901, 26 251)

**Uranous sulphate, U(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O**

Sol in H<sub>2</sub>O with immediate decomp Easily sol in dil H<sub>2</sub>SO<sub>4</sub>+Aq (Kohl-schütter, B 1901, 34 3629)

Decomp by H<sub>2</sub>O into insol basic, and sol acid salt Sol in dil H<sub>2</sub>SO<sub>4</sub> or HCl+Aq Difficultly sol in conc acids (Ebelmen, A ch (3) 5 215)

**Solubility of U(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O in H<sub>2</sub>O at t°**

t°	% U(SO <sub>4</sub> ) <sub>2</sub>	t°	% U(SO <sub>4</sub> ) <sub>2</sub>
29	9 8	48 2	8 1
37	8 3	63	7 3

(Giolitti and Bucci, Gazz ch it 1905, 35 (2) 162)

1 pt is sol in 4 23 pts H<sub>2</sub>O at 13°, 4 3 pts at 11 3°, 4 4 pts at 9 1° (de Connck, A ch 1903, (7) 28 12)

+8H<sub>2</sub>O

**Solubility of U(SO<sub>4</sub>)<sub>2</sub>+8H<sub>2</sub>O in H<sub>2</sub>O at t°**

t°	% U(SO <sub>4</sub> ) <sub>2</sub>	t°	% U(SO <sub>4</sub> ) <sub>2</sub>
18	10 17	48 2	28 72
25 6	13 32	62	36 8
37	19 98	93	63 2

(Giolitti and Bucci, Gazz ch it 1905, 35 (2) 162)

**Sp gr of U(SO<sub>4</sub>)<sub>2</sub>+Aq at t°**

t	% salt	Sp gr
16	1	1 0058
16 8	2	1 0107
16	3	1 0165
17 8	4	1 0218
17 2	5	1 0272
18	6	1 0320
18 3	7	1 0379
17 4	8	1 0429
15 2	9	1 0485
15 6	10	1 0539

(de Connck, A ch 1903, (7) 28 11)

**Solubility in acids+Aq**  
1 pt U(SO<sub>4</sub>)<sub>2</sub> is sol in pts acid at t°

t°	Acid	Concentra-tion of acid	Pts acid
9 7 9 2	HCl "	1 4 "	5 74 5 8
11 2 10 3	HNO <sub>3</sub> "	1 4 "	5 4 5 53
11 4 10 7	H <sub>2</sub> SeO <sub>4</sub> (sp gr 1 4) "	1 4 "	4 57 4 66
15 14 2	HBr "	1 4 "	4 4 23
15 5 14 4	HC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> "	1 4 5 "	4 1 4 3
16 5 15 9	" "	1 2 "	3 72 3 85
11 7 10 9 10 1 9	H <sub>2</sub> SO <sub>4</sub> " " "	1 4 " " "	6 36 6 42 6 45 6 5

(de Connck, Chem Soc 1902, 82 (2) 45)

Sp gr of U(SO<sub>4</sub>)<sub>2</sub>+HCl(d=1 046) at t°  
d<sub>1</sub>=Sp gr referred to H<sub>2</sub>O  
d<sub>2</sub>=Sp gr referred to HCl

t	% salt	d <sub>1</sub>	d <sub>2</sub>
16	1	1 0525	1 0063
17	2	1 0572	1 0109
18	3	1 0619	1 0154
18 4	4	1 0667	1 0199
17 6	5	1 0714	1 0243

(de Connck, A ch 1903, (7) 28 11)

Sp gr of U(SO<sub>4</sub>)<sub>2</sub>+H<sub>2</sub>SO<sub>4</sub>(d=1 14) at t°  
d<sub>1</sub>=Sp gr referred to H<sub>2</sub>O  
d<sub>2</sub>=Sp gr referred to H<sub>2</sub>SO<sub>4</sub>

t	% salt	d <sub>1</sub>	d <sub>2</sub>
18 7	1	1 1442	1 0038
18 3	2	1 1494	1 0083
17 4	3	1 1539	1 0123
17 6	4	1 1583	1 0162
18 1	5	1 1626	1 0204

(de Connck, A ch 1903, (7) 28 11)

1 pt is sol in 8 pts alcohol (94°)+A (1 4) at 10 4° (de Connck)

Solubility in glycol at 14 8°=3 15% (Connck, C C 1905, II 883)

Min Johannite sl sol in H<sub>2</sub>C.

**Uranous hydrogen sulphate, U(SO<sub>4</sub>)<sub>2</sub>, H<sub>2</sub>SC+10H<sub>2</sub>O**

(Giolitti, C C 1905, II 1226)

**Uranyl sulphate, basic,  $3\text{UO}_3, \text{SO}_3 + 2\text{H}_2\text{O}$** 

(Athanasesco)  
 +14H<sub>2</sub>O Sol in H<sub>2</sub>O (Ordway, Sil  
 Am J (2) **26** 208)

4UO<sub>3</sub>, SO<sub>3</sub>+7H<sub>2</sub>O (Athanasesco, C R  
**103** 271)

UO<sub>2</sub>, 4UOSO<sub>4</sub>+8H<sub>2</sub>O Less sol in min  
 acids, especially dil H<sub>2</sub>SO<sub>4</sub>+Aq, than UOSO<sub>4</sub>  
 +2H<sub>2</sub>O (de Coninck, C C **1901**, II 1038)

**Uranyl sulphate, (UO<sub>2</sub>)SO<sub>4</sub>**

+H<sub>2</sub>O (de Coninck)  
 +3H<sub>2</sub>O Efflorescent Very sol in H<sub>2</sub>O  
 and alcohol

1 pt is sol in 0.6 pt cold H<sub>2</sub>O, in 0.45  
 pt boiling H<sub>2</sub>O, in 25 pts cold absolute  
 alcohol, in 20 pts boiling absolute alcohol  
 (Bucholz)

Sol in 0.47 pt H<sub>2</sub>O at 21°, and 0.28 pt  
 boiling H<sub>2</sub>O (Ebelmen)

100 pts H<sub>2</sub>O at 15.5° dissolve 160 pts, and  
 at 100°, 220 pts (Ure's Dict)

1 pt is sol in 5.3 pts H<sub>2</sub>O at 13.2°, 5.16  
 pts at 14.1°, 4.96 pts at 15.1°, 4.88 pts at  
 15.5° (de Coninck, A ch 1903, (7) **28** 8)

Sp gr of (UO<sub>2</sub>)SO<sub>4</sub>+Aq at t°

t°	% (UO <sub>2</sub> )SO <sub>4</sub>	Sp gr
14	1	1.0062
15.5	2	1.0113
11.3	3	1.0172
10.2	4	1.0229
10.2	5	1.0280
10	6	1.0338
14	7	1.0389
15.6	8	1.0442
11	9	1.0503
10.3	10	1.0557
11.4	11	1.0612
11.6	12	1.0669

(de Coninck, A ch 1903, (7) **28** 7)

**Solubility in acids +Aq**

1 pt (UO<sub>2</sub>)SO<sub>4</sub> is sol in  
 3.4 pts conc HCl at 12.8°  
 3.25 " " " 13.6°  
 5.9 " HBr(d=1.21) " 12.9°  
 6.1 " " " " 11.2°  
 10.8 " conc HNO<sub>3</sub> " 12.3°  
 11.2 " " " " 10.8°  
 4.3 " H<sub>2</sub>SO<sub>4</sub>(d=1.38) " 12.7°  
 4.1 " " " " 14.0°  
 5.6 " aqua regia (equal vol HCl+HNO<sub>3</sub>)  
 at 15.4°  
 5.47 pts aqua regia (equal vol HCl+  
 HNO<sub>3</sub>) at 16.4°  
 3.7 pts selenic acid (d=1.4) at 15.3°

(de Coninck, A ch 1903, (7) **28** 8)

Sp gr of (UO<sub>2</sub>)SO<sub>4</sub>+H<sub>2</sub>SO<sub>4</sub>(d=1.168) at t°

d<sub>1</sub>=Sp gr referred to H<sub>2</sub>O

d<sub>2</sub>=Sp gr referred to H<sub>2</sub>SO<sub>4</sub>

t°	% salt	d <sub>1</sub>	d <sub>2</sub>
20.6	1	1.1738	1.0050
22.2	2	1.1775	1.0082
21.1	3	1.1880	1.0129
22.7	4	1.1872	1.0165
22.3	5	1.1918	1.0204

(de Coninck, A ch 1903, (7) **28** 7)

1 pt is sol in 37.9 pts alcohol (85°) at  
 16.7°, 38.6 pts at 15.8° (de Coninck, A  
 ch 1903, (7) **28** 8)

Very sl sol in formic and glacial acetic  
 acids (de Coninck, A ch 1903, (7) **28** 9)

Completely pptd from (UO<sub>2</sub>)SO<sub>4</sub>+Aq by  
 HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> (Persoz)

**Uranyl hydrogen sulphate, (UO<sub>2</sub>)SO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>**

Very deliquescent (Schultz-Sellack)  
 2(UO<sub>2</sub>)SO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>+5H<sub>2</sub>O Very deliques-  
 cent (Wyrouboff, Bull Soc Min 1909, **32**  
 351)

**Uranyl pyrosulphate, (UO<sub>2</sub>)S<sub>2</sub>O<sub>7</sub>**

Very deliquescent Hisses with H<sub>2</sub>O  
 (Schultz-Sellack)

**Uranouranyl sulphate, USO<sub>4</sub>, (UO<sub>2</sub>)SO<sub>4</sub>**

Sol in H<sub>2</sub>O (Ebelmen) Decomp by  
 boiling (Berzelius)  
 Min *Voghannte*

**Uranyl sulphate ammonia, (UO<sub>2</sub>)SO<sub>4</sub>, 2NH<sub>3</sub>**

(v Unruh, Dissert **1909**)  
 (UO<sub>2</sub>)SO<sub>4</sub>, 3NH<sub>3</sub> (v Unruh)  
 (UO<sub>2</sub>)SO<sub>4</sub>, 4NH<sub>3</sub> (v Unruh)

**Vanadous sulphate, V<sub>2</sub>O<sub>3</sub>, 4SO<sub>3</sub>+9H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Brierlev, Chem Soc **49**  
 882)

**Vanadium sulphate, V<sub>2</sub>O<sub>5</sub>, 2SO<sub>3</sub>=(VO<sub>2</sub>)<sub>2</sub>S<sub>2</sub>O<sub>7</sub>**

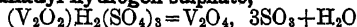
Deliquescent Easily sol in H<sub>2</sub>O  
 V<sub>2</sub>O<sub>5</sub>, 3SO<sub>3</sub> Deliquescent Sol in H<sub>2</sub>O  
 and alcohol

+3H<sub>2</sub>O Deliquescent Very sol in H<sub>2</sub>O,  
 but decomp by boiling Sol in alcohol  
 (Ditte, C R **102** 757)

VSO<sub>4</sub>+7H<sub>2</sub>O Decomp by air, very un-  
 stable, sol in H<sub>2</sub>O (Piccini, Z anorg 1899,  
**19** 204)

**Vanadium sesquisulphate, V<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>**

*Anhydrous*  
 Insol in H<sub>2</sub>O  
 Insol in conc H<sub>2</sub>SO<sub>4</sub>, but slowly sol in  
 boiling dil H<sub>2</sub>SO<sub>4</sub> Sol in HCl  
 Insol in alcohol and ether (Stahler, B  
 1905, **38** 3979)

**Vanadium hydrogen sulphate,**Sol in  $H_2O$ Sol in HCl Insol in 60%  $H_2SO_4$  + Aq, alcohol, ether and acetic acid (Stahler, B 1905, 38 3978)**Divanadyl sulphate,  $V_2O_5(SO_4)_2$** Insol in  $H_2O$ , HCl, or  $H_2SO_4$  + Aq, but on heating to 400° becomes sol in  $H_2O$  if heated to 130° therewith (Gerland)+4 $H_2O$  Very slowly sol in  $H_2O$  at 10°, quickly at 60°, and still more rapidly at 100°. Deliquesces in warm moist air more quickly than it dissolves in  $H_2O$  at 10° Insol in absolute alcohol Very sol in alcohol of 0.833 sp gr (Berzelius)+5 $H_2O$  (Koppel and Behrendt, Z anorg 1903, 35 168)+7 $H_2O$ , and 10 $H_2O$ +13 $H_2O$  Efflorescent (Gerland)2 $V_2O_5$ , 5 $SO_3$  + 18 $H_2O$  (Gain, C R 1906, 143 1154) $V_2O_5$ , 3 $SO_3$  + 10 $H_2O$  (G)2 $V_2O_5$ , 7 $SO_3$  + 20 $H_2O$  (G)2 $V_2O_5$ , 9 $SO_3$  + 22 $H_2O$  (G) $V_2O_5$ , 5 $SO_3$  + 12 $H_2O$  (G)**Divanadyl hydrogen sulphate,**+2 $H_2O$ +3 $H_2O$  Deliquescent Very slowly sol in cold  $H_2O$  or alcohol Easily sol in hot  $H_2O$  (Gerland)+5 $H_2O$  Deliquescent Insol in ether Scarcely sol in alcohol Slowly sol in cold, easily in hot  $H_2O$ , (Crow)+14 $H_2O$  Easily sol in cold  $H_2O$  or dil alcohol (Gerland)2 $VO_2$ , 3 $SO_3$  Sl sol in  $H_2O$  (Koppell and Behrendt, Z anorg 1903, 35 163)2 $VOSO_4$ ,  $H_2SO_4$  +  $H_2O$  Very slowly sol in  $H_2O$  (Koppel and Behrendt, Z anorg 1903, 35 163)2 $VOSO_4$ , 3 $H_2SO_4$  + 15 $H_2O$  (Gain, C R 1906, 143 1156)2 $VOSO_4$ , 4 $H_2SO_4$  + 16 $H_2O$  (G)2 $VOSO_4$ , 5 $H_2SO_4$  + 15 $H_2O$  (G)2 $VOSO_4$ , 7 $H_2SO_4$  + 15 $H_2O$  (G)2 $VOSO_4$ , 8 $H_2SO_4$  + 16 $H_2O$  (G)**Ytterbium sulphate,  $Yb_2(SO_4)_3 + 8H_2O$** Quite slowly sol in  $H_2O$  even at 100° Anhydrous salt is easily sol in much  $H_2O$ , but if little  $H_2O$  is used the hydrous salt is formed, which only slowly dissolves Sol in  $K_2SO_4$  + Aq100 pts  $H_2O$  dissolve at

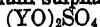
0° 15 5° 35° 55° 60°

44 2 34 6 19 1 11 5 10 4 pts  $Yb_2(SO_4)_3$ ,

70° 80° 90° 100°

7 22 6 93 5 83 4 67 pts  $Yb_2(SO_4)_3$ 

(Cleve, Z anorg 1902, 32 143)

**Yttrium sulphate, basic,  $Y_2O_3, SO_3 =$** Insol in  $H_2O$  (Berzelius)2 $Y_2O_3$ ,  $SO_3$  + 10 $H_2O$  (Cleve)**Yttrium sulphate,  $Y_2(SO_4)_3$** *Anhydrous* More sol in  $H_2O$  than the hydrous salt, and more sol in cold than hot  $H_2O$  Solution sat at 0° separates  $Y_2(SO_4)_3$  + 8 $H_2O$  at 50° 100 pts  $H_2O$  dissolve 15.2 pts anhydrous salt at ord temp5.38 pts are sol in 100 pts  $H_2O$  at 25° (James and Holden, J Am Chem Soc 1913, 35 561)Easily sol in large amount of sat  $K_2SO_4$  + Aq, from which 3 $K_2SO_4$ , 2 $Y(SO_4)_3$  is pptd on warming (Cleve and Höglund, Sv V A H Bih 1 No 8)Solubility of  $Y_2(SO_4)_3$  in  $Na_2SO_4$  + Aq at 25°

Pts $Y_2(SO_4)_3$ per 100 pts $H_2O$	Pts $Na_2SO_4$ per 100 pts $H_2O$	Solid phase
5 61	1 29	$Y_2(SO_4)_3$
6 38	3 85	
7 40	6 21	
8 43	8 53	
5 86	7 57	
4 75	7 72	$Y_2(SO_4)_3, Na_2SO_4 + 2H_2O$
3 42	10 14	
2 36	11 36	
2 02	13 42	
1 90	14 89	
1 79	16 51	$Na_2SO_4 + 10H_2O$
1 86	18 44	
2 99	19 96	
3 04	21 05	
2 27	27 14	
1 52	28 22	
1 61	28 13	
5 38	0 0	

(James and Holden, J Am Chem Soc 1913, 35 560)

+8 $H_2O$  100 pts  $H_2O$  dissolve 9.3 pts of cryst salt at ord temp, and 4.8 pts at 100° (Cleve, Bull Soc (2) 21 344)Less sol in  $H_2O$  containing  $H_2SO_4$  than in pure  $H_2O$  (Berzelius)Completely pptd by  $HC_2H_3O_2$  + Aq Insol in alcohol**Yttrium hydrogen sulphate,  $Y_2(SO_4)H_3$** 

(Brauner, Z anorg 1904, 38 332)

**Zinc sulphate, basic, 8 $ZnO, SO_3 + 2H_2O$** Insol in  $H_2O$  (Schindler, Mag Pharm 31 181)6 $ZnO$ ,  $SO_3$  + 10 $H_2O$  Insol in  $H_2O$  (Kane, A ch 72 310)4 $ZnO$ ,  $SO_3$  + 2 $H_2O$  Scarcely sol in hot or cold  $H_2O$  Sol in  $ZnSO_4$  + Aq (Kuhn, Schw J 60 337)

+3H<sub>2</sub>O (Werner, B 1907, **40** 4443)  
 +5H<sub>2</sub>O Nearly insol in H<sub>2</sub>O (Habermann, M **5** 432)  
 +6H<sub>2</sub>O (Kraut, Z anorg 1897, **13** 5)  
 +7H<sub>2</sub>O (Athanasesco, C R **103** 271)  
 +8H<sub>2</sub>O Extremely slowly decomp by H<sub>2</sub>O (Reindel, J pr 1869, (1) **106** 373)  
 +10H<sub>2</sub>O (Schindler)  
 3ZnO, SO<sub>3</sub> Insol in cold, sl sol in hot H<sub>2</sub>O. (Vogel)  
 2ZnO, SO<sub>3</sub> (Athanasesco)  
 5ZnO, SO<sub>3</sub> (Pickering, Chem Soc 1907, **91** 1986)  
 +4H<sub>2</sub>O (Moody, Am J Sci 1906, [4] **22** 184)  
 9ZnO, 2SO<sub>3</sub>+12H<sub>2</sub>O (Reindel, J pr 1869, (1) **106** 374)

**Zinc sulphate, ZnSO<sub>4</sub>**

Sol in H<sub>2</sub>O with evolution of heat  
 Sol in HCl+Aq  
 +H<sub>2</sub>O (Etard)  
 +2H<sub>2</sub>O Insol in alcohol (Kuhn)  
 +3½H<sub>2</sub>O (Anthon)  
 +5H<sub>2</sub>O Insol in boiling alcohol of 0.86 sp gr (Kuhn)  
 +6H<sub>2</sub>O (Marignac)  
 +7H<sub>2</sub>O Slowly efflorescent  
 M-pt of ZnSO<sub>4</sub>+7H<sub>2</sub>O=50° (Tilden, Chem Soc **45** 409)  
 For solubility data on hydrated salts, see below

Sol in 2+ pts H<sub>2</sub>O at ord temp and in less at 100° (Bergmann)  
 100 pts H<sub>2</sub>O at 104.4° dissolve 81.81 pts ZnSO<sub>4</sub> (Griffiths)  
 100 pts H<sub>2</sub>O at ord temp dissolve 140 pts ZnSO<sub>4</sub>+7H<sub>2</sub>O (Dumas)  
 Sol in 2.29 pts H<sub>2</sub>O at 18.75° (Abl)  
 100 pts H<sub>2</sub>O at 15.56° dissolve 140 pts ZnSO<sub>4</sub>+7H<sub>2</sub>O (Ures Diet)  
 100 pts H<sub>2</sub>O at 15° dissolve 140.53 pts ZnSO<sub>4</sub>+7H<sub>2</sub>O and has sp gr = 1.4442 (Michel and Krafft)

1 pt of the crystals dissolves in 0.923 pt H<sub>2</sub>O at 17.5°, and forms a solution of 1.4353 sp gr (Karsten)

100 pts ZnSO<sub>4</sub>+Aq sat at 18.20° contain 35.36 pts ZnSO<sub>4</sub> (v Hauer, J B **1866** 59)  
 100 pts H<sub>2</sub>O dissolve at

0°	20°	50°	75°
41.3	53.0	66.9	80.4

pts ZnSO<sub>4</sub> (Tobler, J B **1855** 309)

100 pts H<sub>2</sub>O at 20.5° dissolve 163.2 pts ZnSO<sub>4</sub>+7H<sub>2</sub>O (Schiff, A **109** 336)

100 pts H<sub>2</sub>O at t° dissolve pts anhydrous ZnSO<sub>4</sub> and pts ZnSO<sub>4</sub>+7H<sub>2</sub>O

t°	Pts ZnSO <sub>4</sub>	Pts ZnSO <sub>4</sub> +7H <sub>2</sub> O	t	Pts ZnSO <sub>4</sub>	Pts ZnSO <sub>4</sub> +7H <sub>2</sub> O
0	43.02	115.22	60	74.20	313.48
10	48.36	138.21	70	79.25	369.36
20	53.13	161.49	80	84.60	442.62
30	58.40	190.90	90	89.78	533.02
40	63.52	224.05	100	95.03	653.59
50	68.75	263.84			

(Poggiale, A ch (3) **8** 467)

**Solubility of ZnSO<sub>4</sub> in 100 pts H<sub>2</sub>O at t°**

t°	Pts ZnSO <sub>4</sub>	t°	Pts ZnSO <sub>4</sub>	t°	Pts ZnSO <sub>4</sub>
0	44.0	14	52.8	27	62.1
1	44.6	15	53.5	28	62.8
2	45.2	16	54.2	29	63.6
3	45.8	17	54.9	30	64.3
4	46.4	18	55.6	31	65.1
5	47.0	19	56.3	32	65.8
6	47.6	20	57.0	33	66.6
7	48.3	21	57.7	34	67.3
8	48.9	22	58.4	35	68.1
9	49.5	23	59.2	36	78.8
10	50.2	24	59.9	37	69.3
11	50.8	25	60.7	38	70.4
12	51.5	26	61.4	39	71.2
13	52.2				

Decomp into basic salt above 40°

(Mulder, Scheik Verhandel **1864** 74)

If solubility S represents number of pts anhydrous salt in 100 pts of solution, S=27.6+0.2604t from -5° to +81°, S=50.0-0.2244t from 81° to 175° (Etard, C R **106** 207)

Sat ZnSO<sub>4</sub>+Aq contains at

1°	13°	20°	41°	49°
29.1	32.6	34.8	40.2	40.9

% ZnSO<sub>4</sub>,

55°	62°	70°	77°	100°
43.4	45.0	47.0	46.5	44.7

% ZnSO<sub>4</sub>,

111°	12°	137°	144°	169°	171°
43.0	40.7	38.0	37.4	30.0	29.0

% ZnSO<sub>4</sub>

(Etard, A ch 1894, (7) **2** 551)

Transition point from +6H<sub>2</sub>O to +1H<sub>2</sub>O is 70° (Etard)

**Solubility of ZnSO<sub>4</sub>+6H<sub>2</sub>O in H<sub>2</sub>O at t°**

t°	g ZnSO <sub>4</sub> in 100 g H <sub>2</sub> O
-5.0	47.08
+0.1	49.48
9.1	54.20
15.0	57.15
25.0	63.74
30.0	65.82
35.0	67.99
39.0	70.08

(Cohen Z phys Ch 1900, **34** 182)

Solubility of the hepta- and hexa-hydrates of  $\text{ZnSO}_4$  at  $t^\circ$

$p$  = wt of salt expressed in percent of solution

$t^\circ$	$p$
0	29 43
0	29 53
0	29 49
15 00	33 66
15 88	33 85
30 70	38 46
39 92	41 36
39 95	41 37
40 73	41 43
41 49	41 70
46 40	42 68
49 97	43 51
49 99	43 41
50 00	43 50
50 02	43 51

Transition point from  $+7\text{H}_2\text{O}$  to  $+6\text{H}_2\text{O}$  is  $39^\circ$

The formula representing the change of solubility between  $0^\circ$  and  $39^\circ$  is

$$p = 29.5 + 0.270t + 0.00068t^2$$

while the expression for the hexahydrate above  $40^\circ$  is

$$p = 41.35 + 0.210t + 0.00070t^2$$

(Barnes, J phys Chem 1900, 4 19)

Solubility of  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	g $\text{ZnSO}_4$ in 100 g $\text{H}_2\text{O}$
-5	39 30
+0 1	41 93
9 1	47 09
15 0	50 88
25 0	57 90
35 0	66 61
39 0	70 05

(Cohen, Z phys Ch 1900, 34 182)

Solubility in  $\text{H}_2\text{O}$  at high pressures

Pressure in atm	$t^\circ$	g $\text{ZnSO}_4$ in 100 g $\text{H}_2\text{O}$	Solubility at 25
1	26	57 95	57 95
500	26	58 43	57 92
500	25 8	58 32	57 91
1000	25 8	57 95	57 55
1000	25 8	57 95	57 55

(Cohen and Sinnige, Z phys Ch 1909, 67 444)

Liable to form supersaturated solutions

Sat  $\text{ZnSO}_4 + \text{Aq}$  at  $8^\circ$  has sp gr = 1.421 (Anthon)

Sp gr of  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$  at  $20^\circ$

$\% = \% \text{ZnSO}_4 + 7\text{H}_2\text{O}$

%	Sp gr	%	Sp gr	%	Sp gr
1	1.0057	21	1.1288	41	1.2754
2	1.0115	22	1.1355	42	1.2834
3	1.0173	23	1.1423	43	1.2917
4	1.0231	24	1.1491	44	1.3000
5	1.0289	25	1.1560	45	1.3083
6	1.0348	26	1.1629	46	1.3167
7	1.0407	27	1.1699	47	1.3252
8	1.0467	28	1.1770	48	1.3338
9	1.0527	29	1.1842	49	1.3424
10	1.0588	30	1.1914	50	1.3511
11	1.0649	31	1.1987	51	1.3599
12	1.0710	32	1.2060	52	1.3688
13	1.0772	33	1.2134	53	1.3779
14	1.0835	34	1.2209	54	1.3871
15	1.0899	35	1.2285	55	1.3964
16	1.0962	36	1.2362	56	1.4057
17	1.1026	37	1.2439	57	1.4151
18	1.1091	38	1.2517	58	1.4246
19	1.1156	39	1.2595	59	1.4342
20	1.1222	40	1.2674	60	1.4439

(Schiff, A 110 72)

Sp gr of  $\text{ZnSO}_4 + \text{Aq}$  at  $15^\circ$

$\% = \% \text{ZnSO}_4 + 7\text{H}_2\text{O}$

%	Sp gr	%	Sp gr	%	Sp gr
1	1.006	21	1.130	41	1.280
2	1.013	22	1.137	42	1.288
3	1.019	23	1.143	43	1.295
4	1.024	24	1.150	44	1.304
5	1.0288	25	1.1574	45	1.3100
6	1.035	26	1.164	46	1.320
7	1.041	27	1.171	47	1.330
8	1.047	28	1.179	48	1.337
9	1.053	29	1.185	49	1.346
10	1.0593	30	1.1933	50	1.3532
11	1.066	31	1.200	51	1.362
12	1.073	32	1.209	52	1.380
13	1.079	33	1.216	53	1.370
14	1.085	34	1.224	54	1.390
15	1.0905	35	1.231	55	1.3986
16	1.097	36	1.240	56	1.408
17	1.103	37	1.246	57	1.416
18	1.110	38	1.255	58	1.425
19	1.116	39	1.263	59	1.435
20	1.1236	40	1.2709	60	1.4451

(Gerlach, Z anal 8 288)

Sp gr of  $\text{ZnSO}_4 + \text{Aq}$  at  $23.5^\circ$  a=no of g, equivalent to  $\frac{1}{2}$  mol wt, dissolved in 1000 g  $\text{H}_2\text{O}$ , b=sp gr if a is  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol wt = 143.5, c=sp gr if a is  $\text{ZnSO}_4$ ,  $\frac{1}{2}$  mol wt = 80.5

a	b	c	a	b
1	1 077	1 084	7	1 368
2	1 143	1 162	8	1 400
3	1 199	1 236	9	1 428
4	1 249	1 307	10	1 453
5	1 294	1 376	11	1 476
6	1 333	1 443		

(Favre and Valson, C R 79 968)

Sp gr of  $\text{ZnSO}_4 + \text{Aq}$  at  $18^\circ$

% $\text{ZnSO}_4$	Sp gr	% $\text{ZnSO}_4$	Sp gr	% $\text{ZnSO}_4$	Sp gr
5	1 0509	15	1 1675	32	1 3045
10	1 1369	20	1 2313	50	1 3788

(Kohlrausch, W Ann 1879 1)

Sp gr of  $\text{ZnSO}_4 + \text{Aq}$  at room temp containing

7 12 16 64 23 09%  $\text{ZnSO}_4$   
1 1064 1 1953 1 2814

(Wagner, W Ann 1883, 18 271)

Sp gr of  $\text{ZnSO}_4 + \text{Aq}$  at  $19.5^\circ$

Mass of salt per unit mass of solution	Density of solution (g per cc)
0 00186	1 00179
0 00371	1 00356
0 00556	1 00530
0 00740	1 00711
0 01106	1 01065
0 01469	1 01410
0 01829	1 01753
0 02187	1 02112
0 02542	1 02446
0 02895	1 02798

(McGregor, C N 1887, 55 4)

Sp gr of  $\text{ZnSO}_4 + \text{Aq}$  at  $25^\circ$

Concentration of $\text{ZnSO}_4 + \text{Aq}$	Sp gr
1—normal	1 0792
$\frac{1}{2}$ —	1 0402
$\frac{1}{4}$ —	1 0198
$\frac{1}{8}$ —	1 0094
$\frac{1}{16}$ —	1 0047

(Wagner, Z phys Ch 1890, 5 40)

Sp gr of  $\text{ZnSO}_4 + \text{Aq}$

g salt in 100 g solution	Sp gr
24 7170	1 3152
21 4444	1 2665
17 7573	1 2145
14 0307	1 1645
9 7426	1 1106
5 1110	1 0565

(Charpy, A ch 1893, (6) 29 27)

Sp gr of  $\text{ZnSO}_4 + \text{Aq}$

g equivalents $\text{ZnSO}_4$ per liter	$t^\circ$	Sp gr $t^\circ/t^\circ$
0 001309	13 59	1 0001126
0 002616	13 575	1 0002258
0 005212	13 573	1 0004451
0 01039	13 585	1 000886
0 09818	13 621	1 008189
0 18842	13 642	1 015587
0 1890	16 11	1 01550
2 493	15 88	1 19385

(Kohlrausch and Hallwachs, W Ann 1894, 53 27)

Sp gr of  $\text{ZnSO}_4 + \text{Aq}$  at  $18.5^\circ$ , when p = percent strength of solution, d = observed density, and w = volume conc in grams per cc ( $\frac{pd}{100} = w$ )

p	d	w
29 22	1 3718	0 40057
25 14	1 3091	0 32910
21 28	1 2528	0 26659
17 08	1 1957	0 20422
11 20	1 1220	0 12567
8 44	1 0894	0 09195
6 65	1 0696	0 07112
3 82	1 0387	0 03968
3 18	1 0318	0 03281
1 46	1 0138	0 01480
0 577	1 0045	0 00580

(Barnes, J phys Chem 1898, 2 542)

Sp gr of dil  $\text{ZnSO}_4 + \text{Aq}$  at  $20.004^\circ$   
Conc = g equiv per l at  $20.004^\circ$   
Sp gr compared with  $\text{H}_2\text{O}$  at  $20.004^\circ = 1$ .

Conc	Sp gr
0 0000	1 000,000,0
0 0001	1 000,008,6
0 0002	1 000,017,2
0 0005	1 000,043,2
0 0010	1 000,086,3
0 0020	1 000,172,3
0 0050	1 000,429,1
0 0060	1 000,514,3
1 0100	1 000,853,9

(Lamb and Lee, J Am Chem Soc 1913, 35 1690)

Sat  $\text{ZnSO}_4 + \text{Aq}$  boils at  $104.4^\circ$ , and solution contains 45 pts  $\text{ZnSO}_4$  to 100 pts  $\text{H}_2\text{O}$  (Griffiths)

Crust forms at  $103.5^\circ$ , the solution containing 68 pts  $\text{ZnSO}_4$  to 100 pts  $\text{H}_2\text{O}$ . Highest temp observed,  $105^\circ$  (Gerlach, Z anal **26** 426)

B-pt of  $\text{ZnSO}_4 + \text{Aq}$  containing pts  $\text{ZnSO}_4$  to 100 pts  $\text{H}_2\text{O}$

B pt	Pts $\text{ZnSO}_4$	B pt	Pts $\text{ZnSO}_4$
100 $5^\circ$	13 1	103 $0^\circ$	61 0
101 0	25 0	103 5	68 0
101 5	37 7	104 0	74 9
102 0	45 4	104 5	80 7
102 5	53 9	105 0	85 7

(Gerlach, Z anal **26** 432)

B-pt of  $\text{ZnSO}_4 + \text{Aq}$

g $\text{ZnSO}_4$ in 100 g $\text{H}_2\text{O}$	Rise of the b-pt	Barometric pressure mm
2 886	0 080	743 0
6 647	0 169	"
10 139	0 266	"
13 389	0 372	"
17 713	0 461	"
22 202	0 591	"
25 199	0 690	"
28 249	0 811	"
30 470	0 899	742 0
32 89	0 995	"
35 18	1 122	"
37 36	1 240	"
39 83	1 381	"
41 30	1 459	"
44 56	1 671	"

(Kahlenberg, J phys Chem 1901, **5** 370)

1 l absolute  $\text{H}_2\text{SO}_4$  dissolves 0.0021 mols  $\text{ZnSO}_4$  at  $25^\circ$  (Bergius, Z phys Ch 1912, **72** 353)

Completely pptd from  $\text{ZnSO}_4 + \text{Aq}$  by  $\text{HC}_2\text{H}_3\text{O}_2$  (Persoz)

Solubility of  $\text{ZnSO}_4$  in  $\text{KOH} + \text{Aq}$

-Mols $\text{KOH}$ to 1 mol $\text{ZnSO}_4$	per cent $\text{ZnO}$ in ppt
0 25	17 11
0 50	35 10
1 00	63 08
1 62	100 00
2 00	98 49
3 00	96 79
5 00	89 76
7 00	68 87
13 20	0 00

(Linebarger, J Am Chem Soc 1895, **17** 360)

Difficultly and slowly sol in sat  $\text{NH}_4\text{Cl} + \text{Aq}$ , with separation of a double sulphate

Sol in considerable quantity in sat  $\text{NaCl} + \text{Aq}$ , without pptn at first, but finally  $\text{Na}_2\text{SO}_4$  separates out See under  $\text{NaCl}$

Sol in sat  $\text{NaNO}_3 + \text{Aq}$  as in  $\text{NaCl} + \text{Aq}$  See under  $\text{NaNO}_3$

Sol in sat  $\text{KNO}_3 + \text{Aq}$  with immediate pptn of double sulphate (Karsten) See under  $\text{KNO}_3$

Very rapidly sol in sat  $\text{K}_2\text{SO}_4 + \text{Aq}$ , with separation of a double salt (Karsten) See under  $\text{K}_2\text{SO}_4$

Abundantly in sat  $\text{CuSO}_4 + \text{Aq}$

Slowly sol in sat  $\text{MgSO}_4 + \text{Aq}$

Very rapidly and abundantly sol in sat  $\text{NaSO}_4 + \text{Aq}$

For solubility of  $\text{ZnSO}_4 + \text{Na}_2\text{SO}_4$  see under  $\text{Na}_2\text{SO}_4$  and  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, **20** 830)

Insol in alcohol of 0.88 sp gr, 1000 pts alcohol of 0.905 sp gr dissolve 2 pts (Anthon)

100 pts of a saturated solution in 40% alcohol contain 3.48 pts  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$ , 20%, 39 pts, 10%, 51.1 pts (Schiff, J B 1861 87)

100 pts absolute methyl alcohol dissolve 0.65 pt  $\text{ZnSO}_4$  at  $18^\circ$  (de Bruyn, Z phys Ch **10** 783)

100 pts absolute methyl alcohol dissolve 59 pts  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$  at  $17^\circ$

100 pts 50% methyl alcohol dissolve 15.7 pts  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$  at  $17^\circ$  (de Bruyn)

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, **37** 4329)

100 pts glycerine dissolve 35 pts  $\text{ZnSO}_4$  at ord temp (Klever, Bull Soc 1872, (2) 18 372)

Insol in methyl acetate (Naumann, B 1909, **42** 3790), ethyl acetate (Naumann, B 1904, **37** 3601)

Min *Gosslarite*

**Zinc hydrogen sulphate**,  $\text{ZnH}_2(\text{SO}_4)_2 + 8\text{H}_2\text{O}$

Somewhat difficultly sol in cold, easily in hot  $\text{H}_2\text{O}$  (v Kobell, J pr **28** 492)

**Zinc sulphate ammonia, basic**,  $4\text{NH}_3$ ,  $4\text{ZnO}$ ,  $\text{SO}_3 + 4\text{H}_2\text{O}$

Ppt (Schundler)

**Zinc sulphate ammonia**,  $\text{ZnSO}_4$ ,  $2\text{NH}_3$

$+ \text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  into basic zinc sulphate

$\text{ZnSO}_4$ ,  $4\text{NH}_3 + 4\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Kane, A ch **72** 304)

$+ 3\text{H}_2\text{O}$  (André, C R **100** 241)

$\text{ZnSO}_4$ ,  $5\text{NH}_3$  Sol in  $\text{H}_2\text{O}$  with partial decomp (Rose, Pogg **20** 149)

**Zinc sulphate cupric oxide**,  $\text{ZnSO}_4$ ,  $2\text{CuO} + 5\text{H}_2\text{O}$

(Mailhe, A ch 1902, (7) **27** 169)

$\text{ZnSO}_4$ ,  $3\text{CuO} + x\text{H}_2\text{O}$  (Reccour, C R 1901, **132** 1415)

+5H<sub>2</sub>O  
 2ZnSO<sub>4</sub>, 3CuO+12H<sub>2</sub>O (Mailhe, A ch  
 1902, (7) 27 169)  
 7ZnSO<sub>4</sub>, 24CuO+xH<sub>2</sub>O (Recoura, C R  
 1901, 132 1415)

### Zinc sulphate hydrazine, ZnSO<sub>4</sub>, 2N<sub>2</sub>H<sub>4</sub>

Sol in NH<sub>4</sub>OH+Aq (Franzen, Z anorg  
 1908, 60 278)  
 Sol in NH<sub>4</sub>OH+Aq without decomp  
 (Curtius, J pr 1894, (2) 50 345)

ZnH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, N<sub>2</sub>H<sub>4</sub> 1 pt is sol in 185 pts  
 H<sub>2</sub>O at 12°. Sl sol in dil acids. Decomp  
 by conc HNO<sub>3</sub> and by hot conc H<sub>2</sub>SO<sub>4</sub>  
 Very sol in NH<sub>4</sub>OH+Aq (Curtius, J  
 pr 1894, (2) 50 331)

### Zirconium sulphate, basic, 3ZrO<sub>2</sub>, 2SO<sub>3</sub>

Insol in H<sub>2</sub>O Sol in HCl+Aq (Pay-  
 kull, B 12 1719)

4ZrO<sub>2</sub>, 3SO<sub>3</sub>+14H<sub>2</sub>O Ppt Difficulty sol  
 in H<sub>2</sub>O (Hauser, B 1904, 37 2024)

3ZrO<sub>2</sub>, SO<sub>3</sub> Insol in boiling H<sub>2</sub>O (Franz,  
 B 3 58)

7ZrO<sub>2</sub>, 6SO<sub>3</sub> Insol in H<sub>2</sub>O (Endemann,  
 J pr (2) 11 219)

ZrO<sub>2</sub>, SO<sub>3</sub> Sol in very little H<sub>2</sub>O More  
 H<sub>2</sub>O decomp into 3ZrO<sub>2</sub>, 2SO<sub>3</sub> and Zr(SO<sub>4</sub>)<sub>2</sub>  
 (Berzelius)

3ZrO<sub>2</sub>, 4SO<sub>3</sub>+15H<sub>2</sub>O Sol in H<sub>2</sub>O (Pay-  
 kull)

6ZrO<sub>2</sub>, 7SO<sub>3</sub>+19H<sub>2</sub>O Sol in H<sub>2</sub>O (Pay-  
 kull)

### Zirconium sulphate, Zr(SO<sub>4</sub>)<sub>2</sub>

Anhydrous Slowly but completely sol  
 in cold, quickly in hot H<sub>2</sub>O

Sol in warm H<sub>2</sub>SO<sub>4</sub>, but separates on cool-  
 ing. Precipitated from aqueous solution by  
 alcohol

+4H<sub>2</sub>O Easily sol in H<sub>2</sub>O

100 pts of the solution contain 59.3 pts  
 of the hydrated salt at 39.5° (Hauser, B  
 1904, 37 2025)

Solubility of Zr(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O in H<sub>2</sub>SO<sub>4</sub>+  
 Aq at t°

100 g of the solution contain

t	g ZrO <sub>2</sub>	g SO <sub>3</sub>
39.5	19.5	25.46
	19.3	25.6
	19.6	25.99
	19.3	26.5
	18.8	27.0
	18.15	27.6
	17.3	25.3
	16.2	29.1
	9.6	32.3
	5.3	34.7
	3.51	36.01
	1.03	38.2
	0.46	39.8
	0.31	42.0

Solubility of Zr(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O in H<sub>2</sub>SO<sub>4</sub>+  
 Aq at t°—Continued

t°	g ZrO <sub>2</sub>	g SO <sub>3</sub>
	0.33	42.1
	0.14	46.8
	0.13	47.1
	0.15	56.7
	0.20	56.8
	0.27	57.1
	0.50	57.5
	0.60	57.8
	2.00	59.5
	3.25	60.4
	4.40	61.4
22	0.10	56.1
	0.13	46.5
	0.21	57.2

(Hauser, Z anorg 1907, 54 197)

### Zirconium hydrogen sulphate, Zr(SO<sub>4</sub>)<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>+H<sub>2</sub>O

Solubility in H<sub>2</sub>SO<sub>4</sub>+Aq at 39.5°

100 g of the solution contain

0.11	0.10	0.10	g ZrO <sub>2</sub>
81.4	81.6	81.5	g SO <sub>3</sub>

(Hauser, Z anorg 1907, 54 200)

+3H<sub>2</sub>O

Solubility in H<sub>2</sub>SO<sub>4</sub>+Aq at t°

100 g of the solution contain

t°	g ZrO	g SO <sub>3</sub>
39.5	4.55	61.5
	3.25	62.5
	3.33	63.8
	3.35	63.8
	1.80	64.2
	1.60	64.6
	1.55	65.0
	1.12	66.8
	0.96	68.4
22	0.80	66.4
	0.65	67.5
	0.60	68.1

(Hauser, Z anorg 1907, 54 200)

### Persulphuric acid, HSO<sub>4</sub>

See Persulphuric acid

### Pyrosulphuric acid and pyrosulphates

See under Sulphuric acid and sulphates

### Sulphuric boric acid

See Borosulphuric acid

### Sulphuric vanadic acid, V<sub>2</sub>O<sub>5</sub>, 3SO<sub>3</sub>+3H<sub>2</sub>O

See Sulphate, vanadium



**Sulphurous acid, anhydrous, SO<sub>2</sub>***See Sulphur dioxide***Sulphurous acid, H<sub>2</sub>SO<sub>3</sub>**

Known only in aqueous solution, from which SO<sub>2</sub> is given off upon heating. Crystallizes in cold, with various amounts of water, forming compounds which approximate H<sub>2</sub>SO<sub>3</sub>+8H<sub>2</sub>O (Pierre, A 68 228), H<sub>2</sub>SO<sub>3</sub>+10H<sub>2</sub>O (Dopping, Bull Ac St Pétersb 7 100), H<sub>2</sub>SO<sub>3</sub>+14H<sub>2</sub>O (Schonfeld, A 95 22), H<sub>2</sub>SO<sub>3</sub>+6H<sub>2</sub>O (Roozeboom, R t c 3 29, 59, 75, 84, Geuther, A 224 218). Crystals are sol in 2 pts H<sub>2</sub>O at 10° (Pierre).

For sp gr of solutions, etc., see sulphur dioxide

**Sulphites**

*Normal* Only the alkali sulphites are sol in H<sub>2</sub>O, and they are insol or only sl sol in alcohol

Insol in liqhd NH<sub>3</sub> (Franklin, Am ch J 1898, 20 824)

*Acid* All the acid sulphites are sol in H<sub>2</sub>O

In general it is rarely possible to determine whether the compd described is a pure chemical compound or not. It is probable that many substances described by Svennsen and others are isomorphic mixtures whose composition depends upon the temp and conc of the solution in which it was pptd (Rosenheim, Z anorg 1900, 25 72)

**m sulphite, basic, Al<sub>2</sub>O<sub>3</sub>, SO<sub>2</sub>+4H<sub>2</sub>O**

in H<sub>2</sub>O, sol in H<sub>2</sub>SO<sub>3</sub>+Aq (Fourdj Vauquelin)

6Al(OH)<sub>3</sub>.Al<sub>2</sub>(SO<sub>3</sub>)<sub>3</sub>+9H<sub>2</sub>O Ppt (Seubert, Z anorg 1893, 4 66)

**Ammonium sulphite, basic, (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, NH<sub>3</sub>+<sup>3</sup>/<sub>2</sub>H<sub>2</sub>O**

Sol in H<sub>2</sub>O Pptd from aqueous solution by alcohol (Muspratt)

Does not exist (Marignac)

**Ammonium sulphite, (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>**

Very hygroscopic (Divers, Chem Soc 1900, 77 336)

Insol in acetone (Eidmann, C C 1899, II 1014)

+H<sub>2</sub>O Slowly sol in H<sub>2</sub>O (Muspratt, A 50 268)

Sol in 1 pt H<sub>2</sub>O at 12° (Fourcroy and Vauquelin, Crell Ann 1800 2 415)

More sol in hot H<sub>2</sub>O with evolution of NH<sub>3</sub>. Sl sol in absolute alcohol (Muspratt)

Much more sol in alcohol than K<sub>2</sub>SO<sub>3</sub> (Pierre)

Loses NH<sub>3</sub> in the air

Sol in H<sub>2</sub>O Conc solution charged with NH<sub>3</sub> will deposit salt on evaporation over KOH. Dil solution decomp on evaporation (Divers, Chem Soc 1900, 77 335)

Insol in acetone (Naumann, B 1904, 37 4329)

**Ammonium hydrogen sulphite, NH<sub>4</sub>HSO<sub>3</sub>**

Insol in acetone (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329)

**Ammonium pyrosulphite, (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>5</sub>**

Deliquescent Very sol in H<sub>2</sub>O and alcohol Insol in ether (Fock and Klüss, B 23 3149)

Very sol in H<sub>2</sub>O, very hygroscopic. Aq solution is sl decomp on evaporation (Divers, Chem Soc 1900, 77 336)

**Ammonium cadmium sulphite, (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, CdSO<sub>3</sub>**

Nearly insol in H<sub>2</sub>C Partly sol in excess of H<sub>2</sub>SO<sub>3</sub>+Aq, but separates out on boiling (Schuler, A 87 34)

**Ammonium cobaltous sulphite, (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, CoSO<sub>3</sub>+xH<sub>2</sub>O**

Decomp on air (Berglund, B 7 469)

**Ammonium cobaltocobaltic sulphite**

*See Cobalt sulphite, ammonium cobalt*

**Ammonium cuprous sulphite, (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, 2Cu<sub>2</sub>SO<sub>3</sub>+2H<sub>2</sub>O**

(Böttger, A 51 411)

(NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, Cu<sub>2</sub>SO<sub>3</sub> Insol in cold, decomp by boiling H<sub>2</sub>O (Rogojski, J B 1851 366)

Decomp by warming with H<sub>2</sub>O, in which it is insol. Sol in acids with evolution of SO<sub>2</sub>. (Rosenheim and Steinhäuser, Z anorg 1900, 25 99)

+2H<sub>2</sub>O (Commaile, J B 1867 300)

2(NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, Cu<sub>2</sub>SO<sub>3</sub>+3H<sub>2</sub>O Very sol in H<sub>2</sub>O. Solution decomp on standing. Decomp by acids (Rosenheim and Steinhäuser)

5(NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, Cu<sub>2</sub>SO<sub>3</sub>+2H<sub>2</sub>O Decomp on air. Sol in H<sub>2</sub>O with decomp (Svensson)

6(NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, Cu<sub>2</sub>SO<sub>3</sub>+4H<sub>2</sub>O Easily decomp (Rosenheim and Steinhäuser)

7(NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, Cu<sub>2</sub>SO<sub>3</sub>+4H<sub>2</sub>O Very sol in H<sub>2</sub>O. Solution soon decomp (Rosenheim and Steinhäuser)

+10H<sub>2</sub>O Decomp on air. Sl sol in warm, less sol in cold H<sub>2</sub>O (de Saint-Gilles)

+14H<sub>2</sub>O Decomp on air. Sol in H<sub>2</sub>O, but solution decomp

Very easily sol in mother liquor (Svensson, Acta Lund 1899 13)

**Ammonium cuprocupric sulphite, (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, 2Cu SO<sub>3</sub>.CuSC<sub>3</sub>+5H<sub>2</sub>O**

Insol in H<sub>2</sub>O and weak acids. Sol in NH<sub>4</sub>OH+Aq (de Saint-Gilles, A ch 3) 42 31)

+6<sup>1</sup>/<sub>2</sub>H<sub>2</sub>O Ppt (Rosenheim and Steinhäuser, Z anorg 1900, 25 98)

**Ammonium glucinum sulphite,**  
 $(\text{NH}_4)_2\text{O}$ ,  $2\text{GfO}$ ,  $3\text{SO}_2 + 4\text{H}_2\text{O}$

Ppt Very unstable in the air (Rosenheim, Z anorg 1897, **15** 310)

**Ammonium gold (aurous) sulphite,**  
 $3(\text{NH}_4)_2\text{SO}_3 \cdot \text{Au}_2\text{SO}_3$

Very easily sol in  $\text{H}_2\text{O}$  Insol in alcohol (Haase, Z Ch **1869** 535)

**Ammonium gold (aurous) sulphite ammonia,**  
 $(\text{NH}_4)_2\text{SO}_3$ ,  $3\text{Au}_2\text{SO}_3$ ,  $6\text{NH}_3 + \text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  Sol in warm  $\text{NH}_4\text{OH} + \text{Aq}$ , but decomp by boiling

$(\text{NH}_4)\text{Au}_3(\text{SO}_3)_2$ ,  $3\text{NH}_3 + 4\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1908, **59** 201)

**Ammonium iridium sulphite**

See Iridosulphite, ammonium

**Ammonium iron (ferrous) sulphite,**  
 $(\text{NH}_4)_2\text{SO}_3$ ,  $\text{FeSO}_3 + x\text{H}_2\text{O}$

(Berglund)

**Ammonium iron (ferric) sulphite sulphate,**  
 $\text{FeSO}_3 \cdot \text{SO}_4 \cdot \text{NH}_4 + \text{H}_2\text{O}$

Sl sol in cold  $\text{H}_2\text{O}$  Decomp by cold dil HCl (Hofmann, Z anorg 1897, **14** 287)

**Ammonium magnesium sulphite,**  
 $(\text{NH}_4)_2\text{Mg}_3(\text{SO}_3)_4 + 18\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$  (Fourcroy and Vauquelin)

Sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$   
 $+ 5\text{H}_2\text{O}$  Much more sol in  $\text{H}_2\text{O}$  than  $\text{MgSO}_3$  (Rammelsberg)

**Ammonium manganous sulphite,**  $(\text{NH}_4)_2\text{SO}_3$ ,  
 $\text{MnSO}_3$

Relatively easily decomp by  $\text{H}_2\text{O}$  (Berglund, Bull Soc (2) **21** 213)

Not easily decomp (Gorgcu, C R **96** 376)

**Ammonium mercuric sulphite,**  $(\text{NH}_4)_2\text{SO}_3$ ,  
 $\text{HgSO}_3$

Very easily sol in  $\text{H}_2\text{O}$ , but  $\text{H}_2\text{O}$  solution gradually decomp, even in the cold

**Ammonium nickel sulphite,**  $(\text{NH}_4)_2\text{SO}_3$ ,  
 $3\text{NiSO}_3 + 18\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Berglund, B **7** 469)

**Ammonium platnous sulphite**

See Platosulphite, ammonium

**Ammonium potassium sulphite,**  $10(\text{NH}_4)_2\text{SO}_3$ ,  
 $\text{K}_2\text{SO}_3 + 11\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$ , etc (Hartog, C R **109** 221)

**Ammonium scandium sulphate,**  
 $(\text{NH}_4)_2\text{SO}_3$ ,  $\text{Sc}_2(\text{SO}_4)_3 + 7\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Difficulty sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  (Meyer, Z anorg 1914, **86** 281)

**Ammonium silver sulphite,**  $(\text{NH}_4)_2\text{SO}_3$ ,  
 $\text{Ag}_2\text{SO}_3$

Insol in  $\text{H}_2\text{O}$ , but gradually decomp thereby (Svensson, B **4** 714)

$6(\text{NH}_4)_2\text{SO}_3$ ,  $\text{Ag}_2\text{SO}_3 + 19\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  without decomp (Svensson)

$3(\text{NH}_4)_2\text{SO}_3$ ,  $4\text{NH}_4\text{HSO}_3$ ,  $\text{Ag}_2\text{SO}_3 + 18\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$ , but decomp by warming

**Ammonium sodium hydrogen sulphite,**  
 $\text{NH}_4\text{Na}_2\text{H}(\text{SO}_3)_2 + 4\text{H}_2\text{O}$

Not deliquescent (Marignac, Ann Min (5) **12** 29)

100 pts  $\text{H}_2\text{O}$  dissolve 42.3 pts salt at  $12.4^\circ$ , and 48.5 pts at  $15^\circ$  (Schwicker, B **22** 1732)

$+ 5\text{H}_2\text{O} = 2\text{Na}_2\text{SO}_3$ ,  $(\text{NH}_4)_2\text{S}_2\text{O}_5 + \text{H}_2\text{O}$  (Tauber, Techn J B **1888** 444)

**Ammonium tellurium sulphite,**  $(\text{NH}_4)_2\text{SO}_3$ ,  
 $\text{TeSO}_3 + x\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Berglund, B **7** 469)

**Ammonium uranyl sulphite,**  
 $\text{NH}_4(\text{UO}_2)(\text{OH})\text{SO}_3$

Insol in pure  $\text{H}_2\text{O}$  More sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  than the K salt, and less than the Na salt (Scheller, A **144** 240)

$(\text{NH}_4)_2\text{O}$ ,  $2\text{UO}_3$ ,  $3\text{SO}_2$

$(\text{NH}_4)_2\text{O}$ ,  $4\text{UO}_3$ ,  $5\text{SO}_2$

$(\text{NH}_4)_2\text{O}$ ,  $3\text{UO}_3$ ,  $2\text{SO}_2$

$(\text{NH}_4)_2\text{O}$ ,  $\text{UO}_3$ ,  $2\text{SO}_2$  (Kohlschutter, A **1900**, **311** 10)

**Ammonium vanadium sulphite**

See Vanadosulphite, ammonium

**Ammonium vanadyl sulphite,**

$(\text{NH}_4)_2\text{SO}_3$ ,  $\text{VO}\text{SO}_3 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with decomp (Koppel, Z anorg 1903, **35** 184)

$(\text{NH}_4)_2\text{O}$ ,  $3\text{VO}_3$ ,  $2\text{SO}_2 + \text{H}_2\text{O}$  Sol in cold  $\text{H}_2\text{O}$  without decomp

Easily sol in mineral acids and alkalis

Sl sol in alcohol and ether (Koppel Z anorg 1903, **35** 182)

**Ammonium zinc sulphite,**  $(\text{NH}_4)_2\text{SO}_3$ ,  $\text{ZnSO}_3$

Sol in  $\text{H}_2\text{O}$  (Berglund, B **7** 469)

**Ammonium sulphite mercuric chloride,**  
 $2(\text{NH}_4)_2\text{SO}_3$ ,  $\text{HgCl}_2$

Sl sol in cold, decomp by boiling  $\text{H}_2\text{O}$  (de St-Giles, A ch (3) **36** 95)

**Antimony sulphite,**  $\text{Sb}_2\text{O}_3$ ,  $3\text{SO}_2(?)$

Insol in  $\text{H}_2\text{O}$  (Berzelius)

Could not be obtained (Rohrig, J pr (2) **37** 241)

**Barium sulphite, BaSO<sub>3</sub>**

Very sl sol in H<sub>2</sub>O (Fourcroy and Vauquelin, A ch 24 301)

Sol in about 46,000 pts H<sub>2</sub>O at 16° (Autenrieth, Z anal 1898, 37 294)

Sol in H<sub>2</sub>SO<sub>3</sub>+Aq

Insol in acetone (Naumann B 1904, 37 4329), methyl acetate (Naumann, B 1909, 42 3790)

Solubility in sugar+Aq at t°

Solvent	t	100 ccm of solution contain g BaSO <sub>3</sub>
water	20	0 01974
sucrose+Aq 10° Brix		0 01040
" " 20° "		0 00968
" " 30° "		0 00782
" " 40° "		0 00484
" " 50° "		0 00298
(sat) " 60° "		0 00223
water	80	0 00177
sucrose+Aq 10° Brix		0 00335
" " 20° "		0 00289
" " 30° "		0 00223
" " 40° "		0 00158
" " 50° "		0 00149
(sat) " 60° "		0 00112

(Rogowicz, C C 1905, II 1223)

**Barium cobaltic sulphite**

See Cobaltisulphate, barium

**Barium gold (aurous) sulphite, 3BaSO<sub>3</sub>,**

Au<sub>2</sub>SO<sub>3</sub>+xH<sub>2</sub>O

Ppt (Haase)

**Barium mercuric sulphite, BaSO<sub>3</sub>, HgSO<sub>3</sub>+H<sub>2</sub>O**

Ppt (Barth, Z phys Ch 9 196)

**Barium mercuric sulphite chloride,**

BaSO<sub>3</sub>, BaCl<sub>2</sub>, 2HgSO<sub>3</sub>+3½H<sub>2</sub>O

(Barth, Z phys Ch 1892, 9 208)

**Bismuth sulphite, basic, Bi<sub>2</sub>O<sub>3</sub>, 3SO<sub>3</sub>+5H<sub>2</sub>O**

Insol in H<sub>2</sub>O, alcohol, or ether Sl sol in H<sub>2</sub>SO<sub>3</sub>+Aq (Rohrig, J pr (2) 37 241)

(BiO)<sub>2</sub>SO<sub>3</sub>, 3(BiOH)SO<sub>3</sub>+H<sub>2</sub>O (Seubert and Elten, Z anorg 1893, 4 72-5)

2(BiO)<sub>2</sub>SO<sub>3</sub>, 3(BiOH)SO<sub>3</sub>+2H<sub>2</sub>O (S and E)

3(BiO)<sub>2</sub>SO<sub>3</sub>, 7(BiOH)SO<sub>3</sub>+10H<sub>2</sub>O (S and E)

4(BiO)<sub>2</sub>SO<sub>3</sub>, (BiOH)SO<sub>3</sub>+5H<sub>2</sub>O (S and E)

9(BiO)<sub>2</sub>SO<sub>3</sub>, (BiOH)SO<sub>3</sub>+2H<sub>2</sub>O (S and E)

**Bismuth cobaltic sulphite**

See Cobaltisulphite, bismuth

**Cadmium sulphite, CdSO<sub>3</sub>**

Difficultly sol in H<sub>2</sub>O Easily sol in d acids (Rammelsberg, Pogg 67 256)

+2H<sub>2</sub>O Difficultly sol in H<sub>2</sub>O Sol H<sub>2</sub>SO<sub>3</sub>+Aq Sol in NH<sub>4</sub>OH+Aq Insol alcohol (Muspratt, Phil Mag (3) 30 414)

Insol in acetone (Naumann, B 1904, 3 4329)

Contains 2½H<sub>2</sub>O (Deniges, Bull Soc (7 569)

**Cadmium sodium sulphite, 3CdSO<sub>3</sub>, Na<sub>2</sub>SO**

Sol in H<sub>2</sub>O (Berglund, B 7 469)

**Cadmium sulphite, ammonia, CdSO<sub>3</sub>, NH**

Decomp by H<sub>2</sub>O Sol without decomp 1 hot NH<sub>4</sub>OH+Aq (Rammelsberg, Pogg 67 256)

**Cæsium sulphite, Cs<sub>2</sub>SO<sub>3</sub>**

Easily sol in H<sub>2</sub>O Sl sol in alcohols (Chabré, C R 1901, 133 297)

**Cæsium hydrogen sulphite, CsHSO<sub>3</sub>**

Easily sol in H<sub>2</sub>O Sl sol in alcohols (Chabré, C R 1901, 133 297)

**Calcium sulphite, basic, Ca<sub>9</sub>S<sub>5</sub>O<sub>16</sub>=6CaO 5SO<sub>2</sub>**

(Schott, Dingl 202 52)

**Calcium sulphite, CaSO<sub>3</sub>+2H<sub>2</sub>O**

Slowly effloresces Sol in 800 pts cold H<sub>2</sub>O (Berzelius)

Insol in H<sub>2</sub>O (Rohrig, J pr (2) 37 230) 0 043 g is sol in 1 l H<sub>2</sub>O at 18° (Weisberg, Bull Soc 1896, (3) 15 1249)

CaSO<sub>3</sub> equiv to 78 mg CaO is sol in 1 l H<sub>2</sub>O at 100° (Robart, C A 1913 2500)

Very sol in H<sub>2</sub>SO<sub>3</sub>+Aq See CaH<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>

Insol in liquid NH<sub>3</sub> (Franklin, Am Ch J 1898, 20 827)

CaSO<sub>3</sub> equiv to 37 mg CaO is sol in 1 l 12% cane sugar+Aq at 100° (Robart, C A 1913 2500)

0 0825 g is sol in 1 l 10% sugar+Aq at 18°, 0 0800 g is sol in 1 l 20% " " +Aq at 18° (Weisberg, Bull Soc 15 1219)

Insol in acetone (Krug and M'Elroy, 1909, 42 3790, ethyl acetate (Naumann, B 1904, 37 3601)

+½H<sub>2</sub>O (Rammelsberg)

**Calcium hydrogen sulphite, CaH<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>**

Known only in solution 100 ccm H<sub>2</sub>O containing 9 g SO<sub>2</sub> dissolve

0 553 g CaSO<sub>3</sub> to form a solution of 1 06 sp gr (Gerland, J pr (2) 4 119)

**Calcium cobaltic sulphite**

See Cobaltisulphite, calcium

**erous sulphite,  $\text{Ce}_2(\text{SO}_3)_3 + 3\text{H}_2\text{O}$** 

More sol in cold than hot  $\text{H}_2\text{O}$   
 Solution gradually decomposes (Berthier,  
 ch (3) 7 77)

**chromous sulphite,  $\text{CrSO}_3$** 

Precipitate Insol in  $\text{H}_2\text{O}$  (Moberg)

**chromium sulphite, basic,  $\text{Cr}_2\text{O}_3, \text{SO}_2$** 

*Colloidal modification* Sol in  $\text{H}_2\text{O}$   
 $2\text{Cr}_2\text{O}_3, \text{SO}_2$  Ppt (Recoura, Bull Soc  
 398, (3) 19 169)

**chromic sulphite**

Known only in aqueous solution, which pre-  
 cipitates a basic salt on boiling  
 $2\text{Cr}_2\text{O}_3, 3\text{SO}_2 + 16\text{H}_2\text{O}$  Precipitate (Dan-  
 in, Chem Soc 2 205)

**chromic potassium sulphite,  $\text{K}_2\text{O}, \text{Cr}_2\text{O}_3,$   
 $2\text{SO}_2 + x\text{H}_2\text{O}$** 

Precipitate (Berglund, B 7 470)

**cobaltous sulphite, basic**

Ppt Decomp by  $\text{H}_2\text{O}$  (Berthier)  
 $\text{Co}(\text{OH})_2, 5\text{CoSO}_3 + 10\text{H}_2\text{O}$  Ppt (Seu-  
 ert and Elten, Z anorg 1893, 4 89)  
 $\text{Co}(\text{OH})_2, 10\text{CoSO}_3 + 15\text{H}_2\text{O}$  (Seubert and  
 Elten)

**cobaltous sulphite,  $\text{CoSO}_3$** 

$+3\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$  Sol in  
 $\text{I}_2\text{SO}_3 + \text{Aq}$  (Rammelsberg)  
 Partly sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
 $+5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{SO}_3 +$   
 $\text{Aq}$  (Muspratt, A 30 282)

**cobaltocobaltic sulphite**

See Cobaltisulphite, cobaltous

**cobaltic sulphite with  $3\text{M}_2\text{SO}_3$** 

See Cobaltisulphite, M

**cobaltous potassium sulphite,  $\text{CoSO}_3, \text{K}_2\text{SO}_3,$   
 $+x\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , easily sol in  $\text{HCl} + \text{Aq}$   
 Schultze, J B 1864 270)

**cobaltic potassium sulphite,  $\text{Co}_2(\text{SO}_3)_3,$   
 $\text{K}_2\text{SO}_3$** 

Sl sol in  $\text{H}_2\text{O}$ , easily sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  or  
 $\text{HCl} + \text{Aq}$  (Schultze)

**cobaltous sodium sulphite,  $3\text{CoO}, \text{Na}_2\text{O},$   
 $3\text{SO}_2$** 

Insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HCl} + \text{Aq}$   
 Schultze)

**cobaltic sodium sulphite,  $\text{Co}_2\text{O}_3, \text{Na}_2\text{O},$   
 $3\text{SO}_2$** 

Sl sol in  $\text{H}_2\text{O}$  (Schultze)

**Cuprous sulphite,  $\text{Cu}_2\text{SO}_3 + \text{H}_2\text{O}$** 

(a) *Red* Sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH}$   
 or  $\text{HCl} + \text{Aq}$  (Rogojski, J B 1851 366)  
 Could not be obtained by St Gilles or  
 Svensson (B 4 713)

Insol in  $\text{H}_2\text{O}$ , alcohol, or ether (Étard, C  
 R 95 38)

Composition is  $(\text{Cu}_2)_2\text{H}_{18}(\text{SO}_3)_3$ , "Cuprous  
 isosulphite," according to Étard  
 $+ \frac{1}{2}\text{H}_2\text{O}$  Étard's formula,  $\text{Cu}_2\text{SO}_3 + \text{H}_2\text{O}$   
 is incorrect

The salt is almost colorless (Ramberg  
 Z phys Ch 1909, 69 512)

(b) *White Normal salt* Insol in  $\text{H}_2\text{O}$ ,  
 alcohol, or ether (Étard)

**Cupric sulphite, basic,  $4\text{CuO}, \text{SO}_2 + 7\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , and decomp by washing  
 therewith (Millon and Commaile)

$7\text{CuO}, 4\text{SO}_2 + 8\text{H}_2\text{O}$  Sol in dil  $\text{H}_2\text{SO}_4$ ,  
 (Seubert and Elten, Z anorg 1893, 4 48)

$3\text{CuO}, 2\text{SO}_2 + 1\frac{1}{2}\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$   
 (Newbury, Am Ch J 14 232)

$7\text{CuO}, 4\text{SO}_2 + 8\text{H}_2\text{O}$ , or  $4\text{CuSO}_3, 3\text{Cu}(\text{OH})_2$   
 $+ 5\text{H}_2\text{O}$  Sol in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Seubert  
 and Elten, Z anorg 1893, 4 50)

**Cuprocupric sulphite,  $\text{CuSO}_3, \text{Cu}_2\text{SO}_3 + 2\text{H}_2\text{O}$** 

Nearly insol in cold  $\text{H}_2\text{O}$  Decomp by  
 boiling

Sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$ ,  $\text{HCl}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$   
 (Berthier)

Sol in very dil  $\text{HNO}_3 + \text{Aq}$  (Döpping,  
 J B 1851 365)

Insol in  $\text{H}_2\text{SO}_3$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{Cu}$  salts  $+ \text{Aq}$   
 (de St Gilles)

$+ 5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Easily sol in  
 $\text{H}_2\text{SO}_3 + \text{Aq}$ ,  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , in cupric salts  
 $+ \text{Aq}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ , or  $\text{HCl} + \text{Aq}$  (de St  
 Gilles, A ch (3) 42 34)

Composition is  $(\text{Cu})_2\text{H}_{18}(\text{SO}_3)_3 + 21\text{H}_2\text{O}$ ,  
 "acid cuprocupric octosulphite" (Étard,  
 C R 96 1475)

**Cuprous ferroferic sodium sulphite,  $\text{Cu}_2\text{O},$   
 $2\text{FeO}, \text{Fe}_2\text{O}_3, \text{Na}_2\text{O}, 6\text{SO}_2 + 16\text{H}_2\text{O}$** 

Sol in about 1000 pts  $\text{H}_2\text{O}$

Sol in cold dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ , sol in cold  
 dil  $\text{HCl} + \text{Aq}$  with a residue of  $\text{Cu}_2\text{Cl}_2$   
 (Stromeyer, A 109 237)

**Cuprous lithium sulphite,  $\text{Cu}_2\text{SO}_3, \text{Li}_2\text{SO}_3 +$   
 $2\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , but gradually decomp  
 thereby (Étard, C R 95 138)

**Cupric mercuric sulphite,  $\text{CuSO}_3, \text{HgSO}_3$** 

Sol in  $\text{H}_2\text{O}$  in all proportions, but decomp  
 on boiling

**Cuprous potassium sulphite,  $\text{Cu}_2\text{SO}_3,$** 

$\text{K}_2\text{SO}_3$  (?)  
 (Vohl, J pr 95 219)  
 $+ 2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with decomp

(Rosenheim and Steinhauser, Z anorg 1890, 25 96)

$\text{Cu}_2\text{SO}_3$ ,  $2\text{K}_2\text{SO}_3$  (Chevreul, Graham, etc.)

Does not exist (Svensson)

$\text{Cu}_2\text{O}$ ,  $3\text{K}_2\text{O}$ ,  $6\text{SO}_2 + 7\text{H}_2\text{O} = 4\text{KHSO}_3$ ,  $\text{K}_2\text{SO}_3$ ,  $\text{Cu}_2\text{SO}_3 + 5\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Svensson, B 4 713)

Could not be obtained (Rosenheim and Steinhauser)

$\text{Cu}_2\text{O}$ ,  $4\text{K}_2\text{O}$ ,  $8\text{SO}_2 + 3\text{H}_2\text{O} = 6\text{KHSO}_3$ ,  $\text{K}_2\text{SO}_3$ ,  $\text{Cu}_2\text{SO}_3$  Decomp by  $\text{H}_2\text{O}$  (Svensson)

Could not be obtained (Rosenheim and Steinhauser)

$\text{Cu}_2\text{SO}_3$ ,  $8\text{K}_2\text{SO}_3 + 16\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  with decomp (Rammelsberg, Pogg 57 391)

Does not exist, according to Svensson

**Cuprocupric potassium sulphite**,  $3\text{Cu}_2\text{SO}_3$ ,  $3\text{CuSO}_3$ ,  $\text{K}_2\text{SO}_3$

Properties as cuprous potassium sulphite (Rogojski, J B 1851 367)

$2\text{Cu}_2\text{SO}_3$ ,  $\text{CuSO}_3$ ,  $\text{K}_2\text{SO}_3 + 5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  and weak acids (de St-Gilles)

$\text{Cu}_2\text{SO}_3$ ,  $4\text{CuSO}_3$ ,  $\text{K}_2\text{SO}_3 + 16\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Rosenheim and Steinhauser)

**Cuprous sodium sulphite**,  $\text{Cu}_2\text{SO}_3$ ,  $\text{Na}_2\text{SO}_3 + 2\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Svensson, 1870)

$+ 11\text{H}_2\text{O}$  Insol in cold  $\text{H}_2\text{O}$ , but decomp by excess (Étard, C R 95 138)

$2\text{Cu}_2\text{SO}_3$ ,  $3\text{Na}_2\text{SO}_3 + 29\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Rosenheim and Steinhauser, Z anorg 1900, 25 94)

$\text{Cu}_2\text{SO}_3$ ,  $5\text{Na}_2\text{SO}_3 + 38\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Svensson)

$\text{Cu}_2\text{SO}_3$ ,  $7\text{Na}_2\text{SO}_3 + 19\text{H}_2\text{O}$  Completely sol in  $\text{H}_2\text{O}$ , but solutions decomp on standing (Svensson)

"Cuprous sodium octosulphite,"

$(\text{Cu}_2)_3\text{H}_{10}\text{Na}_{16}\text{S}_8\text{O}_{32} + 43\text{H}_2\text{O}$  (Étard)

$5\text{Cu}_2\text{SO}_3$ ,  $2\text{Na}_2\text{SO}_3 + 30\text{H}_2\text{O}$  Easily decomp (Rosenheim and Steinhauser, Z anorg 1900, 25 94)

**Cuprocupric sodium sulphite**,

$\text{Cu}_2\text{SO}_3$ ,  $2\text{CuSO}_3$ ,  $2\text{Na}_2\text{SO}_3 + 6\text{H}_2\text{O}$

Nearly insol in cold, decomp by hot  $\text{H}_2\text{O}$  (Rosenheim and Steinhauser, Z anorg 1900, 25 95)

$+ 8\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Rosenheim and Steinhauser)

**Cuprocupric sodium hydrogen sulphite**,

$\text{Na}_3\text{Cu}^{\text{II}}(\text{Cu}^{\text{I}})_2(\text{SO}_4)_3 \cdot 6\text{H}_2(\text{SO}_4) + 5\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Étard, C R 94 1422)

$(\text{Cu}^{\text{I}})_2\text{Cu}^{\text{II}}\text{Na}_3\text{H}_{18}(\text{SO}_4)_8$  (Étard)

**Copper sodium sulphites**

Doubtless many of the compds described in this class are in reality isomorphous mixtures whose composition depends upon the temp and conc of the solution in which pptd

(Rosenheim and Steinhauser, Z anorg 1900, 25 92-95)

**Didymium sulphite**,  $\text{D}_{12}(\text{SO}_3)_3 + 3\text{H}_2\text{O}$ , or  $6\text{H}_2\text{O}$

Precipitate Insol in  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$ , from which it is reprecipitated by heating, redissolving on cooling (Marignac, A ch (3) 38 167)

**Erbium sulphite**,  $\text{Er}_2(\text{SO}_3)_3 + 3\text{H}_2\text{O}$

Precipitate

**Glucinum sulphite, basic**,  $2\text{GlSO}_3$ ,  $9\text{Gl}(\text{OH})_2 + 6\text{H}_2\text{O}$

Ppt (Seubert, Z anorg 1893, 4 52)

$\text{GlSO}_3$ ,  $\text{GlO}$  Decomp by  $\text{H}_2\text{O}$  or alcohol (K and M)

$3\text{GlSO}_3$ ,  $\text{GlC}$  Sol in alcohol (K and M)

**Glucinum sulphite**,  $\text{GlSO}_3$

Decomp by  $\text{H}_2\text{O}$  or alcohol (Krüss and Moraht, B 23 734)

**Glucinum potassium sulphite**,

$2\text{GlSO}_3$ ,  $\text{K}_2\text{SO}_3 + 9\text{H}_2\text{O}$

Unstable in the air (Rosenheim, Z anorg 1897, 15 310)

**Gold (aurous) potassium sulphite**,  $\text{Au}_2\text{SO}_3$ ,  $3\text{K}_2\text{SO}_3$

Very sol in  $\text{H}_2\text{O}$ , insol in alcohol (Haase)

**Gold (auric) potassium sulphite**,  $\text{Au}_2\text{O}_3$ ,  $5\text{K}_2\text{O}$ ,  $8\text{SO}_2 + 5\text{H}_2\text{O} = 5\text{K}_2\text{SO}_3$ ,  $\text{Au}_2(\text{SO}_3)_3 + 5\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with decomp

Decomp by acids, insol in alkalis (Fremy, A 79 46)

**Gold (auric) potassium sulphite**,  $\text{Au}_2(\text{SO}_3)_3$ ,  $5\text{K}_2\text{SO}_3 + 10\text{H}_2\text{O}$

(Rosenheim and Hertzmann, Z anorg 1908, 59 199)

**Gold (auric) potassium sulphite ammonia**,  $\text{Au}_2(\text{SO}_3)_3$ ,  $3\text{K}_2\text{SO}_3$ ,  $4\text{NH}_3 + 4\text{H}_2\text{O}$

As the corresponding  $\text{NH}_4$  salt (Rosenheim and Hertzmann, Z anorg 1908, 59 202)

**Gold (aurous) sodium sulphite**,  $\text{Au}_2\text{SO}_3$ ,  $3\text{Na}_2\text{SO}_3 + 3\text{H}_2\text{O}$

Sol in less than 1 pt  $\text{H}_2\text{O}$  Insol in alcohol (Hasse)

$+ 5\text{H}_2\text{O}$  (Himly)

**Gold (auric) sodium sulphite**,  $\text{Au}_2(\text{SO}_3)_3$ ,  $5\text{Na}_2\text{SO}_3 + 28\text{H}_2\text{O}$

As K salt (Rosenheim and Hertzmann, anorg 1908, 59 199)

**Sold (aurous) sulphite ammonia**,  $3\text{Au}_2\text{O}_3$ ,  $4\text{SO}_2$ ,  $8\text{NH}_3 + 4\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  with decomp Decomp by acids

Sl sol in cold, more easily in hot  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp by boiling (Hasse, Zeit Ch 869 535)

**Sold (auric) sulphite ammonia**,  $\text{Au}_2(\text{SO}_3)_2$ ,  $4\text{NH}_3 + 4\text{H}_2\text{O}$

Ppt Decomp in moist air and in neutral solution (Herzmann, Z anorg 1908, 59 98)

**ndium sulphite**,  $2\text{In}_2\text{O}_3$ ,  $3\text{SO}_2 + 8\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  (Bayer, A 158 372)

**ridium sulphite**,  $\text{Ir}_2(\text{SO}_3)_3 + 6\text{H}_2\text{O}$

Scarcely sol in  $\text{H}_2\text{O}$ , easily sol  $\text{HCl} + \text{Aq}$  Birnbaum, A 136 179)

**ridyl sulphite**,  $(\text{IrO})\text{SO}_3 + 4\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$  Birnbaum)

**ridous potassium sulphite**,  $\text{IrO}$ ,  $3\text{K}_2\text{O}$ ,  $5\text{SO}_2(?)$

Sl sol in  $\text{H}_2\text{O}$ , more sol in  $\text{KOH} + \text{Aq}$  Easily sol in  $\text{HCl} + \text{Aq}$  (Claus, J pr 42 59)

**ridous sulphite potassium chloride**

See Iridosulphite, potassium

**ridium sulphite with  $\text{M}_2\text{SO}_3$**

See Iridosulphite, M

**ron (ferrous) sulphite**,  $\text{FeSO}_3 + 2\frac{1}{2}\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  Insol in alcohol, but sol therein in presence of  $\text{SO}_2$  (Muspratt)

**ron (ferric) sulphite**,  $\text{Fe}_2\text{O}_3$ ,  $\text{SO}_2 + 6\text{H}_2\text{O}$

Very sl sol in  $\text{H}_2\text{O}$  Sol in acids (Koene)  $2\text{Fe}_2\text{O}_3$ ,  $3\text{SO}_2$  Deliquescent, decomp by  $\text{H}_2\text{O}$  into  $\text{SO}_2$  and above comp  $3\text{Fe}_2\text{O}_3$ ,  $8\text{O}_2 + 7\text{H}_2\text{O}$  Ppt

**ron (ferroferric) potassium sulphite**,  $\text{FeSO}_3$ ,  $(\text{FeO})_2\text{SO}_3$ ,  $2\text{K}_2\text{SO}_4$

Ppt (Berglund)

**ron (ferric) potassium sulphite**,  $\text{K}_2\text{O}$ ,  $\text{Fe}_2\text{O}_3$ ,  $3\text{SO}_3 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  (Koene, Pogg 63 53)

$\text{Fe}_2\text{O}_3$ ,  $2\text{K}_2\text{O}$ ,  $3\text{SO}_2 + 5\text{H}_2\text{O}$  Ppt (Muspratt, Phil Mag (3) 30 414)

**ron (ferric) potassium sulphite sulphate**,  $\text{FeSO}_3\text{SO}_3\text{K}$

Sl sol in cold  $\text{H}_2\text{O}$

Sol in 20%  $\text{HCl}$  decomp on boiling Hofmann, Z anorg , 14

$\text{Fe}(\text{SO}_3)_2\text{SO}_3\text{K}$  Almost insol in cold  $\text{H}_2\text{O}$  Decomp by boiling with dil acids (Hofmann)

$\text{Fe}_2(\text{SO}_3)_4\text{SO}_3\text{K}_4 + 5\text{H}_2\text{O}$  Insol in cold  $\text{H}_2\text{O}$ , sol in cold 20%  $\text{HCl} + \text{Aq}$ , decomp on boiling with  $\text{H}_2\text{O}$  (Hofmann)

**Iron (ferric) sodium sulphite sulphate**,  $\text{Fe}(\text{SO}_3)_2\text{SO}_3\text{Na}_3 + 6\text{H}_2\text{O}$

Almost insol in  $\text{H}_2\text{O}$

Decomp by boiling with dil acids (Hofmann, Z anorg 1897, 14 289)

**Iron (ferric) sodium hydrogen sulphite sulphate**,  $\text{FeSO}_4(\text{SO}_3)_4\text{H}_2\text{Na}_2 + 2\text{H}_2\text{O}$

Only very sl sol in  $\text{H}_2\text{O}$  (Hofmann)

**Lanthanum sulphite**,  $\text{La}_2(\text{SO}_3)_3 + 4\text{H}_2\text{O}$

Precipitate (Cleve)

**Lead sulphite**,  $\text{PbSO}_3$

Insol in  $\text{H}_2\text{O}$  Decomp by acids Sl sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  (Rohrig, J pr (2) 37 233)

**Lithium sulphite**,  $\text{Li}_2\text{SO}_3 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , precipitated from aqueous solution by abs alcohol (Danson, Chem Soc 2 205) Sol in  $\text{H}_2\text{SO}_3 + \text{Aq} + \text{H}_2\text{O}$  Sl sol in alcohol, and still less sol in ether (Rohrig, J pr (2) 37 225)  $+ 2\text{H}_2\text{O}$  (Rohrig)

**Lithium potassium sulphite**,  $\text{LiKSO}_3 + \frac{1}{2}\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Rohrig, J pr (2) 37 251)

**Lithium sodium sulphite**,  $6\text{Li}_2\text{SO}_3$ ,  $\text{Na}_2\text{SO}_3 + 8\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Rohrig)

**Magnesium sulphite**,  $\text{MgSO}_3 + 6\text{H}_2\text{O}$

Sol in 20 pts cold and in less hot  $\text{H}_2\text{O}$  (Foureroy and Vauquelin)

Sol in 80 pts cold, and in 120 pts boiling  $\text{H}_2\text{O}$  (Hager, C C 1875 135)

More easily sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 828)

Precipitated from aqueous solution by alcohol

$+ 3\text{H}_2\text{O}$  (Rohrig, J pr (2) 37 234)

**Manganous sulphite**,  $\text{MnSO}_3 + 2\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , alcohol, or ether Easily sol in acids, also in  $\text{H}_2\text{SO}_3 + \text{Aq}$

Insol in acetone (Naumann, B 1904, 37 4329)

$+ 2\frac{1}{2}\text{H}_2\text{O}$  (Rammelsberg)  $+ 3\text{H}_2\text{O}$  Sol in 10,000 pts cold, and 5000 pts hot  $\text{H}_2\text{O}$ , more sol in conc Mn salts  $+ \text{Aq}$ , sol in 1000 pts  $\text{H}_2\text{CO}_3 + \text{Aq}$  100 pts  $\text{H}_2\text{SO}_3 + \text{Aq}$  dissolve 15-17 pts (Gorgeu, C R 96 341)

Salt with  $2\frac{1}{2}\text{H}_2\text{O}$  is the only one which exists (Rohrig, J pr (2) 37 2)

**Manganous potassium sulphite**,  $2\text{MnSO}_3 \cdot \text{K}_2\text{SO}_3$

Insol in  $\text{H}_2\text{O}$ , even when boiling (Gorgeu, C R 96 376)

$\text{MnSO}_3 \cdot \text{K}_2\text{SO}_3$  Sol in  $\text{H}_2\text{O}$  (Gorgeu)

**Manganous sodium sulphite**,  $\text{MnSO}_3 \cdot \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$

Insol in hot  $\text{H}_2\text{O}$ , but decomp by cold  $\text{H}_2\text{O}$  (Gorgeu)

$4\text{MnSO}_3 \cdot \text{Na}_2\text{SO}_3$  Insol in  $\text{H}_2\text{O}$  (Gorgeu)

**Mercuric sulphite**,  $2\text{HgO} \cdot \text{SO}_2$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl}$ , alkali sulphites with subsequent decomp, and in  $\text{KCN} + \text{Aq}$  (de St-Gilles, A ch (3) 36 80)

$\text{HgSO}_3$  Decomp by cold  $\text{H}_2\text{O}$  (de St-Gilles)

Does not exist (Divers and Shimidzu, Chem Soc 49 553)

$\text{HgO} \cdot 2\text{SO}_2 + \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , but decomp by boiling (de St-Gilles) Exists only in aqueous solution (Divers and Shimidzu)

**Mercuriomercuric sulphite**,  $\text{Hg}_3(\text{SO}_3)_2 + 2\text{H}_2\text{O} = \text{Hg}_2\text{SO}_3 \cdot \text{HgSO}_3$

Very efflorescent Insol in  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$  Insol in dil  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$

$+4\text{H}_2\text{O}$  Very efflorescent

**Hypomercurosic sulphite**,  $\text{Hg}_4(\text{SO}_3)_2 + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , but easily decomp on standing therewith Almost absolutely insol in dil  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Divers and Shimidzu)

**Mercuric oxy sulphite**,  $\text{Hg}(\text{SO}_2\text{OHgO})_2 \cdot \text{Hg} + \text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$  Insol in dil  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$  Sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  (Divers and Shimidzu)

**Mercuric potassium sulphite, basic**,

$\text{K}_2\text{O} \cdot 2\text{HgO} \cdot 2\text{SO}_2$

(Barth, Z phys Ch 1892, 9 210)

$\text{K}_2\text{O} \cdot 3\text{HgO} \cdot 3\text{SO}_2$  Insol in  $\text{H}_2\text{O}$  Partly sol in  $\text{KOH} + \text{Aq}$  (Barth)

**Mercuric potassium sulphite**,  $\text{HgSO}_3 \cdot \text{K}_2\text{SO}_3 + \text{H}_2\text{O}$

Sl sol in cold  $\text{H}_2\text{O}$  Decomp on boiling (de St-Gilles, A ch (3) 36 90)

**Mercuric potassium sulphite mercuric chloride**,  $\text{K}_2\text{Hg}(\text{SO}_3)_2 \cdot \text{HgCl}_2$

Decomp by  $\text{H}_2\text{O}$  (Barth, Z phys Ch 1892, 9 206)

**Mercuric silver sulphite**,  $\text{HgSO}_3 \cdot \text{Ag}_2\text{SO}_3 + 2\text{H}_2\text{O}$

Decomp rapidly, insol in  $\text{H}_2\text{O}$  (Barth, Z phys Ch 9 195)

**Mercuric sodium sulphite**,  $\text{HgSO}_3 \cdot \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (de St-Gilles)

Sol in 25 pts cold  $\text{H}_2\text{O}$ , and decomp on heating (Divers and Shimidzu)

$+2\text{H}_2\text{O} = \text{Na}_2(\text{SO}_3)_2 \cdot \text{Hg} + 2\text{H}_2\text{O}$  (Barth, Z phys Ch 9 193)

$2\text{HgSO}_3 \cdot \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$  Much more sol in  $\text{H}_2\text{O}$  than the above comp especially on heating (de St-Gilles)

Does not exist (Divers and Shimidzu)

**Mercuric strontium sulphite**,  $\text{HgSO}_3 \cdot \text{SrSO}_3 + 2\text{H}_2\text{O}$

Ppt (Barth)

**Mercuric sulphite ammonium bromide**,

$\text{HgSO}_3 \cdot \text{NH}_4\text{Br}$

As  $\text{NH}_4\text{Cl}$  comp (Barth, Z phys Ch 1892, 9 215)

**Mercuric sulphite ammonium chloride**,

$\text{HgSO}_3 \cdot \text{NH}_4\text{Cl}$

As K salt (Barth)

**Mercuric sulphite potassium chloride**,

$\text{HgSO}_3 \cdot \text{KCl}$

Sol in  $\text{H}_2\text{O}$  (Barth)

**Mercuric sulphite sodium chloride**,  $\text{HgSO}_3 \cdot \text{NaCl} + \text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Barth)

**Nickel sulphite, basic**,  $2\text{NiSO}_3 \cdot \text{Ni}(\text{OH})_2 + 6\text{H}_2\text{O}$

Ppt (Seubert and Elten, Z anorg 1893, 4 91)

**Nickel sulphite**,  $\text{NiSO}_3 + 4\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  with evolution of  $\text{SO}_2$  (Muspratt, A 50 259)

$+6\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  (Rammelsberg, Pogg 67 391)

**Nickel sulphite ammonia**,  $\text{NiSO}_3 \cdot 3\text{NH}_3 + 3\text{H}_2\text{O}$

Sol in little  $\text{H}_2\text{O}$  Decomp by much  $\text{H}_2\text{O}$  or heat (Rammelsberg, Pogg 67 245)

**Osmious sulphite**,  $\text{OsSO}_3$

Insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HCl} + \text{Aq}$  without evolution of  $\text{SO}_2$  Very slowly decomp by  $\text{KOH} + \text{Aq}$  (Claus)

**Osmious potassium sulphite**,  $\text{OsSO}_3 \cdot 2\text{K}_2\text{SO}_3 \cdot 2\text{KHSO}_3 + 4\text{H}_2\text{O}$

Nearly insol in  $\text{H}_2\text{O}$

**Ammonium potassium sulphite chloride**,  $\text{OsO}_2 \cdot 2\text{SO}_3 \cdot 6\text{KCl}$

Easily sol in  $\text{H}_2\text{O}$

**Alloyed sodium sulphite**,  $\text{PdSO}_3 \cdot 3\text{Na}_2\text{SO}_3 + 2\text{H}_2\text{O} = \text{Na}_6\text{Pd}(\text{SO}_3)_4 + 2\text{H}_2\text{O}$

Sol in hot  $\text{H}_2\text{O}$  Sol in  $\text{NaOH} + \text{Aq}$  or  $\text{I}_2\text{SO}_3 + \text{Aq}$  (Wohler and Frerichs, A 174 99)

**Platinous sulphite**,  $\text{PtO}_2 \cdot 2\text{SO}_3$

Easily sol in  $\text{H}_2\text{O}$  or alcohol (Dobereiner, pr 15 315)

Formula is  $\text{PtSO}_3$  (Gmelin)  
 $\text{PtSO}_3 \cdot \text{H}_2\text{SO}_3$  (Birnbaum, A 139 172)

**Platinic potassium sulphite**,  $\text{PtO}_2 \cdot \text{SO}_3 \cdot \text{K}_2\text{SO}_3 + \text{H}_2\text{O}$

Sol in  $\text{KOH} + \text{Aq}$  (Birnbaum, A 139 73)

**Platinic sodium sulphite**,  $\text{PtO}_2 \cdot \text{SO}_3 \cdot 2\text{Na}_2\text{SO}_3 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Birnbaum)

**Platinous sulphite with  $\text{M}_2\text{SO}_3$**

See Platosulphite, M

**Platinum sulphite ammonium chloride**  
See Chloroplatosulphite, ammonium

**Potassium sulphite**,  $\text{K}_2\text{SO}_3 + 2\text{H}_2\text{O}$

Somewhat deliquescent Sol in 1 pt cold, and still less hot  $\text{H}_2\text{O}$  (Fourcroy and Vauquelin, A ch 24 254)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch 1898, 20 829)

Very slightly soluble in alcohol Insol in thyl acetate (Casasaca, C R 30 821)

**Potassium hydrogen sulphite**,  $\text{KHSO}_3$

Sol in  $\text{H}_2\text{O}$  Insol in absolute alcohol

**Potassium pyrosulphite**,  $\text{K}_2\text{S}_2\text{O}_5$

Slowly sol in  $\text{H}_2\text{O}$  Very sl sol in alcohol, insol in ether (Muspratt, A 50 259)

**Potassium rhodium sulphite**,  $3\text{K}_2\text{SO}_3 \cdot \text{Rh}_2(\text{SO}_3)_3 + 6\text{H}_2\text{O}$

See Rhodosulphite, potassium

**Potassium ruthenium sulphite**,

$\text{O}[\text{Ru}(\text{SO}_3)_4\text{K}_6]_2 + 2\text{H}_2\text{O}$

Ppt (Miolati, C C 1901, I 501)

**Potassium sodium sulphite**,  $\text{KNaSO}_3$

Sol in  $\text{H}_2\text{O}$  (Spring, B 7 1161)

+1, and  $2\text{H}_2\text{O}$  (Schwicker, B 22 1731)

Isomeric salts,  $\text{KSO}_3\text{Na}$  and  $\text{NaSO}_3\text{K}$  Barth, Z phys Ch 9 176)

**Potassium sodium hydrogen sulphite**,  
 $\text{KNa}_2\text{H}(\text{SO}_3)_2 + 4\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$ , 100 pts  $\text{H}_2\text{O}$  dissolve 69 pts salt at  $15^\circ$  (Schwicker, B 22 1731)

$\text{K}_2\text{NaH}(\text{SO}_3)_2 + 3\text{H}_2\text{O}$  (Schwicker)

**Potassium uranyl sulphite**,  $\text{K}(\text{UO}_2)(\text{OH})\text{SO}_3$

Insol in  $\text{H}_2\text{O}$ , but sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  (Scheller)

$\text{K}_2\text{O} \cdot 2\text{UO}_3 \cdot 3\text{SO}_2$  (Kohlschütter, A 1900, 311 10 *et seq*)

$\text{K}_2\text{O} \cdot 4\text{UO}_3 \cdot 5\text{SO}_2$  (K)

$\text{K}_2\text{O} \cdot 3\text{UO}_3 \cdot 2\text{SO}_2$  (K)

$\text{K}_2\text{O} \cdot \text{UO}_3 \cdot 2\text{SO}_2$  (K)

**Potassium vanadium sulphite**

See Vanadosulphite, potassium

**Potassium vanadyl sulphite**,  $\text{K}_2\text{SO}_3 \cdot \text{VO}_2\text{SO}_3 + 5\frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  without decomp and can be recryst therefrom (Koppel and Behrendt, B 1901, 34 3932)

$\text{K}_2\text{O} \cdot 3\text{VO}_2 \cdot 2\text{SO}_2$  Sol without decomp in cold and hot  $\text{H}_2\text{O}$

Insol in alcohol and ether (Koppel, Z anorg 1903, 35 182)

**Potassium zinc sulphite**,  $\text{K}_2\text{SO}_3 \cdot 3\text{ZnSO}_3 + 7\frac{1}{2}\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  with decomp (Berglund, Acta Lund 1872)

**Rhodium sulphite**,  $\text{Rh}_2(\text{SO}_3)_3 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Claus)

**Rhodium sodium sulphite**

See Rhodosulphite, sodium

**Ruthenium sulphite**,  $\text{Ru}_2(\text{SO}_3)_3$

Colloidal substance, sol in a large quantity of  $\text{H}_2\text{O}$  (Lucchesi, Gazz ch it 1900, 30 (2) 71)

**Ruthenium sodium sulphite**,  $\text{Na}_7\text{Ru}(\text{SO}_3)_5 + 2\text{H}_2\text{O}$

Ppt (Miolati, C C 1901, I 501)

**Samarium sulphite**,  $\text{Sm}_2(\text{SO}_3)_3$

Amorphous precipitate (Cleve)

**Scandium sulphite**,  $\text{Sc}_2(\text{SO}_3)_3$

Insol in cold  $\text{H}_2\text{O}$  Sl sol in hot  $\text{H}_2\text{O}$   
Sol in excess of sodium sulphite when heated (Crookes, Phil Trans 1910, 210 A 363)

+ $6\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$

Decomp by boiling with  $\text{H}_2\text{O}$  with separation of  $\text{H}_2\text{SO}_3$  (R J Meyer, Z anorg 1914, 86 281)



**Selenium sulphite,  $\text{SeSO}_3$** 

Correct composition for "selenium sulphoxide" (Divers, Chem. Soc 49 583)

**Silver sulphite,  $\text{Ag}_2\text{SO}_3$** 

Very sl sol in cold  $\text{H}_2\text{O}$  Decomp on heating

Solubility in  $\text{H}_2\text{O}$  is  $< 1/20,000$  (Baubigny, C R 1909, 149 858)

Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , and alkali sulphites + Aq Insol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  Decomp by strong acids, but not by acetic acid (Berthier, A ch (3) 7 82)

Easily sol in alkali thiosulphates + Aq (Herschel)

Cold  $\text{NaHSO}_3 + \text{Aq}$  dissolves a considerable amount of  $\text{Ag}_2\text{SO}_3$  (Rosenheim and Steinhäuser, Z anorg 1900, 25 78)

Practically insol in  $\text{HNO}_3 + \text{Aq}$  or dil  $\text{AgNO}_3 + \text{Aq}$ , also in  $\text{H}_2\text{SO}_3 + \text{Aq}$  (Divers, Chem Soc 49 579)

**Silver sodium sulphite,  $\text{Ag}_2\text{SO}_3, \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  (Svensson, B 4 714)

**Sodium sulphite,  $\text{Na}_2\text{SO}_3$** 

100 pts dissolve at  $0^\circ$ , 14.1 pts, at  $20^\circ$ , 25.8 pts, at  $40^\circ$ , 49.5 pts  $\text{Na}_2\text{SO}_3$  (Kremers Pogg 99 50) Maximum solubility is at  $33^\circ$  (Mitscherlich)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t$	Pts $\text{Na}_2\text{SO}_3$
60 4	28 29
59 8	28 29
59 8	28 65
59 8	28 75
37 0	28 01
37 0	28 07
47 0	28 19
47 0	28 07
55 6	28 21
84 0	28 26

The temp at which  $\text{Na}_2\text{SO}_3 + 7\text{H}_2\text{O}$  changes into  $\text{Na}_2\text{SO}_3$  is about  $21.6^\circ$

(Hartley and Barrett, Chem Soc 1909, 95 1183)

See also  $+7\text{H}_2\text{O}$

Sp gr of sat solution at  $15^\circ = 1.21$  (Greenish and Smith, Pharm J 1901, 66 774)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Insol in alcohol

Insol in ethyl acetate (Casaseca, C R 30 821), methyl acetate (Naumann, B 1909, 42 3790)

Insol in benzonitrile (Naumann, B 1914, 47 1370)

$+7\text{H}_2\text{O}$  Decomp slowly on air.  
Sol in 4 pts  $\text{H}_2\text{O}$  at  $15^\circ$  with absorption of heat (Dumas), and in 1 pt boiling  $\text{H}_2\text{O}$  (Fourcroy)

Solubility in 100 pts  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts $\text{Na}_2\text{SO}_3$
37 2	44 08
33 5	39 64
29 0	34 99
23 5	29 92
18 2	25 31
10 6	20 01
5 9	17 61
2 0	14 82
-1 9	13 09

Supersolubility curves have also been plotted for ice and  $\text{Na}_2\text{SO}_3 + 7\text{H}_2\text{O}$

(Hartley and Barrett, Chem Soc 1909, 95 1181)

$+10\text{H}_2\text{O}$  Efflorescent Somewhat less sol than above salt (Muspratt)

**Sodium hydrogen sulphite,  $\text{NaHSO}_3$** 

More difficulty sol in  $\text{H}_2\text{O}$  than  $\text{NaHCO}_3$ , and is precipitated by alcohol from aqueous solution (Muspratt)

Insol in acetone. (Eidmann, C C 1899, II 1014, Naumann, B 1904, 37 4329) methyl acetate (Naumann, B 1909, 42 3790)

$+4\text{H}_2\text{O}$  (Clark)

**Sodium pyrosulphite,  $\text{Na}_2\text{S}_2\text{O}_5$** 

Decomp gradually on the air

**Sodium uranyl sulphite,  $\text{Na}(\text{UO}_2)(\text{OH})\text{SO}_3$** 

Sl sol in  $\text{H}_2\text{O}$  More sol in  $\text{H}_2\text{SO}_3 + \text{Aq}$  than the K salt (Scheller)

$\text{Na}_2\text{O}, 2\text{UO}_3, 3\text{SO}_2$

$\text{Na}_2\text{O}, 3\text{UO}_3, 2\text{SO}_2$  (Kohlschütter A 1900, 311 10 et seq)

**Sodium vanadyl sulphite,  $\text{N}_2\text{O}, 2\text{SO}_2, \text{VO}_2 + 5\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  with decomp

$\text{Na}_2\text{O}, 2\text{SO}_2, 3\text{VO}_2 + 4\text{H}_2\text{O}$  Sol in cold  $\text{H}_2\text{O}$ , decomp on heating (Koppel, B 1901, 34 3933)

**Sodium zinc sulphite,  $\text{Na}_2\text{SO}_3, 3\text{ZnSO}_3 + 7\frac{1}{2}\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  with decomp (Berglund, Acta Lund, 1872)

**Sodium sulphite silver chloride,  $3\text{Na}_2\text{SO}_3, \text{AgCl} + 21\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Svensson)

**Strontium sulphite, SrSO<sub>3</sub>**

Precipitate Almost insol in H<sub>2</sub>O Sol in H<sub>2</sub>SO<sub>3</sub>+Aq (Muspratt)  
Sol in about 30,000 pts H<sub>2</sub>O at 16-18°  
Autenrieth, Z anal 1898, **37** 293)  
Abundantly sol in H<sub>2</sub>SO<sub>3</sub>+Aq (Rohrig)

**Tellurium sulphite, TeSO<sub>3</sub>**

Correct composition of "tellurium sulphoxide" (Divers, Chem Soc **49** 583)

**Thallous sulphite, Tl<sub>2</sub>SO<sub>3</sub>**

Sl sol in cold, easily in hot H<sub>2</sub>SO<sub>3</sub>+Aq  
Rohrig, J pr (2) **37** 229)  
100 pts H<sub>2</sub>O dissolve 3.34 pts at 15.5°  
Easily sol in hot H<sub>2</sub>O, insol in alcohol  
Seubert and Elten, Z anorg **2** 434)

**Thallous vanadyl sulphite, 2Tl<sub>2</sub>SO<sub>3</sub>,**

V<sub>2</sub>O<sub>5</sub>SO<sub>3</sub>+4H<sub>2</sub>O  
(Gain, A ch 1908, (8) **14** 278)  
Tl<sub>2</sub>SO<sub>3</sub>, 3V<sub>2</sub>O<sub>5</sub>SO<sub>3</sub>+8H<sub>2</sub>O (Gain)

**Thorium sulphite, Th(SO<sub>3</sub>)<sub>2</sub>+H<sub>2</sub>O**

Precipitate (Cleve)

**Tin (stannous) sulphite, 5SnO, 2SO<sub>2</sub>+xH<sub>2</sub>O**

Ppt Partly sol in H<sub>2</sub>SO<sub>3</sub>+Aq (Rohrig,  
J pr (2) **37** 249)  
+20H<sub>2</sub>O (Rohrig)  
8SnO, 2SO<sub>2</sub>+20H<sub>2</sub>O  
11SnO, 2SO<sub>2</sub>+20H<sub>2</sub>O (Rohrig)

**Uranous sulphite, basic, U(OH)<sub>2</sub>SO<sub>3</sub>+H<sub>2</sub>O**

Insol in H<sub>2</sub>O Easily sol in acids Sol  
in H<sub>2</sub>SO<sub>3</sub>+Aq, but is soon decomp (Rammelsberg)

**Uranyl sulphite, basic, 3UO<sub>2</sub>(OH)<sub>2</sub>,**

5(UO<sub>2</sub>)SO<sub>3</sub>+10H<sub>2</sub>O  
(Seubert and Elten, Z anorg 1893, **4** 80)

**Uranyl sulphite, (UO<sub>2</sub>)SO<sub>3</sub>+4H<sub>2</sub>O**

Insol in H<sub>2</sub>O Sol in H<sub>2</sub>SO<sub>3</sub>+Aq or alcoholic solution of SO<sub>2</sub> (Rohrig, J pr (2) **37** 240)

**Vanadyl sulphite, 3VO<sub>2</sub>, 2SO<sub>2</sub>+4½H<sub>2</sub>O**

Decomp slowly on standing  
Sol in H<sub>2</sub>O without apparent decomp  
(Koppel, Z anorg 1903, **35** 186)  
2V<sub>2</sub>O<sub>4</sub>, 3SO<sub>2</sub>+10H<sub>2</sub>O Sol in H<sub>2</sub>O, aq  
sol decomp on boiling giving off SO<sub>2</sub> and  
forming V<sub>2</sub>O<sub>4</sub>, 2H<sub>2</sub>O (Gün, C R 1906, **143**  
324)

**Vanadyl zinc sulphite, ZnO, 3VO<sub>2</sub>, 2SO<sub>2</sub>**

Decomp slowly in the air  
Sol in H<sub>2</sub>O without decomp (Koppel, Z  
anorg 1903, **35** 183)

**Ytterbium sulphite, Yb<sub>2</sub>(SO<sub>3</sub>)<sub>3</sub>+9H<sub>2</sub>O**

Insol in H<sub>2</sub>O (Cleve, Z anorg 1902, **32**  
143)

**Yttrium sulphite, Y<sub>2</sub>(SO<sub>3</sub>)<sub>3</sub>+3H<sub>2</sub>O**

Sl sol in H<sub>2</sub>O (Cleve)

**Zinc sulphite, basic, 2ZnSO<sub>3</sub>, 3Zn(OH)<sub>2</sub>**

(Seubert, Arch Pharm **229** 321)  
ZnSO<sub>3</sub>, Zn(OH)<sub>2</sub>+H<sub>2</sub>O (Seubert)

**Zinc sulphite, ZnSO<sub>3</sub>+2, and 2½H<sub>2</sub>O**

Very sl sol in H<sub>2</sub>O 100 pts H<sub>2</sub>O dissolve  
0.16 pt ZnSO<sub>3</sub>+2H<sub>2</sub>O (Henston and Tich-  
borne, Brit Med J **1890** 1063)  
Easily sol in H<sub>2</sub>SO<sub>3</sub>+Aq (Koene)  
Sol in NH<sub>4</sub>OH+Aq  
Insol in alcohol  
Decomp into basic salt by boiling H<sub>2</sub>O  
(Seubert, Arch Pharm **229** 1)

**Zinc sulphite ammonia, ZnSO<sub>3</sub>, NH<sub>3</sub>**

Decomp by H<sub>2</sub>O Sol in NH<sub>4</sub>OH+Aq  
(Rammelsberg, Pogg **67** 255)

**Zirconium sulphite**

Insol in H<sub>2</sub>O Somewhat sol in H<sub>2</sub>SO<sub>3</sub>+  
Aq, from which it is reprecipitated on boiling Sol  
in (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>+Aq, from which Zr hydroxide  
is pptd on boiling (Berzelius)  
Zr(SO<sub>3</sub>)<sub>2</sub>+7H<sub>2</sub>O Ppt (Venable, J Am  
Chem Soc 1895, **17** 449)

**Sulphuryl bromide, SO<sub>2</sub>Br<sub>2</sub>**

(Odling, Chem Soc **7** 2)  
Does not exist (Sestini, Bull Soc **10**  
226, Melsens, C R **76** 92, Michaelis)

**Sulphuryl chloride, SO<sub>2</sub>Cl<sub>2</sub>**

Decomp by H<sub>2</sub>O and alcohol  
Decomp by moist air, water, or abs  
alcohol, more rapidly by alkalis, HCl, SO<sub>2</sub>,  
etc (Schiff, A **102** 111)  
+H<sub>2</sub>O Only sl sol in H<sub>2</sub>O at 0° with  
slow decomp (Baeyer, B 1901, **34** 737)  
+15H<sub>2</sub>O Sl sol in H<sub>2</sub>O at 0° and stable  
therein for several hours (Baeyer)

**D<sub>2</sub>sulphuryl chloride (Pyrosulphuryl chlor-  
ide), S<sub>2</sub>O<sub>5</sub>Cl<sub>2</sub>**

Decomp slowly with H<sub>2</sub>O (Rose, Pogg  
**44** 291)  
Sol in CCl<sub>4</sub> and CHCl<sub>3</sub>, miscible with  
liquid SO<sub>2</sub>

**Sulphuryl hydroxyl chloride,**

SO<sub>2</sub>HCl =  $\frac{HO}{Cl}SO_2$

Decomp on moist air, and violently with  
H<sub>2</sub>O Not miscible with CS<sub>2</sub> Decomp with  
alcohol

**Sulphuryl titanium chloride, SO<sub>2</sub>, TiCl<sub>4</sub>=  
TiCl<sub>3</sub>OSO<sub>2</sub>Cl**

Slowly deliquescent (Clausnitzer, B **11**  
2011)

**Disulphuryl chloride stannic oxychloride,**  
 $5\text{S}_2\text{O}_5\text{Cl}_2, 4\text{SnOCl}_2$ 

Sol in a little  $\text{H}_2\text{O}$ , but decomp by more  $\text{H}_2\text{O}$  (Rose, Pogg **44** 320)

**Sulphuryl fluoride,  $\text{SO}_2\text{F}_2$** 

1 pt is sol in 10 pts  $\text{H}_2\text{O}$  at  $9^\circ$  3 vol are sol in 1 vol alcohol at  $9^\circ$ , insol in conc  $\text{H}_2\text{SO}_4$  at  $66^\circ$ , sol in aq solution of  $\text{KOH}$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{Ba}(\text{OH})_2$  and in alcoholic solution of alkalis (Moissan, C R 1901, **132** 377)

**Sulphuryl hydroxyl fluoride,  $\text{HSO}_3\text{F}$** 

Violently decomp by  $\text{H}_2\text{O}$  (Thorpe and Kirwan, Z anorg **3** 63)

**Sulphuryl peroxide,  $\text{SO}_4$** 

See Sulphur heptoxide

**Sulphydic acid**

See Hydrogen Sulphide

**Sulphhydroxyl**

See Sulphhydroxyl

**Tantalalic acid,  $\text{H}_4\text{Ta}_2\text{O}_7$  (?)**

Sol in  $\text{HF}$  (Rose), and  $\text{KH}_2(\text{C}_2\text{O}_4)_2 + \text{Aq}$  (Gahn, Schw J **16** 437) At the instant of precipitation is sol in various acids (Rose)

**Aluminum tantalate**

Insol in  $\text{H}_2\text{O}$  (Berzelius)

**Ammonium hexatantalate,  $(\text{NH}_4)_2\text{H}_7\text{Ta}_7\text{O}_{19} + \text{H}_2\text{O}$** 

Somewhat sol in  $\text{H}_2\text{O}$  (Rose, Pogg **102** 57)

**Barium hexatantalate,  $\text{Ba}_4\text{Ta}_6\text{O}_{19} + 6\text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  (Rose)

**Cesium tantalate,  $4\text{Cs}_2\text{O}, 3\text{Ta}_2\text{O}_5 + 14\text{H}_2\text{O}$** 

Completely sol in a small amount of hot  $\text{H}_2\text{O}$  (E F Smith, J Am Chem Soc 1908, **30** 1666)

$7\text{Cs}_2\text{O}, 6\text{Ta}_2\text{O}_5 + 38\text{H}_2\text{O}$  Pptd from its aqueous solution by alcohol (Smith)

**Ferrous tantalate,  $\text{Fe}(\text{TaO}_3)_3$** 

Min *Tantalite*

$5\text{FeO}, 4\text{Ta}_2\text{O}_5$  Min *Taprochite*

**Magnesium hexatantalate,  $\text{Mg}_4\text{Ta}_6\text{O}_{19} + 9\text{H}_2\text{O}$** 

Ppt (Rose, Pogg **102** 61)

$4\text{MgO}, \text{Ta}_2\text{O}_5$  Insol in  $\text{H}_2\text{O}$  (Joly, C R **81** 266)

**Mercurous tantalate,  $5\text{Hg}_2\text{O}, 4\text{Ta}_2\text{O}_5 + 5\text{H}_2\text{O}$** 

Decomp by warm  $\text{HNO}_3 + \text{Aq}$  (1 21 sp gr) with separation of  $\text{Ta}_2\text{O}_5$  (Rose, Pogg **102** 64)

**Potassium tantalate,  $\text{KTaO}_3$** 

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{KOH} + \text{Aq}$  (Marignac, A ch (4) **9** 249)

**Potassium hexatantalate,  $\text{K}_3\text{Ta}_6\text{O}_{19} + 16\text{H}_2\text{O}$** 

Sol without decomp in moderately warm  $\text{H}_2\text{O}$  Decomp by boiling (Marignac, A ch (4) **9** 259)

**Rubidium tantalate,  $4\text{Rb}_2\text{O}, 3\text{Ta}_2\text{O}_5 + 14\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (E F Smith, J Am Chem Soc 1908, **30** 1666)

**Silver tantalate,  $4\text{Ag}_2\text{O}, 3\text{Ta}_2\text{O}_5$** 

Completely sol in  $\text{NH}_4\text{OH} + \text{Aq}$   $\text{HNO}_3 + \text{Aq}$  dissolves  $\text{Ag}_2\text{O}$ , and  $\text{Ta}_2\text{O}_5$  separates out (Rose, Pogg **102** 64)

**Sodium tantalate,  $\text{NaTaO}_3$** 

Insol in  $\text{H}_2\text{O}$  (Rose)

**Sodium hexatantalate,  $\text{Na}_3\text{Ta}_6\text{O}_{19} + 25\text{H}_2\text{O}$** 

1 pt salt dissolves in 493 pts  $\text{H}_2\text{O}$  at  $13.5^\circ$ , and in 162 pts at  $100^\circ$  Very slightly sol in alcohol Insol in alkaline solutions (Rose)

**Pertantalalic acid**

See Pertantalalic acid

**Tantalum, Ta**

Not attacked by  $\text{HCl}$ ,  $\text{HNO}_3$ , aqua regia, or hot conc  $\text{H}_2\text{SO}_4$  Easily sol in a mixture of  $\text{HNO}_3$  and  $\text{HF}$  (Berzelius, Pogg **4** 6, Rose) Also sol in  $\text{HF}$  alone (Berzelius)

Not attacked by alkali hydrates +  $\text{Aq}$  Insol in single acids and in aqua regia Oxidized by a mixture of  $\text{HF}$  and aqua regia (Moissan, C R 1902, **134** 211)

Pure Ta is insol in boiling  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ , aqua regia or mixtures of these acids, slowly sol in  $\text{HF} + \text{Aq}$  (v Bolton, Zeit Elektrochem 1905, **11** 45)

**Tantalum bromide,  $\text{TaBr}_5$** 

Decomp by  $\text{H}_2\text{O}$  (Rose)

**Tantalum dichloride,  $\text{TaCl}_2 + 2\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  when freshly prepared (Chabrie, C R 1907, **144** 805)

**Tantalum pentachloride,  $\text{TaCl}_5$** 

Takes up  $\text{H}_2\text{O}$  from the air without deliquescing Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{SO}_4$  Sol in cold  $\text{HCl} + \text{Aq}$  to a cloudy liquid, which gelatinises after a time Not completely sol in boiling  $\text{HCl} + \text{Aq}$ , and the solution does not gelatinise by the subsequent addition of water, but all goes into solution Partly sol in  $\text{KOH} + \text{Aq}$  Insol in  $\text{K}_2\text{SO}_3 + \text{Aq}$  Sol in absolute alcohol

**Tantalum pentafluoride, TaF<sub>5</sub>**

Very hygroscopic, sol in H<sub>2</sub>O (Ruff, B 1909, 42 494)

**Tantalum fluoride with MF**

See Fluotantalate, M

**Tantalum hydroxide, Ta<sub>2</sub>O<sub>5</sub>, xH<sub>2</sub>O**

See Tantallic acid

**Tantalum nitride, TaN**

Not sol in any acids, except a mixture of HF and HNO<sub>3</sub> (Rose, Pogg 100 146)  
Ta<sub>2</sub>N<sub>5</sub> (Joly, Bull Soc (2) 25 506)

**Tantalum dioxide, Ta<sub>2</sub>O<sub>3</sub>(?)**

Sol in HF with evolution of hydrogen (Hermann, J pr (2) 5 69)

**Tantalum tetroxide, Ta<sub>2</sub>O<sub>4</sub>**

Not attacked by any acid, not even a mixture of HNO<sub>3</sub> and HF (Berzelius, Pogg 4 20)

Decomp by HCl (Smith, Z anorg 1894, 7 98)

**Tantalum pentoxide, Ta<sub>2</sub>O<sub>5</sub>**

Insol in any acid, even boiling H<sub>2</sub>SO<sub>4</sub> or in HF (Berzelius)

Sol in fused KHSO<sub>4</sub>, 10 pts being necessary to dissolve 1 pt Ta<sub>2</sub>O<sub>5</sub>

**Tantalum silicide, TaSi<sub>2</sub>**

Insol in most inorganic acids Sol in HF and in HF+HNO<sub>3</sub>

Decomp by fused alkali hydroxides (Hönigschmid, M 1907, 28 1027)

**Tantalum sulphide, Ta<sub>2</sub>S<sub>4</sub>**

Not attacked by HCl+aq Oxidised by boiling with HNO<sub>3</sub>+aq, more rapidly with aqua regia Attacked by H<sub>2</sub>SO<sub>4</sub> on heating Not completely sol in HF or a mixture of HF and HNO<sub>3</sub>

**Telluretted hydrogen, TeH<sub>2</sub>**

See Hydrogen telluride

**Telluric acid, H<sub>2</sub>TeO<sub>4</sub>**

Insol in H<sub>2</sub>O, cold conc HCl, hot HNO<sub>3</sub>, or boiling KOH+aq, but when heated with H<sub>2</sub>O is gradually converted into H<sub>2</sub>TeO<sub>4</sub>+2H<sub>2</sub>O and dissolved

+2H<sub>2</sub>O Very slowly sol in cold H<sub>2</sub>O, but sol in hot H<sub>2</sub>O in every proportion Insol in absolute alcohol, sol in dil alcohol according to the amount of H<sub>2</sub>O present Sol in acids and alkalis Insol in alcohol or ether

Insol in alcohol, sol in NaOH+aq (Mylius, B 1901, 34 2216)

Stable in the air

Sol in H<sub>2</sub>O, pptd by HNO<sub>3</sub> (Staudenmaier, Z anorg 1895, 10 191)

**Solubility in H<sub>2</sub>O**

Solid phase	Temp	% H <sub>2</sub> TeO <sub>4</sub>	Mols H <sub>2</sub> O to 1 mol H <sub>2</sub> TeO <sub>4</sub>	Mols H <sub>2</sub> TeO <sub>4</sub> to 100 mols H <sub>2</sub> O
H <sub>2</sub> TeO <sub>4</sub> +6H <sub>2</sub> O	0°	13 92	66 2	1 51
"	5°	17 84	49 2	2 03
"	10°	26 21	30 2	3 31
"	15°	32 79	21 9	4 55
H <sub>2</sub> TeO <sub>4</sub> 2H <sub>2</sub> O	10°	25 29	31 7	3 15
"	18°	28 90	26 2	3 82
"	30°	33 36	21 4	4 67
"	40°	36 38	18 8	5 33
"	60°	43 67	14 2	7 04
"	80°	51 55	10 07	9 93
"	100°	60 84	6 89	14 52

(Mylius, B 1901, 34 2211)

+6H<sub>2</sub>O Obtained from solutions at 0° (Staudenmaier, Z anorg 1895, 10 191)

**Allotelluric acid, H<sub>2</sub>TeO<sub>4</sub>**

Miscible with H<sub>2</sub>O

Sol in alcohol, pptd by NaOH+aq but sol in excess (Mylius, B 1901, 34 2216)

**Tellurates**

Neutral alkali salts are sol in H<sub>2</sub>O, the acid salts are only sl sol therein, but dissolve in HCl+aq

**Aluminum tellurate**

Ppt Sol in excess of aluminum salts+aq (Berzelius)

**Ammonium tellurate, (NH<sub>4</sub>)<sub>2</sub>TeO<sub>4</sub>**

Slowly but completely sol in H<sub>2</sub>O Sl sol in NH<sub>4</sub>OH+aq or NH<sub>4</sub>Cl+aq Sl sol in alcohol (Berzelius)

(NH<sub>4</sub>)<sub>2</sub>O, 2TeO<sub>3</sub> Sl sol in H<sub>2</sub>O, but more sol than the corresponding K salt

(NH<sub>4</sub>)<sub>2</sub>O, 4TeO<sub>3</sub> Very sl sol in H<sub>2</sub>O Insol in alcohol (Berzelius)

**Barium tellurate, BaTeO<sub>4</sub>+3H<sub>2</sub>O**

Sl sol in cold, more in boiling H<sub>2</sub>O Easily sol in HNO<sub>3</sub>+aq (Berzelius)

BaH<sub>2</sub>(TeO<sub>4</sub>)<sub>2</sub>+2H<sub>2</sub>O More sol in H<sub>2</sub>O than BaTeO<sub>4</sub> Decomp by H<sub>2</sub>O (Berzelius)

BaO, 4TeO<sub>3</sub> More sol in H<sub>2</sub>O than either BaTeO<sub>4</sub> or BaH<sub>2</sub>(TeO<sub>4</sub>)<sub>2</sub> (Berzelius)

**Bismuth tellurate, Bi<sub>2</sub>TeO<sub>5</sub>+2H<sub>2</sub>O**

Min Montanite Sol in HCl+aq with evolution of Cl

**Cadmium tellurate, CdTeO<sub>4</sub>**

Ppt Sol in HCl+aq (Oppenheim)

**Cæsium hydrogen tellurate, CsHTeO<sub>4</sub>+½H<sub>2</sub>O**

1 pt is sol in 30 pts H<sub>2</sub>O (Norris, Am Ch J 1901, 26 321)

**Calcium tellurate,  $\text{CaTeO}_4$** Ppt Sol in hot  $\text{H}_2\text{O}$  (Berzelius)**Chromic tellurate,  $\text{Cr}_2(\text{TeO}_4)_3$** 

Ppt Sol in excess of Cr salts + Aq

**Cobaltous tellurate**

Ppt (Berzelius)

**Cupric tellurate,  $\text{CuTeO}_4$** 

Ppt (Berzelius)

 $\text{CuO}$ ,  $2\text{TeO}_3$  Ppt (B) $\text{Cu}_2\text{TeO}_6$  Insol in  $\text{H}_2\text{O}$ Sol in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{NH}_4\text{OH}$ ,  $\text{KCN}$  and acetic acid (Hutchins, J Am Chem Soc 1905, 27 1181)**Glucinum tellurate,  $\text{GlTeO}_4$** Insol in  $\text{H}_2\text{O}$ **Iron (ferrous) tellurate,  $\text{FeTeO}_4$** Ppt Min *Ferrotellurate***Iron (ferric) tellurate,  $\text{Fe}_2(\text{TeO}_4)_3$** 

Ppt Sol in ferric salts + Aq (Berzelius)

**Lead tellurate, basic**Not completely insol in  $\text{H}_2\text{O}$ **Lead tellurate,  $\text{PbTeO}_4$** Somewhat sol in  $\text{H}_2\text{O}$  $\text{PbO}$ ,  $2\text{TeO}_3$  More sol than  $\text{PbTeO}_4$  $\text{PbO}$ ,  $4\text{TeO}_3$  Sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  + Aq, less sol in  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq (Berzelius)**Lithium tellurate,  $\text{Li}_4\text{TeO}_6 + x\text{H}_2\text{O}$** Sl sol in  $\text{H}_2\text{O}$  with decomp (Mylius, B 1901, 34 2209)**Magnesium tellurate,  $\text{MgTeO}_4$** Ppt More sol in  $\text{H}_2\text{O}$  than the Ba, Sr or Ca salts $\text{MgTe}_2\text{O}_7$  More sol in  $\text{H}_2\text{O}$  than  $\text{MgTeO}_4$ **Manganous tellurate**

Ppt

**Mercurous tellurate, basic,  $3\text{Hg}_2\text{O}$ ,  $2\text{TeO}_3$** 

Ppt (Hutchins, J Am Chem Soc 1905, 27 1178)

**Mercurous tellurate,  $\text{Hg}_2\text{TeO}_4$** Ppt Min *Magnobite***Mercuric tellurate,  $\text{HgTeO}_4$** Ppt Very easily decomp by  $\text{H}_2\text{O}$  (Hutchins, J Am Chem Soc 1905, 27 1179)+  $2\text{H}_2\text{O}$  Slowly decomp by cold  $\text{H}_2\text{O}$ Rapidly decomp by boiling  $\text{H}_2\text{O}$  (Hutchins) $\text{Hg}_2\text{TeO}_6$  Insol in  $\text{H}_2\text{O}$  Unchanged by boiling with  $\text{H}_2\text{O}$ Sol in  $\text{HNO}_3$ , but more readily sol in  $\text{HCl}$  (Hutchins)**Mercuric tellurate**

Ppt (Berzelius)

**Mercurous hydrogen tellurate,  $\text{HgHTeO}_4 + 3\text{H}_2\text{O}$** Stable in the air if protected from the light  
Insol in  $\text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}$  or by an excess of cold conc  $\text{HgNO}_3$  + Aq  
Sol in dil  $\text{HNO}_3$  or dil acetic acid (Hutchins, J Am Chem Soc 1905, 27 1177)**Nickel tellurate**

Ppt

**Potassium tellurate,  $\text{K}_2\text{TeO}_4 + 5\text{H}_2\text{O}$** Deliquesces Sol in  $\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  containing  $\text{KOH}$ 100 g  $\text{H}_2\text{O}$  dissolve at

0°

8 82

20°

27 53

30°

50 42 g  $\text{K}_2\text{TeO}_4$ 

(Rosenheim and Weinheber, Z anorg 1911, 69 264)

Insol in alcohol (Berzelius)

 $\text{K}_2\text{O}$ ,  $2\text{TeO}_3$  Insol in  $\text{H}_2\text{O}$ , acids, or alkalies (B) $\text{KHTeO}_4 + \frac{1}{2}\text{H}_2\text{O}$  Sl sol in cold, more sol in hot  $\text{H}_2\text{O}$  (Berzelius) $\text{K}_2\text{O}$ ,  $3\text{TeO}_3 + 5\text{H}_2\text{O}$  Much more sol in hot than in cold  $\text{H}_2\text{O}$  (Hutchins, J Am Chem Soc 1905, 27 1174) $\text{K}_2\text{O}$ ,  $4\text{TeO}_3$  Insol in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or  $\text{HNO}_3$  + Aq Sol by long heating with conc  $\text{HNO}_3$  + Aq $\text{KHTeO}_4$ ,  $\text{H}_2\text{TeO}_4 + \frac{1}{2}\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$ **Rubidium tellurate,  $\text{Rb}_2\text{TeO}_4 + 3\text{H}_2\text{O}$** Sol in about 10 pts  $\text{H}_2\text{O}$  (Norris, Am Ch J 1901, 26 322)**Rubidium hydrogen tellurate,  $\text{RbHTeO}_4 + \frac{1}{2}\text{H}_2\text{O}$** Sol in about 20 pts cold  $\text{H}_2\text{O}$  Sl more sol in hot  $\text{H}_2\text{O}$  (Norris, Am Ch J 1901, 26 320)**Silver tellurate,  $3\text{Ag}_2\text{O}$ ,  $\text{TeO}_3$** Sol in  $\text{NH}_4\text{OH}$  + Aq $3\text{Ag}_2\text{O}$ ,  $2\text{TeO}_3$  Insol in boiling  $\text{H}_2\text{O}$ +  $3\text{H}_2\text{O}$  Ppt Unchanged by cold  $\text{H}_2\text{O}$ Gradually decomp by boiling  $\text{H}_2\text{O}$  (Hutchins, J Am Chem Soc 1905, 27 1169) $\text{Ag}_2\text{TeO}_4$  Decomp by  $\text{H}_2\text{O}$  into  $3\text{Ag}_2\text{O}$ ,  $\text{TeO}_3$  Sol in  $\text{NH}_4\text{OH}$  + Aq+  $2\text{H}_2\text{O}$  Insol in hot and cold  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH}$ ,  $\text{KCN}$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq Decomp by conc  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  or acetic acid (Hutchins, J Am Chem Soc 1905, 27 1165)

$\text{Ag}_2\text{TeO}_7$  Ppt  
 $\text{Ag}_2\text{O}$ ,  $4\text{TeO}_3$  Ppt  
 Could not be obtained (Hutchins, J Am Chem Soc 1905, 27 1168)

### Sodium tellurate, $\text{Na}_2\text{TeO}_4 + 2\text{H}_2\text{O}$

Very sl sol in hot or cold  $\text{H}_2\text{O}$ . When heated to drive off  $2\text{H}_2\text{O}$  becomes insol in  $\text{H}_2\text{O}$ , but sol in dil  $\text{HNO}_3 + \text{Aq}$  (Berzelius).  
 1 pt is sol in about 130 pts  $\text{H}_2\text{O}$  at  $18^\circ$ , 50 pts  $\text{H}_2\text{O}$  at  $100^\circ$   
 $+4\text{H}_2\text{O}$  1 pt is sol in about 70 pts  $\text{H}_2\text{O}$  at  $18^\circ$ , 40 pts  $\text{H}_2\text{O}$  at  $50^\circ$  (Mylius, B 1901, 34 2209)

$\text{Na}_2\text{Te}_2\text{O}_7 + 4\text{H}_2\text{O} = \text{NaHTeO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$   
 Slowly but completely sol in  $\text{H}_2\text{O}$ . Sl sol in  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Insol in alcohol (Berzelius)

$\text{Na}_2\text{O}$ ,  $4\text{TeO}_3$  Insol in  $\text{H}_2\text{O}$ , acids, or alkalies, except by long boiling with  $\text{HNO}_3 + \text{Aq}$

$+x\text{H}_2\text{O}$  (a) Slowly sol in  $\text{H}_2\text{O}$  ( $\beta$ ) Insol even in boiling  $\text{H}_2\text{O}$

$\text{Na}_4\text{TeO}_6 + 8\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  but with decomp (Mylius)

### Strontium tellurates

Resemble Ca salts

### Thallous tellurate, $\text{Tl}_2\text{TeO}_4$

Sl sol in  $\text{H}_2\text{O}$  (Dennis, J Am Chem Soc 1898, 18 975)

### Thorium tellurate

Ppt Insol in excess of thorium salts  $+ \text{Aq}$

### Uranium tellurate, $\text{U}_2(\text{TeO}_4)_3(?)$

Ppt Insol in  $\text{H}_2\text{O}$  or  $\text{UO}_2(\text{NO}_3)_2 + \text{Aq}$

### Yttrium tellurate

Ppt Insol in  $\text{H}_2\text{O}$  or Yt salts  $+ \text{Aq}$

### Zinc tellurate, $\text{Zn}_3\text{TeO}_6$

Insol in  $\text{H}_2\text{O}$

Sol in  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and acetic acid (Hutchins, J Am Chem Soc 1905, 27 1181)

### Zirconium tellurate

Ppt (Berzelius)

### Tellurium, Te

Insol in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ . Sl sol in hot conc  $\text{H}_2\text{SO}_4$ , but separates out on cooling. Sol in boiling conc  $\text{H}_2\text{SO}_4$ . Easily oxidised by  $\text{HNO}_3$  or aqua regia. Sol in boiling very conc  $\text{KOH} + \text{Aq}$ , separating out again on cooling.

Not attacked by boiling conc  $\text{HNO}_3 + \text{Aq}$ , according to Hartung-Schwartzkoff (Ann Min (4) 19 345)

Sol in warm conc  $\text{KCN} + \text{Aq}$

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1893, 20 830)

100 pts methylene iodide dissolve 0.1 pt Te at  $12^\circ$  (Retgers, Z anorg 3 343)  
 $\frac{1}{2}$  ccm oleic acid dissolves 0.0014 g Te in 6 days (Gates, J phys Ch 1911, 15 143)

A colloidal solution of Te in  $\text{H}_2\text{O}$  can be obtained. It exists in two modifications, a brown and a blue-gray. Both can be diluted with  $\text{H}_2\text{O}$  or concentrated by boiling without decomp. They are, however, decomp by electrolytes, especially  $\text{NH}_4\text{Cl}$  (Gutbier, Z anorg 1902, 32 53)

### Tellurium dibromide, $\text{TeBr}_2$

Decomp on air or by  $\text{H}_2\text{O}$  (Rose, Pogg 21 443)

Conc tartaric acid dissolves partly without decomp (Brauner, M 1891, 12 34)

### Tellurium tetrabromide, $\text{TeBr}_4$

Sol in a little, but decomp by much  $\text{H}_2\text{O}$ . Completely sol in tartaric acid  $+ \text{Aq}$  (1:1) (Brauner, M 1891, 12 34)

### Tellurium hydrogen bromide, $\text{TeBr}_4, \text{HBr} + 5\text{H}_2\text{O}$

Fumes in the air. Deliquescent. Stable in an atmos of  $\text{HBr}$  (Metzner, C R 1897, 124 1951)

### Tellurium dichloride, $\text{TeCl}_2$

Decomp on air, or by  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$  (Rose, Pogg 21 443)

### Tellurium tetrachloride, $\text{TeCl}_4$

Extremely deliquescent. Decomp by cold  $\text{H}_2\text{O}$ , with separation of oxychloride and tellurous acid. Sol in hot  $\text{H}_2\text{O}$  with decomp. Sol in dil  $\text{HCl} + \text{Aq}$  without decomp (Rose, Pogg 21 443)

Insol in sulphur chloride and in  $\text{CS}_2$  (Lenher, J Am Chem Soc 1902, 24 188)

### Tellurium hydrogen chloride, $\text{TeCl}_4, \text{HCl} + 5\text{H}_2\text{O}$

Easily decomp (Metzner, C R 1897, 125 24)

### Tellurium chloride with $\text{MCl}$

See Chlorotellurate, M

### Tellurium tetrachloride ammonia,

$\text{TeCl}_4, 3\text{NH}_3$

Decomp by  $\text{H}_2\text{O}$  (Metzner, C R 1897, 124 33)

$\text{TeCl}_4, 4\text{NH}_3$  Not deliquescent. Decomp by  $\text{H}_2\text{O}$  (Espenschied, J pr 80 480)

### Tellurium tetrachloride sulphur trioxide,

$\text{TeCl}_4, \text{SO}_3$

Ppt ((Prandtl, Z anorg 1909, 62 247)  
 $\text{TeCl}_4, 2\text{SO}_3$  Decomp by moisture. On heating at  $120^\circ$ , it gives  $\text{TeCl}_4, \text{SO}_3$  (Prandtl)

**Tellurium tetrafluoride,  $\text{TeF}_4$** 

(Metzner, C R 1897, **125** 25 )  
 $+\text{H}_2\text{O}$  (Hogbom, Bull Soc (2) **35** 60 )

**Tellurium hexafluoride,  $\text{TeF}_6$** 

Decomp by  $\text{H}_2\text{O}$  slowly but completely  
 (Prideaux, Chem Soc 1906, **39** 322 )

**Tellurium zirconum fluoride,**  
*See Fluozirconate, tellurium*
**Tellurium dioxide,  $\text{TeO}_2$** 

Insol in  $\text{H}_2\text{O}$  (Rose, Pogg **21** 443 )

**Tellurium tetraiodide,  $\text{TeI}_4$** 

Insol in cold, decomp by hot  $\text{H}_2\text{O}$  or alcohol Sol in  $\text{HI}$ , but only sol in  $\text{MI} + \text{Aq}$  (Berzelius )

Data on solubility of  $\text{TeI}_4$  in  $\text{HI} + \text{I} + \text{Aq}$  are given by Menke (Z anorg 1912, **77** 283 )

**Tellurium hydrogen iodide,  $\text{TeI}_4$ ,  $\text{HI} + 8\text{H}_2\text{O}$ , and  $+9\text{H}_2\text{O}$** 

Deliquescent (Metzner, A ch 1898, (7) **15** 203 )

**Tellurium nitride,**

Two forms

ble at ord temp

stable at ord temp

— Fischer, B 1910, **43** 1472 )

Not attacked by  $\text{H}_2\text{O}$  or dil acetic

Insol in liquid  $\text{NH}_3$  Decomp by  $\text{KOH} + \text{Aq}$  (Metzner, A ch 1898, (7) **15** 203 )

**Tellurium monoxide,  $\text{TeO}$** 

Sl sol in cold dil  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$  Easily oxidised by  $\text{HNO}_3 + \text{Aq}$  or aqua regia Decomp immediately by boiling conc  $\text{HCl} + \text{Aq}$  Slowly decomp by  $\text{KOH} + \text{Aq}$  (Divers and Shmosé, Chem Soc **35** 563 )

**Tellurium dioxide,  $\text{TeO}_2$** 

Very sl sol in  $\text{H}_2\text{O}$  Sl attacked by acids Sl sol in  $\text{NH}_4\text{OH}$  or alkali carbonates  $+ \text{Aq}$  Easily sol in  $\text{NaOH}$  or  $\text{KOH} + \text{Aq}$  Not sol in less than 150,000 pts  $\text{H}_2\text{O}$  Easily sol in warm dil  $\text{HNO}_3 + \text{Aq}$  Sol in warm  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Klein and Morel, Bull Soc (2) **43** 203 )

20%  $\text{H}_2\text{SO}_4 + \text{Aq}$  dissolves on warming about 0.7%, 30%  $\text{H}_2\text{SO}_4 + \text{Aq}$ , about 0.85%, 50%  $\text{H}_2\text{SO}_4 + \text{Aq}$ , about 4.4%

These solutions are supersat and  $\text{TeO}_2$  separates from the more dil acids on standing (Brauner, M 1891, **12** 34 )

Min Tellurite

**Tellurium dioxide hydrobromic acid,  $\text{TeO}_2, 3\text{HBr}$** 

(Ditte, C R **83** 336 )

**Tellurium dioxide hydrochloric acid,  $\text{TeO}_2, 2\text{HCl}$** 

(Ditte, C R **83** 336 )  
 $\text{TeO}_2, 3\text{HCl}$  (Ditte )

**Tellurium trioxide,  $\text{TeO}_3$** 

Insol in cold or hot  $\text{H}_2\text{O}$ , cold  $\text{HCl} + \text{Aq}$ , or cold or hot  $\text{HNO}_3 + \text{Aq}$  Insol in moderately conc  $\text{KOH} + \text{Aq}$ , but, when the  $\text{KOH} + \text{Aq}$  is very conc, is sol if boiling

**Tellurium oxide,  $2\text{TeO}_2, \text{TeO}_3$** 

"Tellurium tellurate"  
 (Metzner, A ch 1898, (7) **15** 203 )

**Tellurium oxybromide**

Insol in  $\text{H}_2\text{O}$  (Ditte, A ch (5) **10** 82 )

**Tellurium oxybromide sulphur trioxide,  $\text{TeOBr}_2, 2\text{SO}_3$** 

Deliquescent (Prandtl, Z anorg 1909, **62** 247 )

**Tellurium oxychloride,  $\text{TeOCl}_2$** 

Insol in  $\text{H}_2\text{O}$  (Ditte )

**Tellurium oxyfluoride,  $\text{TeF}_4, \text{TeO}_2 + 2\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$  Decomp by  $\text{H}_2\text{O}$

$2\text{TeF}_4, 3\text{TeO}_2 + 6\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Metzner, C R 1897, **125** 25 )

**Tellurium sulphide,  $\text{TeS}$** 

Insol in  $\text{CS}_2$ , very unstable (Snelling, J Am Chem Soc 1912, **34** 802 )

**Tellurium disulphide,  $\text{TeS}_2$** 

Insol in  $\text{H}_2\text{O}$  or dil acids Sol in alkali hydrates or sulphides  $+ \text{Aq}$

$\text{CS}_2$  dissolves out S, so that the substance is probably a mixture (Becker, A **180** 257 )

**Tellurium trisulphide,  $\text{TeS}_3$** 

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{K}_2\text{S} + \text{Aq}$

**Tellurium sulphoxide,  $\text{TeSO}_3$** 

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{SO}_4$  (Wcher, J pr (2) **25** 218 )

Is tellurium sulphite (Divers, Chem Soc **49** 583 )

**Tellurous acid,  $\text{H}_2\text{TeO}_3$** 

Appreciably sol in  $\text{H}_2\text{O}$  and acids Sol in alkali hydrates or carbonates  $+ \text{Aq}$

**Tellurites**

The neutral and acid tellurites of the alkali metals are sol in  $\text{H}_2\text{O}$  Ba, Sr Ca, and Mg tellurites are sl sol, and the other salts insol in  $\text{H}_2\text{O}$  Most tellurites are sol in  $\text{HCl} + \text{Aq}$

**Aluminum tellurite**

Ppt Insol in Al salts + Aq (Berzelius)

**Ammonium tellurite,  $(\text{NH}_4)\text{HTeO}_3$ ,  $\text{H}_2\text{TeO}_3 + 3\frac{1}{2}\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$ , from which it is precipitated by  $\text{NH}_4\text{Cl}$  + Aq or alcohol (Berzelius)

**Barium tellurite,  $\text{BaTeO}_3$** 

Sl sol in  $\text{H}_2\text{O}$  when prepared in the moist way (Berzelius)

$\text{BaO}$ ,  $4\text{TeO}_2$

**Cadmium tellurite**

Ppt Sol in  $\text{HNO}_3$ , and  $\text{HCl}$  + Aq (Oppenheim)

**Calcium tellurite,  $\text{CaTeO}_3$** 

Sl sol in cold, more sol in hot  $\text{H}_2\text{O}$  (Berzelius)

$\text{CaO}$ ,  $4\text{TeO}_2$

**Chromium tellurite**

Ppt Sol in excess of chromic salts + Aq

**Cobaltous tellurite**

Ppt

**Cupric tellurite**

Insol in  $\text{H}_2\text{O}$  (Berzelius)

**Glucinum tellurite**

Insol in  $\text{H}_2\text{O}$

**Indium tellurite,  $\text{In}_2(\text{TeO}_3)_2$ ,  $2\text{In}(\text{OH})_3$** 

Ppt (Renz, Dissert 1902)

**Ferrous tellurite**

Ppt

**Ferric tellurite**

Ppt

**Lead tellurite,  $\text{PbTeO}_3$** 

Ppt Easily sol in acids (Berzelius)

**Lithium tellurite,  $\text{Li}_2\text{TeO}_3$** 

Sol in  $\text{H}_2\text{O}$  (Berzelius)  
 $\text{Li}_2\text{O}$ ,  $2\text{TeO}_2$  Decomp by cold  $\text{H}_2\text{O}$  into  $\text{Li}_2\text{TeO}_3$  and  $\text{Li}_2\text{O}$ ,  $4\text{TeO}_2$  (B)  
 $\text{Li}_2\text{O}$ ,  $4\text{TeO}_2$  Sol in hot, much less in cold  $\text{H}_2\text{O}$  (B)

**Magnesium tellurite,  $\text{MgTeO}_3$** 

Precipitate Much more sol in  $\text{H}_2\text{O}$  than the Ba, Sr, or Ca salt (Berzelius)

**Manganous tellurite**

Ppt

**Mercurous tellurite**

Ppt

**Mercuric tellurite**

Ppt

**Nickel tellurite**

Ppt

**Potassium tellurite,  $\text{K}_2\text{TeO}_3$** 

Not deliquescent Slowly sol in cold, more quickly in boiling  $\text{H}_2\text{O}$  (Berzelius)  
 $\text{K}_2\text{O}$ ,  $2\text{TeO}_2$  Completely sol in boiling  $\text{H}_2\text{O}$ , from which  $\text{K}_2\text{O}$ ,  $4\text{TeO}_2$  crystallises (B)  
 $\text{K}_2\text{O}$ ,  $4\text{TeO}_2 + 4\text{H}_2\text{O}$  Decomp by cold  $\text{H}_2\text{O}$  into  $\text{K}_2\text{O}$ ,  $\text{TeO}_2$ , and  $\text{K}_2\text{O}$ ,  $2\text{TeO}_2$ , which dissolve, and  $\text{H}_2\text{TeO}_3$ , which is insol (B)

**Potassium hexatellurite,  $\text{K}_2\text{O}$ ,  $6\text{TeO}_2 + 2\text{H}_2\text{O}$** 

Not decomp by, but sl sol in  $\text{H}_2\text{O}$  (Klein and Morel, C R 100 1140)

**Silver tellurite,  $\text{Ag}_2\text{TeO}_3$** 

Ppt Sol in  $\text{NH}_4\text{OH}$  + Aq (Berzelius)  
The freshly pptd salt is insol in  $\text{H}_2\text{O}$ , sol in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , acetic and tartaric acid, decomp by  $\text{HCl}$  (Lenher, J Am Chem Soc 1913, 35 727)  
 $\text{AgHTeO}_3$  Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  + Aq (Rose, Pogg 18 60)

**Sodium tellurite,  $\text{Na}_2\text{TeO}_3$** 

Slowly sol in cold, more quickly in hot  $\text{H}_2\text{O}$  Precipitated from aqueous solution by alcohol (Berzelius)  
 $\text{Na}_2\text{O}$ ,  $2\text{TeO}_2$  Decomp by  $\text{H}_2\text{O}$  as K salt (B)  
 $\text{Na}_2\text{O}$ ,  $4\text{TeO}_2 + 5\text{H}_2\text{O}$  As above (B)

**Strontium tellurite,  $\text{SrTeO}_3$** 

Resembles Ba salt  
 $\text{SrH}_2\text{Te}_4\text{O}_{10}$  Very sl sol in  $\text{H}_2\text{O}$ , more easily in  $\text{HNO}_3$  + Aq

**Thorium tellurite**

Precipitate Insol in  $\text{H}_2\text{O}$  or Th salts + Aq

**Stannous tellurite**

Pptd in presence of 60,000 pts  $\text{H}_2\text{O}$  (Fischer)

**Uranium tellurite,  $\text{U}_2(\text{TeO}_3)_3$** 

Ppt Insol in U salts + Aq

**Yttrium tellurite**

Precipitate

**Zinc tellurite,  $\text{ZnTeO}_3$** 

Ppt

**Zirconium tellurite**

Ppt

**Terbium, Tb**

Metal has not been isolated  
Has been decomp into two or more elements by Kruss (Z anorg 4 27)



**Terbium chloride,  $TbCl_3 \cdot 6H_2O$** 

Sol in  $H_2O$ , very hygroscopic, sol in alcohol (Urban, C R 1908, **146** 128)

**Terbium hydroxide**

Sol in dilute acids Decomposes  $NH_4$  salts +  $Aq$

**Terbium oxide,  $Tb_2O_3$** 

Sol in dil acids, even after ignition

**Terbium peroxide,  $Tb_4O_7$** 

Sol in  $HNO_3$  and in hot  $HCl$  (Urban, C R 1907, **146** 127)

**Tetramine chromium compounds**

See—

Bromotetramine chromium compounds

Chlorotetramine chromium compounds

Iodotetramine chromium compounds

**Tetramine cobaltic compounds,**

See—

Bromotetramine cobaltic compounds

Carbonatotetramine cobaltic compounds

Chlorotetramine cobaltic compounds

Croceocobaltic compounds

Fusocobaltic compounds

Flavocobaltic compounds

Iodotetramine cobaltic compounds

Nitratotetramine cobaltic compounds

Praseocobaltic compounds

Roseotetramine cobaltic compounds

Sulphatotetramine cobaltic compounds

See also under octamine cobaltic salts for many tetramine salts as yet unclassified

**Tetramine cobaltic nitrite with  $MnO_2$ ,**

See Diamine cobaltic nitrite

**Tetrathionic acid,  $H_2S_4O_6$** 

Known only in aqueous solution

Dil solution can be boiled without decompose  
Conc solution decompose by boiling

Addition of  $H_2SO_4$  or  $HCl$  makes solution more stable (Fordos and Gélis, C R **15** 920)

**Tetrathionates**

Tetrathionates are all easily sol in  $H_2O$ , but insol in alcohol

**Barium tetrathionate,  $BaS_4O_6 + 2H_2O$** 

Very sol in  $H_2O$ , but precipitated by addition of alcohol

**Cadmium tetrathionate**

Deliquescent Solution in  $H_2O$  gradually decomposes (Kessler, Pogg **74** 249)

**Cesium tetrathionate,  $Cs_2S_4O_6$** 

(J Meyer, B 1907, **40** 1361)

**Cuprous tetrathionate,  $Cu_2S_4O_6$** 

Decomp by  $H_2O$  (Chancel and Diacon, C R 1863, **56** 711)

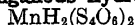
**Cupric tetrathionate,  $CuS_4O_6$** 

Sol in  $H_2O$

Decomp by long boiling (Curtius and Henkel, J pr 1883, (2) **37** 148)

**Lead tetrathionate,  $PbS_4O_6 + 2H_2O$** 

Sol in  $H_2O$

**Manganous hydrogen tetrathionate,**

Deliquescent Very sol in  $H_2O$  and alcohol (Curtius and Henkel, J pr (2) **37** 148)

**Nickel tetrathionate ammonia,  $NiS_4O_6, 6NH_3$** 

Ppt Decomp by  $H_2O$  Insol in alcohol (Ephraim, B 1913, **46** 3109)

**Potassium tetrathionate,  $K_2S_4O_6$** 

Soluble in  $H_2O$  Insol in alcohol

Difficultly sol in  $H_2O$  (Kessler, Pogg 1847, **74** 254)

**Rubidium tetrathionate,  $Rb_2S_4O_6$** 

Not hygroscopic (J Meyer, B 1907, **40** 1356)

**Sodium tetrathionate,  $Na_2S_4O_6$** 

Sol in  $H_2O$  Precipitated therefrom by a great excess of alcohol (Kessler, J pr **95** 13)

+  $2H_2O$  (Berthelot, A ch (b) **17** 450)

**Strontium tetrathionate,  $SrS_4O_6 + 6H_2O$** 

Sol in  $H_2O$  (Kessler, Pogg **74** 255)

More sol in  $H_2O$  than Ba salt

**Zinc tetrathionate**

Sol in  $H_2O$  (Fordos and Gélis)

**Zinc hydrogen tetrathionate,  $ZnH_2(S_4O_6)_2$** 

Extremely sol in  $H_2O$  and alcohol (Curtius and Henkel, J pr (2) **37** 147)

**Zinc tetrathionate ammonia,  $ZnS_4O_6, 3NH_3$** 

Ppt (Ephraim, B 1915, **48** 641)

**Thallic acid****Potassium thallate**

Known only in aqueous solution (Carstanjen, J pr **101** 55)

Does not exist (I epsius, Chem Ztg **1890**, 1327)

**Thallium, Tl**

Not attacked by pure  $H_2O$ . Easily sol in dil  $H_2SO_4$  or  $HNO_3$ +Aq. Difficultly sol in  $HCl$ +Aq. Absolute alcohol dissolves considerable quantity in a short time, also methyl alcohol, and acetic ether (Bottger). Not easily attacked by  $HF$ +Aq (Kuhlmann).

Insol in liquid  $NH_3$  (Franklin, Am Ch J 1893, 20 830).

$\frac{1}{2}$  ccm oleic acid dissolves 0.0424 g Tl in 6 days (Gates, J phys Chem 1911, 15 143).

**Thallium arsenide,  $TlAs$** 

Decomp by  $H_2SO_4$  (Carstanjen).

**Thalious azomide,  $TlN_3$** 

Sl, sol in  $H_2O$ .

0.1712 pt is sol in 100 pts  $H_2O$  at  $0^\circ$ ,

0.1965 pt is sol in 100 pts  $H_2O$  at  $5^\circ$ ,

0.3 pt is sol in 100 pts  $H_2O$  at  $16^\circ$ .

Insol in abs alcohol and ether.

(Curtius, J pr 1898, (2) 58 284.)

**Thallothallic azomide,  $TlN_3$ ,  $TlN_3$** 

Explosive. Decomp by hot  $H_2O$  and by acids (Dennis, J Am Chem Soc 1896, 18 973).

**Thalious bromide,  $TlBr$** 

Nearly insol in cold, sl sol in boiling  $H_2O$  (Willm, Bull Soc (2) 2 89).

1 l  $H_2O$  dissolves 0.00869 g mol  $TlBr$  at  $68.5^\circ$  (Noyes, Z phys Ch 6 248).

Sl sol in  $H_2O$ .  $0.48 \times 10^{-2}$  g is dissolved in a liter of sat solution at  $20^\circ$  (Bottger, Z phys Ch 1903, 46 603).

1 l  $H_2O$  dissolves 420 mg  $TlBr$  at  $18^\circ$  (Kohlrausch, Z phys Ch 1904, 50 356).

238 mg  $TlBr$  are contained in 1 l sat solution at  $0.13^\circ$ , 289 mg at  $9.37^\circ$ , 423 mg at  $18^\circ$ , 579 mg at  $25.68^\circ$  (Kohlrausch, Z phys Ch 1908, 64 168).

Solubility of  $TlBr$  in  $Tl(NO_3)_3$ +Aq at  $68.5^\circ$

g mols per l		g mols per l	
$TlNO_3$	$TlBr$	$TlNO_3$	$TlBr$
0	0.00869	0	2.469
0.0163	0.00410	4.336	1.164
0.0294	0.00289	7.820	0.821
0.0955	0.00148	25.400	0.420

(Noyes, Z phys Ch 1890, 6 248.)

Insol in acetone (Naumann, B 1904, 37 4329), pyridine (Naumann, B 1904, 37 4610), acetone (Eidmann, C C 1899, II 1014).

**Thallic bromide,  $TlBr_3$** 

Deliquescent. Easily sol in  $H_2O$  and alcohol (Willm).

Insol in methyl acetate (Naumann, B 1909, 42 3790).

+ $H_2O$  Very unstable Sol in  $H_2O$ ,

alcohol and ether (Meyer, Z anorg 1900, 24 353).

+ $4H_2O$  Very sol in  $H_2O$  (Thomas, C R 1902, 134 546).

**Thallothallic bromide,  $TlBr_3$ ,  $TlBr_3$** 

Decomp by  $H_2O$  (Meyer, Z anorg 1900, 24 354).

$3TlBr$ ,  $TlBr_3$  Decomp by  $H_2O$  into  $TlBr$  and  $TlBr_3$ .

**Thallic hydrogen bromide,  $TlBr_3$ ,  $HBr$** 

Very sol in  $H_2O$  (Thomas, C R 1902, 134 546).

**Thallic bromide ammonia,  $TlBr_3$ ,  $3NH_3$** 

Decomp by  $H_2O$ .

**Thallium bromochloride,  $TlClBr$** 

Decomp by  $H_2O$  (Thomas, C R 1901, 132 1489).

$TlClBr_2$ + $4H_2O$  Ppt

$TlCl_2Br$ + $4H_2O$  Ppt Decomp by  $H_2O$  (Thomas, C R 1902, 134 546).

$Tl_3Cl_2Br_4$  Decomp by  $H_2O$ ,  $H_2SO_4$  or  $HNO_3$  (Thomas, C R 1900, 131 894, C R 1901, 132 1489).

$Tl_4Cl_2Br_3$  Sol in  $H_2O$  (Thomas, C R 1901, 132 82).

$TlClBr_3$ ,  $3TlCl$  Cryst from  $H_2O$  containing  $HNO_3$  (Cushman, Am Ch J 1900, 24 222).

$TlCl_3$ ,  $3TlBr$  Sol in  $H_2O$  without decomp (Cushman).

$TlBr_3$ ,  $3TlCl$  Decomp by  $H_2O$  (Cushman).

$TlBr_3$ ,  $TlCl$  Sol in  $H_2O$  with decomp (Cushman).

$TlCl_3$ ,  $2TlBr$ ,  $TlCl$  Sol in  $H_2O$  (Meyer, Z anorg 1900, 24 355-360).

$TlBr_3$ ,  $2TlCl$ ,  $TlBr$  Ppt Decomp by  $H_2O$  (Meyer).

$(TlCl_3, TlCl)$ ,  $2(TlBr_3, TlBr)$  Ppt (Meyer).

$2(TlCl_3, TlCl)$ ,  $(TlBr_3, TlBr)$  Ppt Decomp by hot  $H_2O$  (Meyer).

**Thallium bromofluoride,  $TlFBr_2$** 

Decomp in moist air.

Sol in abs alcohol (Gewecke, A 1909, 366 233).

**Thallium bromofluoride ammonia,**

$TlFBr_2$ ,  $4NH_3$ .

Decomp by moisture.

Difficultly sol in abs alcohol (Gewecke, A 1909, 366 234).

**Thalious chloride,  $TlCl$** 

Solubility in pts  $H_2O$  at  $t^\circ$ , according to H=Hebberling, C=Crookes, L=Lamy

$0^\circ$	$15^\circ$	$16^\circ$	$16.5^\circ$
504	283.4	377	359 pts $H_2O$ ,
H	C	H	H
$100^\circ$	$100^\circ$	$100^\circ$	
about 50	52.5	63 pts $H_2O$	
L	C	H	

1 l H<sub>2</sub>O dissolves 0.0161 g mol TiCl<sub>3</sub> at 25° (Noyes, Z phys Ch 6 249)

3.26 × 10<sup>2</sup> grams are dissolved in 1 liter of sat solution at 20° (Bottger, Z phys Ch 1903, 46 603)

1 l H<sub>2</sub>O at 25° dissolves 0.01606 g mol TiCl<sub>3</sub> (Geffcken, Z phys Ch 1904, 49 296)

#### Solubility in H<sub>2</sub>O at t°

100 cc sat solution contain at

t°	0°	10°	20°	30°	40°	50°
g TiCl <sub>3</sub>	0.17	0.24	0.34	0.46	0.60	0.80

t°	60°	70°	80°	90°	99°	3°
g TiCl <sub>3</sub>	1.02	1.29	1.60	1.97	2.41	

(Berkeley, Trans Roy Soc 1904, 203, A, 208)

1 l H<sub>2</sub>O dissolves 3.040 TiCl<sub>3</sub> at 18° (Kohlrausch, Z phys Ch 1904, 50 356)

2.27 g are dissolved in 1 l of sat solution at 9.54°, 3.05 g at 17.7°, 3.97 g at 25.76° (Kohlrausch, Z phys Ch 1908, 64 168)

0.01629 mol is sol in 1 l H<sub>2</sub>O at 25° (Hill, J Am Chem Soc 1910, 32 1385)

0.01607 g equiv is sol in 1 l H<sub>2</sub>O at 25° (Bray and Winninghoff, J Am Chem Soc 1911, 33 1665)

Much less sol in H<sub>2</sub>O containing HCl or HNO<sub>3</sub>

Solubility in HCl + Aq at 25° 1 l dissolves g mol TiCl<sub>3</sub>

g HCl added	TiCl <sub>3</sub>	g HCl added	TiCl <sub>3</sub>
	0.01610	0.1468	0.00316
283	0.00836	1.000	0.00200
560	0.00565		

(Noyes, Z phys Ch 6 249)

#### Solubility in HCl + Aq at 25°

Concentration of HCl equivalents per liter	Solubility of TiCl <sub>3</sub> equivalents per liter
0	0.01612
0.025	0.00869
0.05	0.00585
0.10	0.00384
0.20	0.00254

(Noyes, Z phys Ch 1892, 9 614)

#### Solubility in HNO<sub>3</sub> + Aq at 25°

Normality HNO <sub>3</sub>	Sp gr of the solution	g TiCl <sub>3</sub> dissolved per l
0.000	0.996	3.952
0.4977	1.0184	5.937
1.0046	1.0359	6.883
2.0452	1.0705	8.143
4.017	1.1362	9.926

(Hill and Simmons, Z phys Ch 1909, 67 605)

Nearly insol in NH<sub>4</sub>OH + Aq  
More sol in K<sub>2</sub>CO<sub>3</sub> + Aq than in H<sub>2</sub>O  
3.86 g TiCl<sub>3</sub> are sol in 1 l H<sub>2</sub>O at 25° 21.84 g TiCl<sub>3</sub> are sol in 1 l 5N-K<sub>2</sub>CO<sub>3</sub> + Aq at 25° (Spencer and Le Pla, C C 1908, II 198)

#### Solubility in KNO<sub>3</sub> + Aq at 25°

Concentration of KNO <sub>3</sub> miliequivalents per l	Solubility of TiCl <sub>3</sub> miliequivalents per l
10	16.07
20	17.16
50	18.26
100	19.61
300	23.13
1000	30.72

(Bray and Winninghoff, J Am Chem Soc 1911, 33 1670)

#### Solubility in K<sub>2</sub>SO<sub>4</sub> + Aq at 25°

Concentration of K <sub>2</sub> SO <sub>4</sub> miliequivalents per l	Solubility of TiCl <sub>3</sub> miliequivalents per l
10	16.07
20	17.79
50	19.42
100	21.37
300	26.00
1000	34.16

(Bray and Winninghoff, J Am Chem Soc 1911, 33 1670)

#### Solubility in Ti<sub>2</sub>SO<sub>4</sub> + Aq at 25°

Concentration of Ti <sub>2</sub> SO <sub>4</sub> miliequivalents per l	Solubility of TiCl <sub>3</sub> miliequivalents per l
10	16.07
20	10.34
50	6.77
100	4.68

(Bray and Winninghoff, J Am Chem Soc 1911, 33 1670)

#### Solubility of TiCl<sub>3</sub> in salts + Aq at 25°

Salt	Concentration of salt g equiv per l	TiCl <sub>3</sub> dissolved g equiv per l
NH <sub>4</sub> Cl	0.025	0.00872
	0.05	0.00593
	0.2	0.00271
CaCl <sub>2</sub>	0.025	0.00899
	0.05	0.00624
	0.10	0.00417
	0.20	0.00284

Solubility of  $\text{TiCl}_3$  in salts + Aq at  $25^\circ$  —  
*Continued*

Salt	Concentration of salt g equiv per l	$\text{TiCl}_3$ dissolved g equiv per l
$\text{CdCl}_2$	0 025	0 01040
	0 05	0 0078
	0 10	0 00578
	0 20	0 00425
$\text{CuCl}_2$	0 025	0 00905
	0 05	0 00614
	0 10	0 00422
	0 20	0 00291
$\text{MgCl}_2$	0 025	0 00904
	0 05	0 00618
	0 10	0 00413
	0 20	0 00275
$\text{MnCl}_2$	0 025	0 00898
	0 05	0 00617
	0 10	0 00412
	0 20	0 00286
$\text{KCl}$	0 025	0 00872
	0 05	0 00593
	0 1	0 00399
	0 2	0 00265
$\text{NaCl}$	0 025	0 00869
	0 05	0 00592
	0 10	0 00395
	0 20	0 00271
$\text{ZnCl}_2$	0 025	0 00899
	0 05	0 00627
	0 10	0 00412
	0 20	0 00281
$\text{TiClO}_3$	0 025	0 00897
$\text{TiNO}_3$	0 025	0 00883
	0 05	0 00626
	0 10	0 00423

(Noyes, Z phys Ch 1892, 9 609)

Solubility of  $\text{TiCl}_3$  in salts + Aq at  $25^\circ$ 

Salt	Mols $\text{TiCl}_3$ sol in 1 liter of				
	0 5-N solution	N solution	2-N solution	3-N solution	4-N solution
$\text{H}_4\text{NO}_3$	0 02587	0 03121	0 03966		
$\text{HNO}_3$	0 02566	0 03077	0 03904		
$\text{H}_2\text{NO}_3$	0 02564	0 03054	0 03851	0 04544	0 05128
$\text{HNO}_3$	0 02542	0 03035	0 03755	0 04438	
$\text{ClO}_3$	0 02370				
$\text{HClO}_3$	0 02320	0 02687	0 03060	0 03303	0 03850

(Geffcken, Z phys Ch 1904, 49 295)

Insol in alcohol Easily sol in hot  
[ $\text{gCl}_2$  + Aq (Carstanjen)]Solubility of  $\text{TiCl}_3$  in  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq at  $25^\circ$   
(g equiv per l)

Acid	$\text{TiCl}_3$
0 000	0 01629
0 5134	0 01580
1 013	0 01495
2 016	0 0132
4 180	0 0099
8 130	0 0054
11 49	0 0026
14 31	0 0012
16 01	0 0005

(Hill, J Am Chem Soc 1910, 32 1189)

Insol in pyridine (Naumann, B 1904, 37 4610), acetone (Naumann, B 1904, 37 4329)

**Thallic chloride,  $\text{TiCl}_3$** *Anhydrous*Easily sol in  $\text{H}_2\text{O}$  and in most ord sol-vents

In contact with moist air, it rapidly becomes hydrated (Thomas, C R 1902, 135 1053)

Difficultly sol in methyl acetate (Naumann, B 1909, 42 3790)

Very sol in acetone (Renz, B 1902, 35 1110)

Difficultly sol in acetone (Naumann, B 1904, 37 4328)

+  $\text{H}_2\text{O}$  Deliquescent, and very easily sol in  $\text{H}_2\text{O}$  (Werther)Deliquescent, and very easily sol in  $\text{H}_2\text{O}$  (Werther)+  $4\text{H}_2\text{O}$  86.2 pts are sol in 100 pts  $\text{H}_2\text{O}$  at  $17^\circ$  Sp gr of sat aq solution at  $17^\circ$  = 1.85 (Thomas, C R 1902, 135 1052)

Very hygroscopic (Meyer, Z anorg 1900, 24 336)

Very sol in alcohol and ether (Meyer, Z anorg 1900, 24 338)

+  $7\frac{1}{2}\text{H}_2\text{O}$  Deliquescent (Werther)**Thallothallic chloride,  $3\text{TiCl}_3$ ,  $\text{TiCl}_3$** 1 pt dissolves in pts  $\text{H}_2\text{O}$  at  $t^\circ$ , according to C = Crookes, H = Hebbeling, L = Lamy

15°	17°	100°	100°
380 1	346	52 9	20-25 pts $\text{H}_2\text{O}$
C	H	C	L

Sl decomp by dissolving (Lamy)

**Thallic hydrogen chloride,  $\text{TiCl}_3$ ,  $\text{HCl}$  +  $3\text{H}_2\text{O}$** 

Very hygroscopic

Decomp by  $\text{H}_2\text{O}$  (Meyer, Z anorg 1900, 24 337)**Thallium tungsten chloride,  $\text{Ti}_3\text{W}_3\text{Cl}_3$** Nearly insol in  $\text{H}_2\text{O}$ Sol in a hot mixture of equal pts  $\text{H}_2\text{O}$  and conc  $\text{HCl}$

Sl sol in conc HCl  
 Nearly insol in most organic solvents  
 (Olsson, B 1913, **46** 575)

**Thallic zinc chloride**,  $2\text{TiCl}_3$ ,  $\text{ZnCl}_2 + 6\text{H}_2\text{O}$   
 Can be cryst from  $\text{H}_2\text{O}$  (Gewecke, A 1909, **366** 224)

**Thallic chloride ammonia**,  $\text{TiCl}_3$ ,  $3\text{NH}_3$   
 Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$  (Willm)

**Thallium chlorofluoride**,  $\text{TlFCl}_2$   
 Very hygroscopic  
 Decomp by moist air  
 Easily sol in abs alcohol (Gewecke, A 1909, **366** 230)  
 $+3\text{H}_2\text{O}$  Not hygroscopic  
 Decomp by  $\text{H}_2\text{O}$ , alcohol and ether (Gewecke)

**Thallium chlorofluoride ammonia**,  $\text{TlFCl}_2$ ,  $4\text{NH}_3$   
 Decomp by  $\text{H}_2\text{O}$   
 Difficultly sol in abs alcohol and in ether

—**oride**,

231)

le, TlF

pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and in much  
 of  $\text{H}_2\text{O}$  Difficultly sol in alcohol  
 mer, W A B **52** 2 644)  
 $\frac{1}{2}\text{H}_2\text{O}$  Deliquescent (Willm)

**Thallic fluoride**,  $\text{TlF}_3$   
 Insol in  $\text{H}_2\text{O}$  and cold  $\text{HCl} + \text{Aq}$  (Willm)  
 Cannot be obtained in pure state (Gewecke, A 1909, **366** 218)

**Thallic hydrogen fluoride**,  $\text{TlF}$ ,  $\text{HF}$   
 Sol in 1 pt  $\text{H}_2\text{O}$  (Buchner)

**Thallic tungstyl fluoride**,  
 See Fluoxytungstate, thallic

**Thallic vanadium fluoride**  
 See Fluovanadate, thallic

**Thallic vanadyl fluoride**  
 See Fluoxylvanadate, thallic

**Thallic hydroxide**,  $\text{TlOH}$   
 Sol in  $\text{H}_2\text{O}$  and alcohol

# Solubility of $\text{TlOH}$ in $\text{H}_2\text{O}$ at $t^\circ$

$t^\circ$	g equiv $\text{TlOH}$ per l	Sp gr $15^\circ/4^\circ$
0	1 151	1 231
18 5	1 554	1 317
19 5	1 582	1 322
29	1 803	1 342
23 1	1 861	1 377
33 1	1 967	1 400
36	2 075	1 417
40	2 240	1 446
44 5	2 442	
54 1	2 940	
59 4	3 281	
64 6	3 601	
78 5	4 673	
90 0	5 705	
99 2	6 708	

(Bahr, Z anorg 1911, **71** 87)

The solubility of  $\text{Tl}_2\text{O}$  in  $\text{H}_2\text{O}$  at these temperatures is the same as that of  $\text{TlOH} + \text{H}_2\text{O}$  (Willm, Bull Soc (2) **5** 354)

**Thallic hydroxide**,  $\text{Tl}_2\text{O}_3$ ,  $\text{H}_2\text{O} = \text{TlO}(\text{OH})$   
 Insol in  $\text{H}_2\text{O}$  Sol in dil acids and ammonium salts +  $\text{Aq}$  Insol in caustic alkali solutions  
 $\text{Tl}(\text{OH})_3$  Easily sol in dil  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$  +  $\text{Aq}$  (Carnegie, C N **60** 113)

**Thallic iodide**,  $\text{TlI}$

Very sl sol in  $\text{H}_2\text{O}$   
 1 pt  $\text{TlI}$  is sol in pts  $\text{H}_2\text{O}$  at  $t^\circ$  C = according to Crookes, H = according to Hebbeling, L = according to Lamy, W = according to Werther  

35°	15°	16°	16-17°	19 4°
20,000	4450	16,000	11,676	14,654 pts $\text{H}_2\text{O}$ ,
W	C	L	H	W

20°	23 4°	45°	100°	100°
11,954	10,482	5407	842	804 pts $\text{H}_2\text{O}$
W	W	W	C	H

Sol in 17,000 pts  $\text{H}_2\text{O}$  at  $20^\circ$  (Long, Z anal **30** 342)

Sat solution at  $20 15^\circ$  contains 636 mg or  $1.92 \times 10^{-4}$  g mol  $\text{TlI}$  per l (Böttger, Z phys Ch 1903, **46** 603)

1 l  $\text{H}_2\text{O}$  dissolves 56 mg  $\text{TlI}$  at  $18^\circ$  (Kohlrausch, Z phys Ch 1904, **50** 356)

36.2 mg are dissolved in 1 l of sat solution at  $9 90^\circ$ , 56 mg at  $18 1^\circ$ , 84.7 mg at  $26^\circ$  (Kohlrausch, Z phys Ch 1908, **64** 168)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 1.76 \times 10^{-4}$  mol per litre (Spencer, Z phys Ch 1912, **80** 708)

Not decomp by dil  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or alkalis +  $\text{Aq}$  Decomp by hot dil  $\text{HNO}_3$  +  $\text{Aq}$ , and cold conc  $\text{HNO}_3$  Sol in aqua regia

Also less sol in acetic acid than in  $\text{H}_2\text{O}$  (Carstanjen)

Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Werther) Not holly insol in  $\text{NH}_4\text{OH} + \text{Aq}$ , and solubility increased by presence of  $(\text{NH}_4)_2\text{SO}_4$  or  $\text{H}_2\text{Cl}$  (Baubigny, C R 113 544)

Sol in 13,000 pts  $\text{NH}_4\text{OH} + \text{Aq}$  ( $6\frac{1}{2}$  or  $\frac{1}{2}\%$   $\text{NH}_3$ ) Sol in 17,000 pts  $\text{NH}_4\text{OH} + \text{Aq}$  ( $\frac{1}{4}\%$   $\text{NH}_3$ ) (Long)

Insol in dil  $\text{KI} + \text{Aq}$  (1%  $\text{KI}$ ) (Baugny)

Much more insol in  $\text{KI} + \text{Aq}$  than in  $\text{H}_2\text{O}$ , pt dissolves in 75,000 pts dil  $\text{KI} + \text{Aq}$  (amy)

Nearly insol in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ , and absolutely insol therein in presence of  $\text{Pb}$  salts (Verner C N 53 51)

Sol in 56,336 pts 85% alcohol at  $13^\circ$  (Werther) Sol in 18,934 pts 98% alcohol  $19^\circ$  (Hebberling)

When  $\text{TII}$  is shaken with alcohol of  $78^\circ\text{B}$  vol  $\text{H}_2\text{O} + 3$  vols 98% alcohol at  $22^\circ$ , and t stand with  $\text{TII}$  for 24 hours, and then evaporated to  $\frac{1}{3}$  vol, there is shown no ppt  $\gamma$   $\text{NH}_4\text{SH} + \text{Aq}$  (Baubigny)

Sol in 260,000 pts 90% alcohol, and 7,000 pts 50% alcohol at  $20^\circ$  (Long)

Insol in methylene iodide (Retgers, Z org 3 343)

Insol in acetone (Naumann, B 1904, 37 329, Eidmann, C C, 1899, II 1014)

Insol in pyridine (Naumann, B 1904, 37 4601)

#### thallous iodide, $\text{TII}_3$

Sol in alcohol

Decomp slowly in the air (Wells, Z org 1894, 6 313)

Sol in ether

#### thallothallous iodide, $\text{TI}_3\text{I}_4 = 5\text{TII}, \text{TII}_3$

Sol in  $\text{H}_2\text{O}$  (Jorgensen, J pr (2) 6 82)

#### thallium nitride

Very unstable (Franz Fischer, B 1901, 3 1470)

#### thallous oxide, $\text{TI}_2\text{O}$

Deliquescent Sol in  $\text{H}_2\text{O}$

See Thallous hydroxide

#### thallous oxide, $\text{TI}_2\text{O}_3$

Insol in  $\text{H}_2\text{O}$  Not attacked by cold  $\text{H}_2\text{SO}_4$  Sol in hot  $\text{H}_2\text{SO}_4$  Sol in cold  $\text{HCl} + \text{Aq}$

Insol in alkalis +  $\text{Aq}$  (Werther, J pr 1 385)

#### black modification

Less sol in dil acids than the brown modification Solution is accompanied by slight reduction to thallous salt

More sol in 10%  $\text{HCl}$  than in 10%  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$

More sol in conc than in dil acids (Rabe, anorg 1906, 48 431)

#### Brown modification

Easily sol in dil mineral acids on warming, with slight reduction to thallous salt

More sol in conc acid (Rabe)

#### Thallium dioxide, $\text{TlO}_2$

Insol in  $\text{H}_2\text{O}$  (Piccini, Gazz ch it 17 450)

#### Thallic oxide ammonia, $\text{TI}_3\text{O}_3, 6\text{NH}_3$

Decomp by much  $\text{H}_2\text{O}$  Insol in alcohol (Carstanjen)

#### Thallic oxyfluoride, $\text{TlOF}$

Insol in  $\text{H}_2\text{O}$  Slowly decomp by boiling with  $\text{H}_2\text{O}$

Sol in mineral acids Almost insol in  $\text{HF}$  (Gewecke, A 1909, 366 226)

#### Thallium phosphide (?)

Ppt (Crookes)

#### Thallous selenide, $\text{TI}_2\text{Se}$

Insol in  $\text{H}_2\text{O}$  Scarcely attacked by cold dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but dissolves when heated (Carstanjen)

#### Thallothallous selenide

Not attacked by cold conc or boiling dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Conc  $\text{H}_2\text{SO}_4$  decomposes (Carstanjen)

#### Thallous sulphide, $\text{TI}_2\text{S}$

Insol in  $\text{H}_2\text{O}$ ,  $(\text{NH}_4)_2\text{S} + \text{Aq}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{KCN} + \text{Aq}$ , and in alkali carbonates, and hydrates +  $\text{Aq}$  Difficultly sol in a solution of oxalic acid or acetic acid (Crookes) Easily sol in  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4 + \text{Aq}$  Difficultly sol in  $\text{HCl} + \text{Aq}$  (Willm)

Sl sol in  $\text{H}_2\text{O}$

$0.21 \times 10^{-4}$  g is dissolved in 1 l sat solution at  $20^\circ$  (Bottger, Z phys Ch 1903, 46 603)

Insol in acetone (Naumann, B 1904, 37 4329)

#### Thallic sulphide, $\text{TI}_3\text{S}$

Insol in  $\text{H}_2\text{O}$  Insol in cold, sol in warm dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  without separation of  $\text{S}$  Sol in other dilute acids with separation of  $\text{S}$  (Carstanjen)

#### Thallium pentasulphide, $\text{TI}_5\text{S}_5$

Ppt (Hofmann, B 1903, 36 3092)

#### Thallothallous sulphide, $5\text{TI}_2\text{S}, 3\text{TI}_3\text{S}$

Very slowly decomp by cold dil  $\text{H}_2\text{SO}_4 + \text{Aq}$

$\text{TI}_2\text{S}, \text{TI}_3\text{S}_3$  (Carstanjen)

$\text{TI}_2\text{S}, 2\text{TI}_3\text{S}_3$  Decomp by dil acids (Schneider, J pr (2) 10 55)

#### Thallium telluride, $\text{TI}_2\text{Te}$

(Fabre, C R 105 673)

**Thio-**

For compounds with prefix thio-, see also under sulpho-

**Thioantimonic acid**

See Sulphantimonic acid

**Thioarsenic acid**

See Sulpharsenic acid

**Thiomolybdic acid**

See Sulphomolybdic acid.

**Thionamic acid**,  $\text{NH}_3\text{SO}_2 = \text{NH}_2\text{SO}(\text{OH})$ 

Very deliquescent, and sol in  $\text{H}_2\text{O}$   
 $\text{H}_2\text{O}$  solution decomp gradually (Rose, Pogg 33 275, 42 425)

**Ammonium thionamate**,  $\text{NH}_2\text{SO}(\text{ONH}_2)$ 

Deliquescent Sol in  $\text{H}_2\text{O}$ , easily decomp when in solution (Rose)

Very sol in alcohol with decomp Sl sol in dry ether (Divers and Ogawa, C C 1900, I 1259)

**Dithionic acid**

See Dithionic acid

**Trithionic acid**

acid.

acid

**Pentathionic acid**

See Pentathionic acid

**Thionyl bromide**,  $\text{SOBr}_2$ 

Unstable  
 Decomp by  $\text{H}_2\text{O}$  (Besson, C R 1896, 122 322)

**Thionyl bromochloride**,  $\text{SOClBr}$ 

Decomp slowly in the cold, rapidly at  $115^\circ$   
 Decomp by  $\text{H}_2\text{O}$  (Besson C R 1896, 122 321)

**Thionyl chloride**,  $\text{SOCl}_2$ 

Sol in  $\text{CHCl}_3$ , and  $\text{C}_6\text{H}_6$  (Oddo, Gazz ch 1899, 29 (2) 318)

**Thionyl fluoride**,  $\text{SOF}_2$ 

Decomp by  $\text{H}_2\text{O}$   
 Sol in  $\text{AsCl}_3$ ,  $\text{C}_6\text{H}_6$ , ether and oil of turpentine (Moissan, C R 1900, 130 1439)

**Thiophosphamic acid**,  $\text{H}_2\text{PNH}_2\text{O}_2\text{S}$  (?)

Known only in its salts (Gladstone and Holmes, Chem Soc (2) 3 1)

**Cadmium thiophosphamate**,  $\text{CdPNH}_2\text{O}_2\text{S}$ 

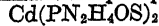
Sol in dil acids, and  $\text{NH}_4\text{OH} + \text{Aq}$  and H)

**Lead —**,  $\text{PbPNH}_2\text{O}_2\text{S}$ 

Ppt Sol in dil  $\text{HNO}_3 + \text{Aq}$  (Gladst and Holmes, Chem Soc (2) 3 1)

**Thiophosphodiamic acid**,  $\text{H}_2\text{PN}_2\text{H}_4\text{OS}$ 

Known only in solution, which soon composes (G and H)

**Cadmium thiophosphodiamate**,

Insol in  $\text{H}_2\text{O}$ , sol in dil acids, and  $\text{NH}_4\text{OH} + \text{Aq}$  (G and H)

**Cupric —**,  $\text{Cu}(\text{PN}_2\text{H}_4\text{OS})_2$ 

Insol in  $\text{H}_2\text{O}$ , dil  $\text{HCl}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$   
 Sol in  $\text{KCN} + \text{Aq}$  (Gladstone and Holmes, Chem Soc (2) 3 1)

**Lead —**,  $\text{Pb}(\text{PN}_2\text{H}_4\text{OS})_2$ 

Insol in  $\text{H}_2\text{O}$  Sol in dil  $\text{HNO}_3 + \text{Aq}$

**Nickel —**,  $\text{Ni}(\text{PN}_2\text{H}_4\text{OS})_2$ 

Sol in dil acids, and  $\text{NH}_4\text{OH} + \text{Aq}$  (Gladstone and Holmes, Chem Soc (2) 3 1)

**Zinc —**,  $\text{Zn}(\text{PN}_2\text{H}_4\text{OS})_2$ 

Ppt Sol in dil acids, and  $\text{NH}_4\text{OH} + \text{Aq}$  (Gladstone and Holmes)

**Thiophosphonitrile**,  $\text{PSN}$ 

Not decomp by cold  $\text{H}_2\text{O}$  Slowly decomp by boiling  $\text{H}_2\text{O}$  Easily decomp by boiling, dil  $\text{HCl}$  (Stock, B 1906, 39 1974)

**Thiophosphoric acid**,  $\text{H}_3\text{PSO}_3 = \text{PS}(\text{OH})_3$ 

Known only in its salts

**Ammonium magnesium thiophosphate**,

Sl sol in cold  $\text{H}_2\text{O}$  (Kubierschky, J pr (2) 31 100)

**Barium —**,  $\text{Ba}_3(\text{PSO}_3)_2$ 

Insol in  $\text{H}_2\text{O}$  (Wurtz, A ch (3) 20 473)

**Cobalt —**

Insol in  $\text{H}_2\text{O}$ , but partially decomp when boiled therewith (Wurtz)

**Cupric —**

Insol in  $\text{H}_2\text{O}$ , very easily decomp (Wurtz)

**Ferric —**

Insol in  $\text{H}_2\text{O}$  (Wurtz)

**Magnesium —**,  $\text{Mg}_3(\text{PSO}_3)_2 + 20\text{H}_2\text{O}$ 

Sl sol in cold  $\text{H}_2\text{O}$  (Kubierschky, J pr (2) 31 99)

- Nickel thiophosphate**  
Insol in  $\text{H}_2\text{O}$ , but decomp when boiled therewith (Wurtz)
- Potassium —**,  $\text{K}_2\text{PSO}_3$   
Very sol in  $\text{H}_2\text{O}$  Known only in aqueous solution (Wurtz)
- Sodium —**,  $\text{Na}_2\text{PSO}_3 + 12\text{H}_2\text{O}$   
Easily sol in boiling  $\text{H}_2\text{O}$  Cryst out on cooling (Wurtz, A ch (3) 20 472)  
Insol in alcohol
- Strontium —**  
Insol in  $\text{H}_2\text{O}$  (Wurtz)
- Dithiometaphosphoric acid**
- Ammonium dithiometaphosphate**,  $\text{NH}_4\text{PS}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$  (Stock, B 1906, 39 1990)
- Monothioorthophosphoric acid**
- Monoammonium monothioorthophosphate**,  $\text{O P}(\text{SNH}_2)(\text{OH})_2$   
Sol in  $\text{H}_2\text{O}$   
Insol in alcohol (Stock, B 1906, 39 1990)
- Triammonium monothioorthophosphate**,  $\text{SNH}_4\text{PO}(\text{ONH}_2)_2$   
(Stock)
- Dithioorthophosphoric acid**
- Ammonium dithiophosphate**,  $(\text{NH}_4)_3\text{PS}_2\text{O}_2 + 2\text{H}_2\text{O}$   
Sl efflorescent Sol in  $\text{H}_2\text{O}$  (Kubierschky, J pr (2) 31 93)
- Ammonium magnesium —**,  $\text{NH}_4\text{MgPS}_2\text{O}_2 + 6\text{H}_2\text{O}$   
Sl sol in cold,  $\text{H}_2\text{O}$  (Kubierschky)
- Barium —**,  $\text{Ba}_3(\text{PS}_2\text{O}_2)_2 + 8\text{H}_2\text{O}$   
Precipitate (Kubierschky, J pr (2) 31 103)  
 $+ 18\text{H}_2\text{O}$  As the *trithio* compound Ephraim, B 1910, 43 287)
- Calcium —**  
Very easily decomposed (Kubierschky)
- Sodium —**,  $\text{Na}_3\text{PS}_2(\text{O})_2 + 11\text{H}_2\text{O}$   
Very sol in  $\text{H}_2\text{O}$  (Kubierschky, J pr 2) 31 93)
- Trithioorthophosphoric acid**
- Ammonium trithioorthophosphate**,  $(\text{NH}_4)_3\text{PS}_3\text{O} + \text{H}_2\text{O}$   
(Stock, B 1906, 39 1985)
- Barium trithioorthophosphate**,  $\text{Ba}_3(\text{PS}_2\text{O})_2 + 20\text{H}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$  and dil acids  
Sol in conc  $\text{HNO}_3$  with oxidation of the sulphur to  $\text{H}_2\text{SO}_4$  (Ephraim, B 1910, 43 286)
- Magnesium —**,  $\text{Mg}_3(\text{PS}_2\text{O})_2 + 20\text{H}_2\text{O}$   
Decomp by  $\text{H}_2\text{O}$  and dil acids (Ephraim)
- Thiophosphorous acid**
- Ammonium thiophosphite (?)**,  $(\text{NH}_4)_4\text{P}_2\text{S}_2\text{O}_3 + 3\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Lemoine, C R 98 45)  
 $+ 6\text{H}_2\text{O}$
- Sodium thiophosphite (?)**,  $\text{Na}_4\text{P}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O} = \text{P}_2\text{O}_3, 2\text{Na}_2\text{S} + 5\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Lemoine, C R 98 45)  
 $\text{Na}_4\text{P}_2\text{S}_2\text{O}_4 + 4\text{H}_2\text{O} = \text{P}_2\text{O}_3, 3\text{Na}_2\text{O}, 2\text{H}_2\text{S} + 2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Lemoine, l c)
- Thiophosphoryl triamide**,  $\text{PS}(\text{NH}_2)_3$   
Rapidly decomp by  $\text{H}_2\text{O}$  Scarcely sol in alcohol, ether, or  $\text{CS}_2$  (Chevrier, C R 66 748)
- Metathiophosphoryl bromide**,  $\text{PS}_2\text{Br}$   
Decomp by  $\text{H}_2\text{O}$  Insol in ether (Michaels, A 164 9)
- Orthothiophosphoryl bromide**,  $\text{PSBr}_3$   
Slowly decomp by cold, rapidly by hot  $\text{H}_2\text{O}$  but volatile with only partial decomp with steam Easily sol in ether,  $\text{CS}_2$ ,  $\text{PCl}_3$ ,  $\text{PBr}_3$   
Decomp by cold alcohol Forms hydrate  $\text{PSBr}_3 + \text{H}_2\text{O}$  (Michaels, A 164 9)
- Pyrothiophosphoryl bromide**,  $\text{P}_2\text{S}_4\text{Br}_4$   
Decomp by  $\text{H}_2\text{O}$  and alcohol Sol in  $\text{CS}_2$  and ether (Michaels)
- Thiophosphoryl phosphorus bromide**,  $\text{PSBr}_3, \text{PBr}_3$   
Decomp by  $\text{H}_2\text{O}$  into  $\text{PSBr}_3$  (Michaels)
- Thiophosphoryl dibromochloride**,  $\text{PSClBr}_2$   
Decomp by  $\text{H}_2\text{O}$  and alkalis  
Fumes in the air (Besson, C R 1896, 122 1059)
- Thiophosphoryl bromodichloride**,  $\text{PSCl}_2\text{Br}$   
Decomp by  $\text{H}_2\text{O}$  and alkalis Reacts violently with  $\text{HNO}_3$  (Besson, C R 1896, 120 1058)
- Thiophosphoryl chloride**,  $\text{PSCl}_3$   
Very slowly decomp by  $\text{H}_2\text{O}$ , and may be distilled with steam without much decomp  
Decomp by alcohol Miscible with  $\text{CS}_2$  (Baudrimont, J pr 87 301)  
Sol in  $\text{CCl}_4$  and  $\text{C}_6\text{H}_6$  (Oddo, Gazz ch it 1899, 29 (2) 318)



**Thiophosphoryl pentachloride,  $\text{PS}_2\text{Cl}_5$  (?)**

Decomp by  $\text{H}_2\text{O}$  Sol in alkalis with residue of S Attacked violently by  $\text{HNO}_3$ , alcohol, ether, oil of turpentine Miscible with  $\text{CS}_2$  (Gladstone, Chem Soc 3 5)

**Thiophosphoryl fluoride,  $\text{PSF}_3$** 

Slowly sol in  $\text{H}_2\text{O}$  with decomp Sl sol in ether

Insol in  $\text{H}_2\text{SO}_4$ ,  $\text{CS}_2$ , or benzene (Thorpe and Rodger, Chem Soc 55 306)

More sol in  $\text{KOH}$  or  $\text{NaOH}$  + Aq than in  $\text{H}_2\text{O}$

**Thiophosphoryl iodide,  $\text{P}_2\text{SI}_2$** 

Very sol in  $\text{CS}_2$  Unstable when heated Fumes in the air (Besson, C R 1896, 122 1201)

**Thiosulphuric (formerly Hyposulphurous) acid,  $\text{H}_2\text{S}_2\text{O}_3$** 

Known only in aqueous solution, which is extremely unstable, and decomposes very quickly after its formation The time before decomposition is exactly proportional to the ratio of the weight of  $\text{H}_2\text{O}$  to the weight of  $\text{H}_2\text{S}_2\text{O}_3$  present, i e, if one solution contains twice as much  $\text{H}_2\text{O}$  for a given amt of  $\text{H}_2\text{S}_2\text{O}_3$  as a second solution, the first solution will decompose in twice the length of time The length of time is about 20 secs at  $10^\circ$ , and 2 secs at  $50^\circ$  for conc solutions, to 120 secs at  $10^\circ$  and 12 secs at  $50^\circ$  for very dilute solutions (See Landolt (B 16 2958) for further figures, also Winkelmann (B 18 406)

**Thiosulphates**

The thiosulphates of the alkalis and of Ca and Sr are easily sol in  $\text{H}_2\text{O}$ , Ba and Sr salts are sl sol and the other salts insol The salts of the metals dissolve in alkali thiosulphates + Aq All are insol in alcohol

Double Salts of Thiosulphuric acid It is impossible to determine whether substances of this class are true chem individuals Many described by Svensson and others are doubt less isomorphic mixtures, whose comp depends on the temp and conc of the solution in which pptd (Rosenheim, Z anorg 1900 25 72)

**Ammonium thiosulphate,  $(\text{NH}_4)_2\text{S}_2\text{O}_3$** 

Very deliquescent Very sol in  $\text{H}_2\text{O}$  Not deliquescent (Fock and Kluss, B 1889, 22 3099)

Crystallises with  $\frac{1}{2}\text{H}_2\text{O}$  (Rammelsberg, Pogg 56 298) Anhydrous (Arppe, A 96 113)

Insol in alcohol (Arppe)

Sol in acetone (Eidmann, C C 1899, II 1014)

Difficultly sol in acetone (Naumann, B 1904, 37 4328)

**Ammonium cadmium thiosulphate,  $3(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{CdS}_2\text{O}_3 + 3\text{H}_2\text{O}$** 

Can be recryst from warm  $\text{H}_2\text{O}$  (Fock and Kluss, B 23 1758)

+  $\text{H}_2\text{O}$  (F and K)  
 $(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{CdS}_2\text{O}_3$  (F and K)

**Ammonium cuprous thiosulphate,**

$(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$

Less sol in  $\text{H}_2\text{O}$  than  $2(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 1\frac{1}{2}\text{H}_2\text{O}$  (Rosenheim and Steinhauser Z anorg 1900, 25 91)

$2(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 1\frac{1}{2}\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  Insol in alcohol (Rosenheim and Steinhauser)

**Ammonium cuprous thiosulphate cuprous iodide,  $7(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3, 8\text{CuI} + 4\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  (Brun, C R 1892, 114 668) Could not be obtained (Rosenheim and Steinhauser, Z anorg 1900, 25 107)

**Ammonium cuprous sodium thiosulphate ammonia,  $3\text{Cu}_2\text{S}_2\text{O}_3, 4\text{Na}_2\text{S}_2\text{O}_3, (\text{NH}_4)_2\text{S}_2\text{O}_3, 6\text{NH}_3$** 

Ppt When drv is fairly stable in the air Partially decomp by  $\text{H}_2\text{O}$

Sol in dil  $\text{H}_2\text{SO}_4$  or acetic acid (Shinn, J Am Chem Soc 1904, 26 948)

**Ammonium lead thiosulphate,  $2(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 3\text{H}_2\text{O}$** 

Easily and completely sol in cold  $\text{H}_2\text{O}$ , but deposits  $\text{PbS}_2\text{O}_3$  by standing or warming (Rammelsberg, Pogg 56 312)

**Ammonium magnesium thiosulphate,**

$(\text{NH}_4)_2\text{Mg}(\text{S}_2\text{O}_3)_2 + 6\text{H}_2\text{O}$

Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Kessler, Pogg 74 283)

Not deliquescent (Fock and Kluss B 23 540)

**Ammonium mercuric thiosulphate,**

$4(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{HgS}_2\text{O}_3 + 2\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , from which it is precipitated by alcohol Extremely easily decomp (Rammelsberg, Pogg 56 318)

**Ammonium potassium thiosulphate,**

$\text{NH}_4\text{KS}_2\text{O}_3$

Sol in  $\text{H}_2\text{O}$  (Fock and Kluss, B 23 536)

**Ammonium silver thiosulphate,  $2(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + x\text{H}_2\text{O}$** 

Faasily sol in  $\text{H}_2\text{O}$  Somewhat sol in alcohol (Herschel, Edinb Phil J 1 395)

$(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + x\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$ , sol in  $\text{NH}_4\text{OH}$  + Aq, from which it is reprecip by an acid (Herschel)

**Ammonium zinc thiosulphate,**  
 $(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{ZnS}_2\text{O}_3 + \text{H}_2\text{O}$ 

Very sol in  $\text{H}_2\text{O}$  (Rosenheim and Davidsohn, Z anorg 1904, **41** 238)

**Ammonium thiosulphate ammonium cuprous bromide,**  $\text{CuBr}, \text{NH}_4\text{Br}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ 

Sol in  $\text{H}_2\text{O}$  (Rosenheim, Z anorg 1900, **25** 107)

The double salts of ammonium thiosulphate with silver and copper haloids are true chemical compounds and may be recryst from  $\text{H}_2\text{O}$  without decomp (Rosenheim, Z anorg 1900, **25** 100)

**Ammonium thiosulphate ammonium silver bromide,**  $\text{AgBr}, \text{NH}_4\text{Br}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ 

Sol in  $\text{H}_2\text{O}$  (Rosenheim)

**Ammonium thiosulphate ammonium cuprous chloride,**  $\text{CuCl}, \text{NH}_4\text{Cl}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ 

Sol in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$  (Rosenheim)

**Ammonium thiosulphate ammonium silver chloride,**  $\text{AgCl}, \text{NH}_4\text{Cl}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ 

Sol in cold  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$   
Decomp by boiling with  $\text{H}_2\text{O}$  and by dil acids (Rosenheim)

**Ammonium thiosulphate ammonium cuprous cyanide**

Composition not constant (Rosenheim)

**Ammonium thiosulphate ammonium silver cyanide**

Composition not constant (Rosenheim)

**Ammonium thiosulphate ammonium cuprous iodide,**  $\text{CuI}, \text{NH}_4\text{I}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ 

Sol in  $\text{H}_2\text{O}$  (Rosenheim)

**Ammonium thiosulphate ammonium cuprous iodide,**  $4(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{NH}_4\text{I}, \text{CuI}$ 

Very sol in  $\text{H}_2\text{O}$  Decomp by boiling (Brun, C R 1892, **114** 668)

**Ammonium thiosulphate ammonium silver iodide,**  $\text{AgI}, \text{NH}_4\text{I}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ 

Sol in  $\text{H}_2\text{O}$  (Rosenheim)

**Ammonium thiosulphate ammonium cuprous sulphocyanide,**  $\text{CuSCN}, \text{NH}_4\text{SCN}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ 

Sol in  $\text{H}_2\text{O}$  (Rosenheim)

**Ammonium thiosulphate ammonium silver sulphocyanide,**  $\text{AgSCN}, \text{NH}_4\text{SCN}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3$ 

Sol in  $\text{H}_2\text{O}$  (Rosenheim)

**Ammonium thiosulphate cuprous iodide,**  
 $(\text{NH}_4)_2\text{S}_2\text{O}_3, 2\text{CuI} + \text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$  (Brun, C R 1892, **114** 668)

Could not be obtained (Rosenheim and Steinhäuser)

**Barium thiosulphate,**  $\text{BaS}_2\text{O}_3 + \text{H}_2\text{O}$ 

Sl sol in  $\text{H}_2\text{O}$  (Rose, Pogg **21** 437)

Insol in alcohol

1 pt cannot be dissolved in 2000 pts  $\text{H}_2\text{O}$

Sol in dil  $\text{HCl} + \text{Aq}$  without decomposition (Herschel, **1819**)

Pptd from  $\text{BaS}_2\text{O}_3 + \text{Aq}$  by dil alcohol (Sobrero and Selmi, A ch (3) **28** 211)

Insol in acetone (Naumann, B 1904, **37** 4329)

**Barium bismuth thiosulphate,**  $\text{Ba}_3[\text{Bi}(\text{S}_2\text{O}_3)_2]_2$ 

Sol in  $\text{H}_2\text{O}$  with decomp (Hauser, Z anorg 1903, **35** 9)

**Barium cadmium thiosulphate,**  $2\text{BaS}_2\text{O}_3, \text{CdS}_2\text{O}_3 + 8\text{H}_2\text{O}$ 

Sl sol in  $\text{H}_2\text{O}$  (Fock and Klüss, B **23** 1761)

$3\text{BaS}_2\text{O}_3, \text{CdS}_2\text{O}_3 + 8\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$

**Barium cuprous thiosulphate**

Easily sol in hot, difficultly sol in cold  $\text{H}_2\text{O}$  (Cohen, Chem Soc **51** 38)

$2\text{BaS}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 7\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$  (Vortmann, M **9** 165)

**Barium gold thiosulphate**

Sl sol in  $\text{H}_2\text{O}$  Insol in alcohol (Fordos and Gélys)

**Barium lead thiosulphate**

Difficultly sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg **56** 313)

**Barium thiosulphate chloride,**  $\text{BaS}_2\text{O}_3, \text{BaCl}_2 + 2\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  (Fock and Klüss, B **23** 3001)

**Bismuth caesium thiosulphate,**  $\text{Cs}_3\text{Bi}(\text{S}_2\text{O}_3)_2$ 

Sol in  $\text{H}_2\text{O}$

Insol in alcohol (Hauser, Z anorg 1903, **35** 8)

**Bismuth potassium thiosulphate,**  $\text{K}_3\text{Bi}(\text{S}_2\text{O}_3)_2 + \frac{1}{2}\text{H}_2\text{O}$ 

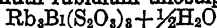
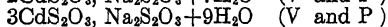
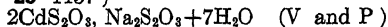
Solubility in  $\text{H}_2\text{O}$

100 cc of the sat solution contain 3.5 g at  $2^\circ$ , 7.0 g at  $18^\circ$  At  $18^\circ$  the solution decomposes

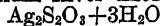
More sol in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  than in pure  $\text{H}_2\text{O}$

Insol in alcohol (Hauser, Z anorg 1903, **35** 5)

$+ \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Carnot, C R **83** 390)

**Bismuth rubidium thiosulphate,**Sol in  $\text{H}_2\text{O}$ Insol in acid alcohol (Hauser, Z anorg 1903, **35** 7)+  $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Hauser, Z anorg 1903, **35** 8)**Bismuth sodium thiosulphate,**Very sol in  $\text{H}_2\text{O}$ , and also in alcohol (Carnot, C R **83** 338) $\text{Na}_3\text{Bi}(\text{S}_2\text{O}_3)_3$  Decomp by  $\text{H}_2\text{O}$  Easily sol in 50% alcohol (Hauser, Z anorg 1903, **35** 3)**Cadmium thiosulphate,  $\text{CdS}_2\text{O}_3 + 2\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Vortmann and Padberg, B **22** 2638)**Cadmium potassium thiosulphate,  $3\text{CdS}_2\text{O}_3, 5\text{K}_2\text{S}_2\text{O}_3$** Cannot be recryst without decomp\* (Fock and Klüss, B **23** 1753) $\text{CdS}_2\text{O}_3, 3\text{K}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$  Can be crystallised from  $\text{H}_2\text{O}$  without decomp (F and K)**Cadmium sodium thiosulphate,  $\text{CdS}_2\text{O}_3, 3\text{Na}_2\text{S}_2\text{O}_3 + 16\text{H}_2\text{O}$** Not deliquescent Sol in  $\text{H}_2\text{O}$  (Jochum, C C **1885**, 642)+  $9\text{H}_2\text{O}$  (Vortmann and Padberg, B **22** 2639)+  $3\text{H}_2\text{O}$  Deliquescent (Fock and Klüss, B **23** 1157)**Cadmium strontium thiosulphate,  $\text{CdS}_2\text{O}_3, 3\text{SrS}_2\text{O}_3 + 10\text{H}_2\text{O}$** (Fock and Klüss, B **23** 1763)**Cæsium thiosulphate,  $\text{Cs}_2\text{S}_2\text{O}_3$** Easily sol in  $\text{H}_2\text{O}$  (Chabrie, C R 1901, **133** 297)+  $2\text{H}_2\text{O}$  Very hygroscopic (J Meyer, B 1907, **40** 1360)**Cæsium cuprous thiosulphate,  $\text{Cs}_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$** Easily sol in  $\text{H}_2\text{O}$  with decomp (J Meyer, B 1907, **40** 1361)**Cæsium lead thiosulphate,  $\text{Cs}_2\text{S}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 2\text{H}_2\text{O}$** 

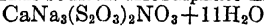
Not hygroscopic

 $2\text{Cs}_2\text{S}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 3\text{H}_2\text{O}$  Hygroscopic (J Meyer)**Cæsium magnesium thiosulphate,  $\text{Cs}_2\text{S}_2\text{O}_3, \text{MgS}_2\text{O}_3 + 6\text{H}_2\text{O}$** Easily sol in  $\text{H}_2\text{O}$  (Meyer)**Cæsium silver thiosulphate,  $2\text{Cs}_2\text{S}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + 3\text{H}_2\text{O}$** 

Not hygroscopic

Decomp by hot  $\text{H}_2\text{O}$  (J Meyer)**Calcium thiosulphate,  $\text{CaS}_2\text{O}_3 + 6\text{H}_2\text{O}$** Sol in 1 pt  $\text{H}_2\text{O}$  at  $3^\circ$ Aqueous solution saturated at  $10^\circ$  has sp gr 1.300 Solution with sp gr 1.11437 at  $15.5^\circ$  contains 0.2081 of its weight in  $\text{CaS}_2\text{O}_3$ Decomp on heating Insol in alcohol (sp gr 0.8234) (Herschel, A ch **14** 355)100 g sat solution contains 29.4 g  $\text{CaS}_2\text{O}_3$  at  $9^\circ$ , and 34.7 g  $\text{CaS}_2\text{O}_3$  at  $25^\circ$  (Kremann and Rodemund, M 1914, **35** 1065)**Solubility of  $\text{CaS}_2\text{O}_3 + \text{Na}_2\text{SO}_3$  in  $\text{H}_2\text{O}$** 

$t^\circ$	$\text{Na}_2\text{S}_2\text{O}_3$	$\text{CaS}_2\text{O}_3$	Solid phase
9	0	29.4	$\text{CaS}_2\text{O}_3, 6\text{H}_2\text{O}$
	11.04	22.64	" + $\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$ $\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$
	25.21	15.84	
	31.01	7.70	
25	0	34.7	$\text{CaS}_2\text{O}_3, 6\text{H}_2\text{O}$
	9.24	29.69	"
	15.67	21.41	
	18.34	25.18	
	28.24	21.14	" + $\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$ $\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$
	30.19	20.33	
	31.24	18.43	
	35.04	11.61	

(Kremann and Rodemund, M 1914, **35** 1065)**Calcium lead thiosulphate,  $2\text{CaS}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 4\text{H}_2\text{O}$** Decomp by  $\text{H}_2\text{O}$  (Rammelsberg)**Calcium potassium thiosulphate,  $\text{CaS}_2\text{O}_3, 3\text{K}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  (Fock and Klüss, B **24** 3016)**Calcium silver thiosulphate,  $2\text{CaS}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + x\text{H}_2\text{O}$** Easily sol in  $\text{H}_2\text{O}$ , less sol in alcohol  
 $\text{CaS}_2\text{O}_3$  -  $\text{S}$   $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , abundantly in  $\text{NaOH} + \text{Aq}$  (Herschel, **1819**)**Calcium sodium thiosulphate nitrate,**(Kremann and Rodemund, M 1914, **35** 1065)**Cobaltous thiosulphate,  $\text{CoS}_2\text{O}_3 + 6\text{H}_2\text{O}$** Sol in  $\text{H}_2\text{O}$  (Rammelsberg)**Cobaltous sodium thiosulphate,  $2\text{CoS}_2\text{O}_3, 5\text{Na}_2\text{S}_2\text{O}_3 + 25\text{H}_2\text{O}$** Efflorescent Sol in  $\text{H}_2\text{O}$  (Jochum)

Could not be obtained by Vortmann and Padberg

$\text{CoS}_2\text{O}_3$ ,  $3\text{Na}_2\text{S}_2\text{O}_3 + 15\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$   
(Vortmann and Padberg, B 22 2641)

**Cuprous thiosulphate**,  $\text{Cu}_2\text{O}$ ,  $3\text{S}_2\text{O}_2 + 2\text{H}_2\text{O} = \text{Cu}_2\text{H}_4(\text{S}_2\text{O}_3)_2$

Sl sol in  $\text{H}_2\text{O}$  Abundantly sol in  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq,  $\text{NH}_4\text{Cl}$  + Aq,  $\text{NH}_4\text{OH}$  + Aq, or  $(\text{NH}_4)_2\text{CO}_3$  + Aq Sol in  $\text{HCl}$  or  $\text{HNO}_3$  + Aq (v Hauer, W A B 13 443)

**Cuprous hydrazine thiosulphate**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $(\text{N}_2\text{H}_4)_2\text{H}_2\text{S}_2\text{O}_3 + \frac{1}{2}\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{NH}_4\text{OH}$  + Aq and in dil acids (Ferratini, C C 1912, I 1281)

**Cupric lead thiosulphate**,  $\text{Pb}(\text{CuS}_2\text{O}_3)_2 + 3\text{H}_2\text{O}$  (?)

Very sol in  $\text{H}_2\text{O}$  and quickly decomp (Girard, C C 1904, I 253)

**Cuprous mercurous thiosulphate**,  $5\text{Cu}_2\text{S}_2\text{O}_3$ ,  $3\text{Hg}_2\text{S}_2\text{O}_3$

Insol or sl sol in cold, decomp by boiling  $\text{H}_2\text{O}$   $\text{HNO}_3$  + Aq dissolves out Cu (Rammelsberg, Pogg 56 319)

**Cuprous potassium thiosulphate**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{K}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$ , decomp on heating with optn of  $\text{CuS}$  Easily sol in  $\text{K}_2\text{S}_2\text{O}_3$  + Aq (Rammelsberg, Pogg 56 321)

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{K}_2\text{S}_2\text{O}_3$  Very sol in cold  $\text{H}_2\text{O}$ , nsol in  $\text{K}_2\text{S}_2\text{O}_3$  + Aq (Cohen, Chem Soc 51 39)

+  $3\text{H}_2\text{O}$  Scarcely sol in cold, sol with sl decomp in hot  $\text{H}_2\text{O}$  Sol in  $\text{HCl}$  + Aq with evolution of  $\text{SO}_2$

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $3\text{K}_2\text{S}_2\text{O}_3 + 3\text{H}_2\text{O}$  More sol in  $\text{H}_2\text{O}$  than  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{K}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$  Solution s not decomp by boiling Sol in excess of  $\text{NH}_4\text{OH}$  + Aq (Rammelsberg)

**Cuprous rubidium thiosulphate**,  $\text{Rb}_2\text{S}_2\text{O}_3$ ,  $\text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$

Ppt (J Meyer, B 1907, 40 1357)  
 $2\text{Rb}_2\text{S}_2\text{O}_3$ ,  $\text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$  Ppt (J Meyer)  
 $3\text{Rb}_2\text{S}_2\text{O}_3$ ,  $\text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$  Ppt (J Meyer)

**Cuprous silver sodium thiosulphate ammonia**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Ag}_2\text{S}_2\text{O}_3$ ,  $5\text{Na}_2\text{S}_2\text{O}_3$ ,  $6\text{NH}_3$

Ppt Becomes dark when exposed to light Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH}$  + Aq Shinn, J Am Chem Soc 1904, 26 949)

**Cuprous sodium thiosulphate**,  $2\text{Cu}_2\text{S}_2\text{O}_3$ ,  $7\text{Na}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$

Ppt from aqueous solution by alcohol Jochum, C C 1885 642)  
+  $12\text{H}_2\text{O}$  Sol in very dil  $\text{HCl}$  + Aq (Jochum)

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $3\text{Na}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$ , insol in alcohol (Rammelsberg)

+  $6\text{H}_2\text{O}$  (Jochum)  
 $3\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3 + 8\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{C}$  (Vortmann)

+  $5\text{H}_2\text{O}$  (Lenz, A 40 99) Formula according to Jochum is—

$5\text{Cu}_2\text{S}_2\text{O}_3$ ,  $4\text{Na}_2\text{S}_2\text{O}_3 + 8\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  or alcohol Sol in  $\text{HCl}$  + Aq without evolution of  $\text{SO}_2$ , also in dil  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$  + Aq Sol in  $\text{NH}_4\text{OH}$  + Aq (Jochum)

+  $6\text{H}_2\text{O}$  As above (Jochum)  
 $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{Na}_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq (Russell, Ch Ztg 9 233)

+  $2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  and alcohol Decomp by dil acids (Rosenheim and Steinhauser, Z anorg 1900, 25 84)

+  $2\frac{1}{2}\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Pptd by alcohol (Bhaduri, Z anorg 1898, 17 1)

+  $3\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Vortmann, M 1888, 9 168)

$3\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3$  (Gerard, C C 1904, I 253)

+  $5\text{H}_2\text{O}$  Sol in 352 pts  $\text{H}_2\text{O}$  (Russell, Ch Z 1885, 9 223)

100 cc 5%  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq dissolve 12 28 g  
" " 7 5% " " 17 46 g  
" " 10% " " 22 54 g

(Russell, Ch Z 1885, 9 223)

$4\text{Cu}_2\text{S}_2\text{O}_3$ ,  $3\text{Na}_2\text{S}_2\text{O}_3 + 6\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  and alcohol

Decomp by dil acids (Rosenheim and Steinhauser, Z anorg 1900, 25 84)

+  $9\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  Pptd by alcohol (Bhaduri, Z anorg 1898, 17 1)

$7\text{Cu}_2\text{S}_2\text{O}_3$ ,  $5\text{Na}_2\text{S}_2\text{O}_3 + 16\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  and by alcohol (Bhaduri, Z anorg 1898, 17 1)

It is impossible to determine whether any of these compds are complex or double salts As a class they are not easily sol and decomp in solution They may therefore be mixtures whose comp depended upon the temp and conc of the solution in which they were pptd (Rosenheim, Z anorg 1900, 25 81)

**Cuprocupric sodium thiosulphate ammonia**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{CuS}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3$ ,  $4\text{NH}_3$

Insol in, but decomp by hot  $\text{H}_2\text{O}$  Sol in  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq Sol in  $\text{NH}_4\text{OH}$  + Aq or  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq (Schutte, C R 42 1267)

**Cuprous sodium thiosulphate cuprous chloride**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3$ ,  $2\text{CuCl}$

(Rosenheim and Steinhauser, Z anorg 1900, 25 86)

**Cupric sodium thiosulphate cupric sulphide**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $\text{CuS} + 4\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$ , easily sol in  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq, and  $\text{NH}_4\text{OH}$  + Aq, insol in alcohol (Lenz, A 40 99)

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $2\text{CuS}$  Sol in  $\text{H}_2\text{O}$  or dil  $\text{HCl}$  + Aq (Kessel, B 11 1585)

**Cuprous sodium thiosulphate sodium chloride**,  $3\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3$ ,  $4\text{NaCl}+8\text{H}_2\text{O}$ 

Sol in  $\text{Na}_2\text{S}_2\text{O}_3+\text{Aq}$  (Siewert, Zeit ges Naturwiss **26** 486)  
 Ppt (Bhaduri, Z anorg 1898, **17** 3)

**Cupric thiosulphate ammonia**,  $\text{CuS}_2\text{O}_3$ ,  $4\text{NH}_3$ 

100 pts  $\text{H}_2\text{O}$  dissolve 21.79 pts at  $25^\circ$   
 (Pudschies, Dissert)

**Cuprocupric thiosulphate ammonium chloride**,  $\text{Cu}_2\text{O}$ ,  $\text{CuO}$ ,  $3\text{S}_2\text{O}_3$ ,  $2\text{NH}_4\text{Cl}$ 

Sol in  $\text{HNO}_3+\text{Aq}$  with separation of S  
 (v Hauer, W A B **13** 447)

**Glucinum thiosulphate**,  $\text{GlS}_2\text{O}_3+11\text{H}_2\text{O}$ 

(Faktor, C C **1901**, II 878)

**Gold (aurous) hydrogen thiosulphate**,  $\text{Au}_2\text{S}_2\text{O}_3$ ,  $3\text{H}_2\text{S}_2\text{O}_3$ 

Known only in solution (Fordos and Gélis, A ch (3) **13** 394)

**Gold (aurous) sodium thiosulphate**,  $\text{Au}_2\text{S}_2\text{O}_3$ ,  $3\text{Na}_2\text{S}_2\text{O}_3+4\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$ , solution decomp on heating  
 Insol in absolute, sl sol in dil alcohol  
 (Fordos and Gélis)

$\text{Au}_2\text{S}_2\text{O}_3$ ,  $6\text{Na}_2\text{S}_2\text{O}_3+10\text{H}_2\text{O}$  Very sol  
 in  $\text{H}_2\text{O}$  but decomp by boiling (Jochum, C

**sulphate**,  $\text{FeS}_2\text{O}_3+5\text{H}_2\text{O}$ 

Very sol in  $\text{H}_2\text{O}$  or alcohol  
 (Pogg **63** 241)

**Iron (ferrous) sodium thiosulphate**,  $\text{FeS}_2\text{O}_3$ ,  $3\text{Na}_2\text{S}_2\text{O}_3+8\text{H}_2\text{O}$ 

Very sol in  $\text{H}_2\text{O}$ , and easily decomp  
 (Vortmann and Padberg, B **22** 2641)

**Lead thiosulphate**,  $\text{PbS}_2\text{O}_3$ 

‡ Sol in 3266 pts  $\text{H}_2\text{O}$  Sol in alkali thio-  
 sulphates +Aq (Rammelsberg, Pogg **56**  
 308)

**Lead lithium thiosulphate**,  $\text{PbS}_2\text{O}_3$ ,  $\text{Li}_2\text{S}_2\text{O}_3$ 

Very hygroscopic  
 Decomp by  $\text{H}_2\text{O}$  with separation of  $\text{PbS}$   
 (J Meyer, B 1907, **40** 1355)

**Lead potassium thiosulphate**,  $\text{PbS}_2\text{O}_3$ ,  $3\text{K}_2\text{S}_2\text{O}_3+2\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  with partial separation of  
 $\text{PbS}_2\text{O}_3$  Sol in  $\text{K}_2\text{S}_2\text{O}_3+\text{Aq}$  (Rammels-  
 berg, Pogg **56** 310)

**Lead rubidium thiosulphate**,  $2\text{Rb}_2\text{S}_2\text{O}_3$ ,  $\text{PbS}_2\text{O}_3+2\text{H}_2\text{O}$ 

Difficultly sol in cold  $\text{H}_2\text{O}$   
 Decomp by  $\text{H}_2\text{O}$  (J Meyer, B 1907,  
**40** 1358)

**Lead sodium thiosulphate**,  $\text{PbS}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3$ 

Sl sol in  $\text{H}_2\text{O}$  Very easily sol in  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2$   
 and  $\text{Na}_2\text{S}_2\text{O}_3+\text{Aq}$  (Lenz, A **40** 98)

Insol in alcohol  
 $2\text{PbS}_2\text{O}_3$ ,  $5\text{Na}_2\text{S}_2\text{O}_3+60\text{H}_2\text{O}$  Easily de-  
 comp (Jochum, C C **1885** 642)

$\text{PbS}_2\text{O}_3$ ,  $3\text{Na}_2\text{S}_2\text{O}_3+12\text{H}_2\text{O}$  Decomp in  
 boiling aqueous solution (Vortmann and  
 Padberg, B **22** 2637)

**Lead strontium thiosulphate**

Sol in  $\text{H}_2\text{O}$  Precipitated as a syrup by  
 alcohol (Rammelsberg)

**Lithium thiosulphate**,  $\text{Li}_2\text{S}_2\text{O}_3+3\text{H}_2\text{O}$ 

Very deliquescent, and sol in  $\text{H}_2\text{O}$  and  
 absolute alcohol (Fock and Kluss, B **22**  
 3099)

**Lithium silver thiosulphate**,  $\text{Li}_2\text{S}_2\text{O}_3$ ,  $\text{Ag}_2\text{S}_2\text{O}_3$ ,  $+ \text{H}_2\text{O}$ 

Hygroscopic  
 Decomp by boiling  $\text{H}_2\text{O}$  and by acids  
 (Meyer and Eggeling, B 1907, **40** 1355)

**Magnesium thiosulphate**,  $\text{MgS}_2\text{O}_3+6\text{H}_2\text{O}$ 

Very easily sol in  $\text{H}_2\text{O}$  Precipitated from  
 conc solution by alcohol (Rammelsberg,  
 Pogg **56** 303)

**Magnesium potassium thiosulphate**,

$\text{MgK}_2(\text{S}_2\text{O}_3)_2+6\text{H}_2\text{O}$   
 Deliquescent, and sol in  $\text{H}_2\text{O}$  Less sol  
 than  $\text{K}_2\text{S}_2\text{O}_3$  (Rammelsberg, Pogg **56** 304)  
 Not deliquescent (Fock and Kluss, B  
**23** 539)

**Magnesium rubidium thiosulphate**,  $\text{MgS}_2\text{O}_3$ ,  $\text{Rb}_2\text{S}_2\text{O}_3+6\text{H}_2\text{O}$ 

Easily sol in  $\text{H}_2\text{O}$  (Meyer B 1907, **40**  
 1358)

**Manganous thiosulphate**,  $\text{MnS}_2\text{O}_3$ 

Sol in  $\text{H}_2\text{O}$ , from which it is pptd by  
 alcohol (Rammelsberg, Pogg **56** 305)  
 $+5\text{H}_2\text{O}$  Decomp very easily (Vort-  
 mann and Padberg, B **322** 2641)

**Manganous sodium thiosulphate**,  $\text{MnS}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3+16\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  Insol or but sl sol in alcohol  
 (Jochum, C C **1885** 642)

**Mercuric potassium thiosulphate**,  $3\text{HgS}_2\text{O}_3$ ,  $5\text{K}_2\text{S}_2\text{O}_3$ 

Sol in 10 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , and  $\frac{1}{2}$  pt at  
 $100^\circ$  Aqueous solution decomp on stand-  
 ing or heating

Insol in alcohol (Kirchhoff, Scher J  
**2** 30)

$\text{HgS}_2\text{O}_3$ ,  $3\text{K}_2\text{S}_2\text{O}_3+3\text{H}_2\text{O}$  (Fock and  
 Kluss, B **24** 1353)

$\text{HgS}_2\text{O}_3$ ,  $5\text{K}_2\text{S}_2\text{O}_3+\text{H}_2\text{O}$  (F and K)

**Nickel thiosulphate,  $\text{NiS}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$** 

Permanent Sol in  $\text{H}_2\text{O}$  (Rammelsberg, Pogg 56 306)

**Nickel sodium thiosulphate,  $2\text{NiS}_2\text{O}_3 \cdot 5\text{Na}_2\text{S}_2\text{O}_3 \cdot 25\text{H}_2\text{O}$** 

Efflorescent Sol in  $\text{H}_2\text{O}$  (Jochum)

**Nickel thiosulphate ammonia,  $\text{NiS}_2\text{O}_3 \cdot 4\text{NH}_3 \cdot 6\text{H}_2\text{O}$** 

Decomp on air Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Rammelsberg, Pogg 56 306)

$\text{NiS}_2\text{O}_3 \cdot 5\text{NH}_3 \cdot \text{H}_2\text{O}$  (Ephraim, B 1913, 46 3108)

$\text{NiS}_2\text{O}_3 \cdot 6\text{NH}_3 \cdot 3\text{H}_2\text{O}$  (Vortmann and Padberg, B 22 2641)

**Platinous sodium thiosulphate**

See Plathiosulphate, sodium

**Potassium thiosulphate,  $\text{K}_2\text{S}_2\text{O}_3 \cdot 1\frac{1}{2}\text{H}_2\text{O}$  and  $2\text{H}_2\text{O}$** 

Very deliquescent Very sol in  $\text{H}_2\text{O}$  with absorption of heat Solution is stable on the air Insol in alcohol

100 pts  $\text{H}_2\text{O}$  dissolve pts  $\text{K}_2\text{S}_2\text{O}_3$  at  $t^\circ$

$t^\circ$	Pts $\text{K}_2\text{S}_2\text{O}_3$	Solid phase
0	96 1	$\text{K}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
17	150 5	$3\text{K}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
20	155 4	"
25	165 0	"
30	175 7	"
35	202 4	$3\text{K}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O} + \text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$
40	204 7	$\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$
45	208 7	"
50	215 2	"
55	227 7	"
60	238 3	"
56 1	234 5	$\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O} + 3\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$
65	245 8	$3\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$
70	255 2	"
75	268 0	"
78 3	292 0	$3\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O} + \text{K}_2\text{S}_2\text{O}_3$
80	293 1	$\text{K}_2\text{S}_2\text{O}_3$
85	298 5	"
90	312 0	"

(Inohiko Io, Mem Coll Sc Kyoto, 1911, 3 212)

Sol in dil  $\text{HCl} \cdot \text{H}_2\text{O}_2 + \text{Aq}$  without decomp (Mathieu-Plessey, C R 101 59)

Insol in ethyl acetate (Cuvillier, C R 30 821)

**Potassium silver thiosulphate,  $2\text{K}_2\text{S}_2\text{O}_3 \cdot \text{Ag}_2\text{S}_2\text{O}_3$** 

Sol in  $\text{H}_2\text{O}$  (Cohen)  
 $\text{K}_2\text{S}_2\text{O}_3 \cdot \text{Ag}_2\text{S}_2\text{O}_3$  Sl sol in  $\text{H}_2\text{O}$  (Herschel)

$3\text{K}_2\text{S}_2\text{O}_3 \cdot \text{Ag}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  Rather sl sol in  $\text{H}_2\text{O}$  (Rosenheim and Steinhäuser, Z anorg 1900, 25 76)

Sl sol in  $\text{H}_2\text{O}$  (Rosenheim)

**Potassium silver thiosulphate ammonia,  $\text{KAgS}_2\text{O}_3 \cdot 2\text{NH}_3$** 

Very sl sol in  $\text{H}_2\text{O}$  Easily sol in hot  $\text{NH}_4\text{OH} + \text{Aq}$  (Schwicker, B 22 1735)

$5\text{K}_2\text{S}_2\text{O}_3 \cdot 3\text{Ag}_2\text{S}_2\text{O}_3 \cdot \text{NH}_3$  Difficultly sol in  $\text{H}_2\text{O}$  with decomp

Sol in hot  $\text{NH}_4\text{OH} + \text{Aq}$  with partial decomp (J Meyer, B 1907, 40 1359)

**Potassium sodium thiosulphate**

(a)  $\text{KNaS}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  dissolve 213 7 pts salt at  $15^\circ$  (Schwicker, B 22 1733)

(b)  $\text{NaKS}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  dissolve 205 3 pts salt at  $15^\circ$  (Schwicker)

**Potassium strontium thiosulphate,  $\text{K}_2\text{S}_2\text{O}_3 \cdot \text{SrS}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Fock and Kluss, B 24 3017)

**Potassium zinc thiosulphate,  $\text{K}_2\text{S}_2\text{O}_3 \cdot \text{ZnS}_2\text{O}_3 \cdot \text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  (Rosenheim and Davidsohn, Z anorg 1904, 41 238)

**Potassium thiosulphate sodium chloride,  $\text{K}_2\text{S}_2\text{O}_3 \cdot \text{NaCl}$** 

Sol in  $\text{H}_2\text{O}$  (Pape, Pogg 139 238)

**Rubidium thiosulphate,  $\text{Rb}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$** 

Very hygroscopic, easily sol in  $\text{H}_2\text{O}$  (J Meyer, B 1907, 40 1356)

**Rubidium silver thiosulphate,  $2\text{Rb}_2\text{S}_2\text{O}_3 \cdot \text{Ag}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$** 

Ppt Not hygroscopic Difficultly sol in cold  $\text{H}_2\text{O}$  Decomp by warm  $\text{H}_2\text{O}$  (J Meyer)

**Rubidium silver thiosulphate ammonia,  $\text{Rb}_2\text{S}_2\text{O}_3 \cdot \text{Ag}_2\text{S}_2\text{O}_3 \cdot \text{NH}_3$** 

Ppt (J Meyer)  
 $3\text{Rb}_2\text{S}_2\text{O}_3 \cdot 4\text{Ag}_2\text{S}_2\text{O}_3 \cdot \text{NH}_3$  Ppt Decomp in the air (J Meyer)

**Samarium thiosulphate**

(Cleve)

**Scandium thiosulphate, basic,  $\text{Sc}(\text{OH})\text{S}_2\text{O}_3$** 

Ppt (R J Meyer, Z anorg 1914, 86 282)

**Silver thiosulphate,  $\text{Ag}_2\text{S}_2\text{O}_3$** 

Sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH}$  or alkali thiosulphates + Aq (Herschel, Fdnb Phil J 1 26)

**Silver sodium thiosulphate,  $\text{Ag}_2\text{S}_2\text{O}_3 \cdot \text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$** 

Sl sol in  $\text{H}_2\text{O}$  Easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , also in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  to form—  
 $\text{Ag}_2\text{S}_2\text{O}_3 \cdot 2\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ , somewhat sol in al-

cohol, especially if warm or dilute (Lenz, A 40 94)

$\text{Ag}_2\text{S}_2\text{O}_3$ ,  $6\text{Na}_2\text{S}_2\text{O}_3 + 21\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Jochum, C C 1885 642)

**Silver sodium thiosulphate acetylde acetylene**,  $2\text{Na}_2\text{S}_2\text{O}_3$ ,  $7\text{Ag}_2\text{S}_2\text{O}_3$ ,  $18\text{Ag}_2\text{C}_2$ ,  $32\text{C}_2\text{H}_2$

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
Insol in alkalis (Bhaduri, Z anorg 1913, 79 356)

$7\text{Na}_2\text{S}_2\text{O}_3$ ,  $5\text{Ag}_2\text{S}_2\text{O}_3$ ,  $86\text{Ag}_2\text{C}_2$ ,  $13\text{C}_2\text{H}_2$  (Bhaduri)

**Silver sodium thiosulphate ammonia**,  $\text{NaAgS}_2\text{O}_3$ ,  $\text{NH}_3$

Very unstable (Schwicker, B 22 1736)

**Silver strontium thiosulphate**,  $\text{Ag}_2\text{S}_2\text{O}_3$ ,  $\text{SrS}_2\text{O}_3$

Nearly insol in  $\text{H}_2\text{O}$  Very sl sol in  $\text{SrS}_2\text{O}_3 + \text{Aq}$ , easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Herschel)

**Sodium thiosulphate**,  $\text{Na}_2\text{S}_2\text{O}_3$  and +1, 2 and  $5\text{H}_2\text{O}$

100 pts  $\text{H}_2\text{O}$  dissolve

At  $16^\circ$ , 65 pts  $\text{Na}_2\text{S}_2\text{O}_3$

" 20", 69 " "

" 25", 75 " "

" 30", 80 " "

" " "

" " "

" " "

114 " "

(Mulder)

100 pts  $\text{H}_2\text{O}$  dissolve at  $0^\circ$ , 476 pts  $\text{Na}_2\text{S}_2\text{O}_3$ , at  $20^\circ$ , 695 pts, at  $40^\circ$ , 104 pts, at  $60^\circ$ , 1923 pts (Kremers, Pogg 99 50)

100 pts  $\text{H}_2\text{O}$  dissolve 171 pts cryst (= 108.9 pts anhydrous) salt at  $19.5^\circ$  to form a solution of 13875 sp gr (Schiff, A 113 350)

By supersaturation 100 pts  $\text{H}_2\text{O}$  may dissolve 2174 pts  $\text{Na}_2\text{S}_2\text{O}_3$  at  $0^\circ$  (Kremers)

#### Solubility in $\text{H}_2\text{O}$

$t^\circ$	% $\text{Na}_2\text{S}_2\text{O}_3$	Solid phase
0	34.43	$\text{Na}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O}$
10	37.89	"
20	41.17	"
30	45.86	"
40	50.65	"
45	54.49	"
50	62.92	$\text{Na}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$
60	67.39	"
72	70.39	"
80 5	71.33	"
90 5	71.76	"
100	72.68	"

(Taylor, Proc Edinburgh Soc 1898, 22 49)

Solubility of anhydrous  $\text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	g $\text{Na}_2\text{S}_2\text{O}_3$ per 100 g	
	Solution	H O
40	67.40	206.70
45	67.60	208.60
50	67.76	210.20
55	68.15	214.00
60	68.48	217.30
65	68.80	220.50
70	69.05	223.10
75	69.35	226.30
80	69.80	231.80

(Young and Burke, J Am Chem Soc 1906, 28 327)

The solubility of the hydrates of  $\text{Na}_2\text{S}_2\text{O}_3$  are exceedingly complicated. There are five groups of hydrates, (I) primary, (II) secondary, (III) tertiary, (IV) quaternary, and (V), quintary, and transitions occur between members of the same and different groups.  $\text{Na}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O}$  (I) is the commercial thiosulphate. The relations and solubility of the various hydrates is shown in the following table

Solubility of  $\text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$

#### I Primary hydrates

$t^\circ$	g $\text{Na}_2\text{S}_2\text{O}_3$ per 100 g		Solid phase
	Solution	H.O	
0	33.40	50.15	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ (I)
5	35.33	54.64	"
10	37.37	59.69	"
15	39.11	64.22	"
20	41.20	70.07	"
25	43.15	75.90	"
30	45.19	82.45	"
35	47.71	91.24	"
40	50.83	105.37	"
45	55.33	123.87	"
48 17			" + $\text{Na}_2\text{SO}_3$ , $2\text{H}_2\text{O}$ (I)
0	52.73	111.60	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ (I)
5	53.45	114.90	"
10	53.94	117.10	"
20	55.15	122.68	"
25	56.03	127.43	"
30	57.13	133.27	"
40	59.38	146.20	"
45	60.73	154.70	"
50	62.28	165.11	"
55	63.85	176.60	"
60	65.68	191.30	"
65	68.04	212.90	"
66 5			" + $\text{Na}_2\text{S}_2\text{O}_3$

Solubility of  $\text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$  —  
Continued

II Secondary hydrates

$t^\circ$	g $\text{Na}_2\text{S}_2\text{O}_3$ per 100 g		Solid phase
	Solu- tion	$\text{H}_2\text{O}$	
0	41 96	72 30	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ (II)
5	43 56	77 17	"
10	45 25	82 65	"
15	47 27	89 36	"
20	49 38	97 55	"
25	52 15	108 98	"
30	56 57	130 26	"
30 22			" $\text{Na}_2\text{S}_2\text{O}_3 \cdot 4\text{H}_2\text{O}$ (II)
33 5	58 59	141 48	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 4\text{H}_2\text{O}$ (II)
36 2	60 51	153 23	"
38 6	62 80	168 82	"
40 65			" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (II)

0	60 47	153 00	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (II)
5	60 74	154 70	"
10	61 04	156 70	"
15	61 57	160 20	"
20	62 11	163 90	"
25	62 73	168 30	"
30	63 56	174 40	"
35	64 32	180 20	"
40	65 22	187 60	"
45	66 02	194 30	"
50	66 82	201 40	"
55	67 90	211 50	"
56 5			" $+\text{Na}_2\text{S}_2\text{O}_3$

III Tertiary hydrates

0	46 14	85 67	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$ (III and IV)
5	48 44	93 95	"
10	51 66	106 80	"
13	54 96	122 00	"
14 35			" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{4}{3}\text{H}_2\text{O}$ (IV)
14 3			" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{3}{2}\text{H}_2\text{O}$ (III)

0	57 42	134 80	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{3}{2}\text{H}_2\text{O}$ (III)
5	57 84	137 20	"
10	58 28	139 70	"
15	58 80	142 70	"
20	59 28	145 60	"
25	60 18	151 10	"
30	60 78	155 00	"
35	61 57	160 20	"
40	62 60	167 40	"
45	63 97	177 50	"
47 5	64 68	183 00	"
48 5			" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (III)

47 5	64 78	183 90	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (III)
50	65 30	188 20	"
52 5	65 89	193 20	"
55	66 45	198 10	"
60	68 07	213 10	"
61			" $+\text{Na}_2\text{S}_2\text{O}_3$

Solubility of  $\text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$  —  
Continued

IV Quaternary hydrate

$t^\circ$	g $\text{Na}_2\text{S}_2\text{O}_3$ per 100 g		Solid phase
	Solu- tion	$\text{H}_2\text{O}$	
0	57 63	136 00	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{4}{3}\text{H}_2\text{O}$ (IV)
5	58 08	138 60	"
10	58 49	140 90	"
15	59 00	143 90	"
20	59 57	147 30	"
25	50 35	152 30	"
30	61 03	156 60	"
35	61 94	162 80	"
40	62 95	169 90	"
45	64 22	179 50	"
50	65 45	189 50	"
55	67 07	203 70	"
58			" $+\text{Na}_2\text{S}_2\text{O}_3$

V Quaternary hydrates

0	57 63	136 00	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ (V)
5	58 23	139 40	"
10	59 05	144 20	"
15	60 02	150 10	"
20	61 02	156 50	"
25	62 30	165 30	"
30	63 56	174 40	"
35	65 27	188 00	"
27 5			" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (V)

30	63 34	172 80	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$ (V)
35	64 07	178 40	"
40	64 75	183 70	"
45	65 58	190 50	"
50	66 58	199 20	"
55	67 59	208 50	"
43			" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$ (V)

25	64 21	179 40	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$ (V)
35	64 60	182 50	"
40	64 99	185 60	"
45	65 61	190 82	"
50	66 02	194 30	"
55	66 57	199 10	"
60	67 40	206 70	"
65	68 24	214 90	"
70	69 06		"
70			" $\text{Na}_2\text{S}_2\text{O}_3$

(Young and Burke, J Am Chem Soc 1906, 28 321)

Heat is absorbed by dissolving in  $\text{H}_2\text{O}$   
110 pts  $\text{Na}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O} + 100$  pts  $\text{H}_2\text{O}$   
lower temp from  $10.7^\circ$  to  $8^\circ$  (Rudorff, B 2 68)  
 $+\frac{1}{2}\text{H}_2\text{O}$  (Young and Burke, J Am Chem Soc 1906, 28 321)  
 $+\text{H}_2\text{O}$   
 $+\frac{4}{3}\text{H}_2\text{O}$  (Young and Burke)  
 $+\frac{3}{2}\text{H}_2\text{O}$  (Young and Burke)



**Thorium hydroxide,  $\text{Th}(\text{OH})_4$** 

Insol in  $\text{H}_2\text{O}$   
Sol in acids, except oxalic, molybdic, and hydrofluoric acids

Insol in alkali hydroxides, but easily sol in alkali carbonates + Aq. More sol in  $\text{NH}_4\text{OH} + (\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  than in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  alone (Berzelius). Not pptd in presence of tartaric and citric acids (Chydenius, Pogg **119** 43).

$4\text{ThO}_2 \cdot \text{H}_2\text{O}$  Insol in water and acids at boiling temp

**Thorium hydroxybromide,  $\text{Th}(\text{OH})_2\text{Br}_2 + 11\text{H}_2\text{O}$** 

Sol in alcohol (Rosenheim, B 1900, **33** 979)

**Thorium hydroxychloride,  $(\text{OH})\text{ThCl}_3 + 11\text{H}_2\text{O}$** 

Sol in alcohol (Rosenheim, B 1900, **33** 978)

$\text{Th}(\text{OH})_2\text{Cl}_2 + 5\text{H}_2\text{O}$  Slowly takes up  $\text{H}_2\text{O}$  from the air

Sol in  $\text{H}_2\text{O}$  without decomp

Sol in alcohol. Pptd from solution in alcohol by ether (Rosenheim, Z anorg 1903, **35** 425)

$+8\text{H}_2\text{O}$  Hydrosopic, sol in alcohol (Rosenheim, B 1900, **33** 978)

**Thorium hydroxyiodide,  $\text{Th}(\text{OH})\text{I}_3 + 10\text{H}_2\text{O}$** 

Evolves iodine in the light (Rosenheim, Z anorg 1903, **35** 430)

**Thorium iodide**

Sol in  $\text{H}_2\text{O}$

**Thorium nitride,  $\text{Th}_3\text{N}_4$** 

Decomp by  $\text{H}_2\text{O}$  (Matignon, C R 1901, **132** 37)

**Thorium oxide,  $\text{ThO}_2$** 

When ignited is insol in  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ . Sol in  $\text{H}_2\text{SO}_4$  by heating to boiling and subsequent addition of  $\text{H}_2\text{O}$ . Insol in alkali hydrates or carbonates + Aq

**Thorium metoxide,  $\text{Th}_3\text{O}_5 + \text{H}_2\text{O}$** 

Sl sol in  $\text{HCl}$  (Locke, Z anorg 1894, **7** 348)

$+2\text{H}_2\text{O}$  Loses 1  $\text{H}_2\text{O}$  at  $100^\circ$ . Sol in  $\text{H}_2\text{O}$ , insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Locke)

**Metathorium oxide**

Sol in  $\text{H}_2\text{O}$  after having been treated with conc  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ , even if previously ignited

$\text{ThO}_2, x\text{Th}(\text{OH})_4$ . Compare  $\text{Th}_3\text{O}_5$  (Locke) (Stevens, Z anorg 1901, **27** 42)

**Thorium peroxide,  $\text{Th}_2\text{O}_7$** 

Precipitate (Cleve, C R **100** 605)

**Thorium oxychloride**

Decomp by  $\text{H}_2\text{O}$  into  $\text{ThCl}_4$  and  $\text{ThO}_2$ .  $\text{ThOCl}_2$  Sol in  $\text{H}_2\text{O}$

Insol in abs alcohol (Matignon, A ch 1907, (8) **10** 133)

$+3\text{H}_2\text{O}$

$+5\text{H}_2\text{O}$  (Matignon, A ch 1907, (8) **10** 135)

**Metathorium oxychloride,  $\text{ThO}_2, x\text{ThCl}_4$** 

Hydrosopic, sol in  $\text{H}_2\text{O}$ , insol in abs alcohol (Stevens, Z anorg 1901, **27** 47)

**Thorium oxyfluoride,  $\text{ThOF}_2$** 

Insol in  $\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{SO}_4$  with decomp (Chauvenet, C R 1908, **146** 974)

**Thorium oxysulphide,  $\text{ThS}_2, 2\text{ThO}_2$** 

(Chydenius)

**Thorium phosphide**

Insol in  $\text{H}_2\text{O}$  (Berzelius)

**Thorium silicide,  $\text{ThSi}_2$** 

Sol in aq min acids, insol in aq alkalis. Decomp by fusion with  $\text{NaOH}$  or  $\text{KOH}$  (Honigschmid, C R 1906, **142** 158)

**Thorium sulphide,  $\text{ThS}_2$** 

Insol in warm  $\text{H}_2\text{SO}_4$ . Very slightly attacked by  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ . Sol in hot aqua regia (Berzelius)

**Thoromolybdic acid****Ammonium thoromolybdate,**

$(\text{NH}_4)_8\text{Th}(\text{Mo}_2\text{O}_7)_6 + 8\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Barbieri, C A **1913** 3724)

$(\text{NH}_4)_8\text{H}_2\text{Th}(\text{Mo}_2\text{O}_7)_6 + 11\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Barbieri)

**Silver thoromolybdate,  $\text{Ag}_8\text{Th}(\text{Mo}_2\text{O}_7)_6$** 

Insol in  $\text{H}_2\text{O}$ , sl sol in  $\text{HNO}_3 + \text{Aq}$ , but nearly insol in presence of  $\text{AgNO}_3$  (Barbieri)

**Sodium thoromolybdate,  $\text{Na}_8\text{Th}(\text{Mo}_2\text{O}_7)_6 + 15\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Barbieri)

$\text{Na}_8\text{H}_2\text{Th}(\text{Mo}_2\text{O}_7)_6 + 17\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Barbieri)

**Thulium, Tm****Thulium chloride,  $\text{Tm}_2\text{Cl}_6 + 14\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  and in alcohol (James, J Am Chem Soc 1911, **33** 1342)

**Thulium hydroxide**

Easily sol in dil acids (James, J Am Chem Soc 1911, **33** 1342)

**Thulium oxide,  $Tm_2O_3$** 

Slowly sol in hot conc acids (James, Am Chem Soc 1911, **33** 1342)

**Tin, Sn**

Insol in  $H_2O$  Tin is not attacked by distilled  $H_2O$  when air is passed through it for a week

Slowly sol in dil cold  $HCl + Aq$ , but rapidly sol if hot and conc Slowly sol in not dil  $H_2SO_4 + Aq$ , but decomp by hot conc  $H_2SO_4$

Readily sol in cold aqua regia Attacked violently by conc  $HNO_3 + Aq$  with pptn of  $SnO_2$  Completely sol in dil cold  $HNO_3 + Aq$  (1 pt  $HNO_3$ , 1 pt  $H_2O$ ) at  $22^\circ$  (Hay, C N **22** 298) Not attacked by pure conc  $HNO_3 + Aq$  of 1.512–1.419 sp gr, but violently attacked by less conc acid Also attacked by most conc acid if it contains  $NO_2$  (Millon, A ch (3) **6** 95)

If Sn is placed in dil  $HNO_3 + Aq$  of 1.15 sp gr it is sl dissolved, but soon pptd again as  $SnO_2$  If a small amt of  $NH_4Cl$  is added, the Sn remains permanently in solution,  $HCl + Aq$  has a similar action (Ordway, Am J Sci (2) **23** 220) Easily sol in the cold in mixture of 1 vol  $H_2SO_4$ , 2 vols  $HNO_3$ , and 3 vols  $H_2O$  (Basset, C N **53** 172)

$HNO_3 + Aq$  containing less than 12%  $HNO_3$  attacks Sn and forms a stannous salt, which decomposes, giving a turbid solution  $HNO_3 + Aq$  (12–45%  $HNO_3$ ) completely dissolves Sn, but solution becomes turbid on standing  $HNO_3 + Aq$  containing more than 45%  $HNO_3$  does not dissolve Sn, but forms a white substance, which is sol in  $H_2O$  if over 70% acid is used, this solution soon becomes turbid (Montemartini, Gazz ch it **22** 381)

Sn dissolves in  $HNO_3 + Aq$  at low temps  $0-21^\circ$  When very dil  $HNO_3 + Aq$  (14%  $HNO_3$ ) is used, the amount of stannous salt formed decreases only slightly with increase of temp while with 30–40% acid it falls to zero at  $21^\circ$  (Walker, J Soc Chem Ind **1893** 845)

In presence of Fe, Cr or Al,  $HNO_3 + Aq$  acts on Sn to form soluble products, from which conc  $HNO_3$  pptts all Sn as metastannic acid (van Leent, C C **1899** I 101)

Much more sol in acids when small quantities of metallic salts have been added This is most noticeable when  $PtCl_4$  or tartar emetic is added to  $HCl + Aq$   $HCl + Aq$  with tartar emetic exerts 11 times, and with  $PtCl_4$  13 times the action exhibited by pure acid (Millon, C R **21** 47)

Sol in 2N  $HClO_4 + Aq$  (Hendrixson, J Am Chem Soc 1904, **26** 755)

Pyrosulphuric acid dissolves Sn on warming (Divers, Chem Soc 1885, **47** 639)

Hot telluric acid attacks Sn (Hutchins, J Am Chem Soc 1905, **27** 1183)

Sn is attacked by 17%  $HN_3 + Aq$  (Curtrius and Russom, J pr 1898, (2) **58** 299)

Sol in a solution of Na in liquid  $NH_3$

(Kraus, J Am Chem Soc 1907, **29** 1562)

Insol in liquid  $NH_3$  (Gore, Am Ch J 1898, **20** 830)

Sol in boiling alum +  $Aq$  (1 pt alum to 4 pts  $H_2O$ )

Sol in  $KHSO_3$ ,  $NH_4Cl$  (1 4), and  $K_2C_4H_4O_6 + Aq$  Sl sol in  $KC_2H_3O_2 + Aq$ , but not attacked by  $MgSO_4$ ,  $K_2SO_4$ ,  $KNO_3$ , or  $Na_2SO_4 + Aq$  (Cludius, J pr **9** 161)

Sol in alkalis +  $Aq$

Attacked easily by conc  $NaCl$ ,  $KCl$ , or  $NH_4NO_3 + Aq$ , not attacked by  $NH_4Cl + Aq$  (Hallowell, Am Ch J **6** 52)

Sol in  $Fe(NO_3)_3 + Aq$  in presence of  $HNO_3 + Aq$  in proportion of 1 atom Sn to 1 atom Fe (Lopez and Storch, W A B **98**, 2b 268)

Solubility in dil saline solutions

100 ccm  $H_2O$  containing 0.5 g  $NaCl$  or  $KCl$  dissolve 6 mg Sn from 11.8 sq cm in one week when air without  $CO_2$  is passed through the solution, but none at all when the air contains  $CO_2$

100 ccm  $H_2O$  containing 1 g  $NH_4Cl$  dissolve 5 mg Sn under above conditions without  $CO_2$ , and none with  $CO_2$

With 1 g  $MgCl_2$ , 1 mg Sn was dissolved without  $CO_2$ , and none with  $CO_2$

With 1 g  $K_2SO_4$ , 2 mg Sn were dissolved without  $CO_2$ , and none with  $CO_2$

With 1 g  $KNO_3$ , 3 mg Sn were dissolved without  $CO_2$ , and 1 mg with  $CO_2$

With 1 g  $Na_2CO_3$ , 7 mg Sn were dissolved without  $CO_2$

With 1 g  $NaOH$ , 220 mg Sn were dissolved without  $CO_2$

$CaO_2.H_2O + Aq$  did not dissolve (Wagner, Dingt **221** 260)

Not attacked by sugar +  $Aq$  (Klein, C R **102** 1170)

$\frac{1}{2}$  ccm oleic acid dissolves 0.0134 g Sn in 6 days (Gates, J phys Chem 1911, **15** 143)

**Tin antimonide,  $SnSb$** 

(Stead, J Soc Chem Ind 1897, **16** 205)

**Tin arsenide,  $Sn_3As_2$** 

(Stead, J Soc Chem Ind 1897, **16** 206)

**Tin (stannous) bromide,  $SnBr_2$** 

Sol in  $H_2O$

Sol in pyridine (Naumann, B 1904, **37** 4609)

Mol weight determined in pyridine and ethyl sulphide (Werner, Z anorg 1897, **15** 23)

**Tin (stannic) bromide, basic,  $SrBr_2.OH + 3H_2O$** 

Sol in  $H_2O$  Decomp in aq solution when warmed

Sol in ether, methyl alcohol ethyl alcohol, acetone, acetic acid and esters of organic acids Nearly insol in benzene, ligroin and  $CHCl_3$  (Pfeiffer, Z anorg 1914, **87** 242)

**Tin (stannic) bromide,  $\text{SnBr}_4$** 

Deliquescent Sol in  $\text{H}_2\text{O}$  without evolution of heat (Balard)

Decomp by  $\text{H}_2\text{O}$  much more quickly than  $\text{SnCl}_4$  (Lorenz, Z anorg 1895, 9 378)

Easily sol in  $\text{AsBr}_3$  (Walden, Z anorg 1902, 29 374),  $\text{PCl}_3$ ,  $\text{PBr}_3$  and  $\text{S}_2\text{Cl}_2$  (Walden, Z anorg 1900, 25 217)

Sol in acetone (Naumann, B 1904, 37 4328)

+ $4\text{H}_2\text{O}$  (Preis and Raymann, C C 1882 773)

**Stannic hydrogen bromide,  $\text{SnBr}_4 \cdot 2\text{HBr}$** 

See Bromostannic acid.

**Stannic bromide with MBr**

See Bromostannate, M

**Tin (stannic) bromochloride,  $\text{SnClBr}_3$** 

Fumes in moist air, decomp by  $\text{H}_2\text{O}$  (Besson, C R 1897, 124 685)

$\text{SnCl}_2\text{Br}_2$  Fumes in moist air Decomp by  $\text{H}_2\text{O}$  (Besson)

$\text{SnCl}_3\text{Br}$  Fumes in moist air Decomp by  $\text{H}_2\text{O}$  (Besson)

**Iodide,  $\text{SnBr} \cdot \text{I}_2$** 

Decomp in aq solution

(Lenormand, C C 1899, II 521, 1899, 10 114)

**(stannous) chloride,  $\text{SnCl}_2$ , and  $+2\text{H}_2\text{O}$** 

Not deliquescent 100 pts  $\text{H}_2\text{O}$  dissolve 83.9 pts  $\text{SnCl}_2$  at  $0^\circ$  (Engel, A ch (6) 17 347) 100 pts  $\text{H}_2\text{O}$  dissolve 269.8 pts  $\text{SnCl}_2$  at  $15^\circ$ , and sat solution has sp gr 1.827 (Michel and Krafft, A ch (3) 41 478) Sol in a certain amount of  $\text{H}_2\text{O}$  without decomp, but more  $\text{H}_2\text{O}$  causes pptn of  $\text{SnO}$ ,  $\text{SnCl}_2$

$\text{SnCl}_2 + \text{Aq}$  absorbs O from air

Melts in crystal  $\text{H}_2\text{O}$  at  $46^\circ$  (Ordway)

Sat solution boils at  $121^\circ$

Sp gr of  $\text{SnCl}_2 + \text{Aq}$  at  $15^\circ$  containing

5 10 15 20 %  $\text{SnCl}_2 + 2\text{H}_2\text{O}$ ,  
1 0331 1 0684 1 1050 1 1442

25 30 35 40 %  $\text{SnCl}_2 + 2\text{H}_2\text{O}$ ,  
1 1855 1 2300 1 2779 1 3298

45 50 55 60 %  $\text{SnCl}_2 + 2\text{H}_2\text{O}$ ,  
1 3850 1 4451 1 5106 1 5823

65 70 75 %  $\text{SnCl}_2 + 2\text{H}_2\text{O}$   
1 6598 1 7452 1 8399

(Gerlach, Dingl 186 131)

Solubility of  $\text{SnCl}_2$  in  $\text{HCl} + \text{Aq}$   $\frac{\text{SnCl}_2}{2} =$

$\frac{1}{2}$  molecules  $\text{SnCl}_2$  in milligrammes in 10 ccm solution,  $\text{HCl} =$  molecules  $\text{HCl}$  in milligrammes in ditto,  $\text{H}_2\text{O} =$  amt  $\text{H}_2\text{O}$  present in grammes

$\frac{\text{SnCl}_2}{2}$	HCl	Sum of equiv	Sp gr of solution	$\text{H}_2\text{O}$
74	0	74	1.532	8.33
66.7	6.6	73.3	1.489	8.35
63.75	13.54	77.29	1.472	8.198
68.4	24.8	93.2	1.524	7.869
81.2	34.9	116.1	1.625	7.305
94.2	40.0	134.2	1.724	6.880
117.6	44	161.6	1.883	6.108
147.6	49.4	197.0	2.114	5.387
156.4	66	222.4	2.190	4.715
157	78	235	2.199	4.309

(Engel, A ch (6) 17 347)

Solubility is thus diminished by  $\text{HCl} + \text{Aq}$  while there are less than 8-10 mols  $\text{HCl}$  for 1 mol  $\text{SnCl}_2$ . When that limit is passed the solubility rapidly increases (Engel)

Sol in very dil  $\text{HCl}$  or tartaric acid +  $\text{Aq}$   
Sol in  $\text{KOH} + \text{Aq}$  Sol in conc  $\text{SnOCl}_2 + \text{Aq}$  (Gerlach) Sol in  $\text{NH}_4\text{Cl} + \text{Aq}$

Anhydrous  $\text{SnCl}_2$  is partially sol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1893, 20 830)

Sol in absolute alcohol Insol in oil of turpentine

11.41 pts  $\text{SnCl}_2$  are sol in 100 pts ether at  $0^\circ$

11.38 pts  $\text{SnCl}_2$  are sol in 100 pts ether at  $16^\circ$

11.38 pts  $\text{SnCl}_2$  are sol in 100 pts ether at  $35.5^\circ$  (Laszczyński, B 1894, 27 2286)

Anhydrous  $\text{SnCl}_2$  is sol in ether (de Jong, Z anal 1902, 41 596)

1 g anhydrous  $\text{SnCl}_2$  is sol in 1.8 g acetone at  $18^\circ$  Sp gr of sat solution  $18^\circ/4^\circ = 1.6$  (Naumann, B 1904, 37 4336)

Sol in acetone and in methylal (Eidmann, C C 1899, II 1014)

Anhydrous  $\text{SnCl}_2$  is sol in methyl acetate to the extent of 15.7% (Schroder and Steiner, J pr 1909, (2) 79 63)

31.20 pts  $\text{SnCl}_2 + 2\text{H}_2\text{O}$  are sol in 100 pts ethyl acetate at  $-2^\circ$

35.53 pts  $\text{SnCl}_2 + 2\text{H}_2\text{O}$  are sol in 100 pts ethyl acetate at  $+22^\circ$

73.44 pts  $\text{SnCl}_2 + 2\text{H}_2\text{O}$  are sol in 100 pts ethyl acetate at  $82^\circ$  (Laszczyński, B 1894, 27 2286)

1 pt anhydrous  $\text{SnCl}_2$  is sol in 22.40 pts ethyl acetate at  $18^\circ$   $D_{18^\circ/4^\circ} = 0.9215$  (Naumann, B 1910, 43 319)

Insol in ethyl amine (Shinn, J phys Ch 1907 11 538), pyridine (Naumann, B 1904, 37 4609), benzonitrile (Naumann, B 1914, 47 1369)

Insol in  $\text{CS}_2$  (Arctowski, Z anorg 1894, 6 257)  
 Sol in urethane (Castoro, Z anorg 1899, 20 61)  
 Mol weight determined in pyridine and ethyl sulphide (Werner, Z anorg 1897, 15 22)

**Tin (stannic) chloride, basic,  $\text{SnCl}_3\text{OH} + 3\text{H}_2\text{O}$**

Hydroscopic  
 Sol in  $\text{H}_2\text{O}$   
 Sol in ether, alcohol, acetone, acetic acid  
 Nearly insol in ligroin and benzene (Pfeiffer Z anorg, 1914, 87 241)

**Tin (stannic) chloride,  $\text{SnCl}_4$**

(a) *Ordinary modification*—Deliquescent. Sol in  $\text{H}_2\text{O}$ . On diluting  $\text{SnCl}_4 + \text{Aq}$  and boiling,  $\text{SnO}_2$  separates out.  $\text{SnCl}_4 + \text{Aq}$  is not pptd by  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ ,  $\text{H}_3\text{PO}_4 + \text{Aq}$  ppts in a few days, and  $\text{H}_3\text{AsO}_4 + \text{Aq}$  in a short time. No ppt is formed by  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{KCl}$ ,  $\text{NaCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{KNO}_3$ , etc +  $\text{Aq}$

Sp gr of  $\text{SnCl}_4 + \text{Aq}$  at  $15^\circ$

% $\text{SnCl}_4 + 5\text{H}_2\text{O}$	Sp gr	% $\text{SnCl}_4 + 5\text{H}_2\text{O}$	Sp gr	% $\text{SnCl}_4 + 5\text{H}_2\text{O}$	Sp gr
2	1.012	34	1.226	66	1.538
4	1.024	36	1.242	68	1.563
6	1.036	38	1.259	70	1.587
8	1.048	40	1.276	72	1.614
10	1.059	42	1.293	74	1.641
12	1.072	44	1.310	76	1.669
14	1.084	46	1.329	78	1.698
16	1.097	48	1.347	80	1.727
18	1.110	50	1.366	82	1.759
20	1.124	52	1.386	84	1.791
22	1.137	54	1.406	86	1.824
24	1.151	56	1.426	88	1.859
26	1.165	58	1.447	90	1.894
28	1.180	60	1.468	92	1.932
30	1.195	62	1.491	94	1.969
32	1.210	64	1.514	96	1.988

(Gerlach Dingl 178 49)

Sp gr of  $\text{SnCl}_4 + \text{Aq}$

Deg Baumé	% Sn	Deg Baumé	% Sn	Deg Baumé	% Sn
65.7	29.45	55	24.47	34	14.90
65	29.12	54	24.02	33	14.45
64	28.64	53	23.56	32	14.00
63	28.17	52	23.11	31	13.56
62	27.70	51	22.65	30	13.11
61	27.24	50	22.20	29	12.67
60	26.77	49	21.74	28	12.23
59	26.30	48	21.29	27	11.79
58	25.84	47	20.83	26	11.35
57	25.38	46	20.38	25	10.91
56	24.93				

(Heermann, Ch Z 1907, 31 680)

Sol in  $\text{S}_2\text{Cl}_2$  (Walden, Z anorg 1900, 25 217)

Easily sol in  $\text{PCl}_3$  and  $\text{PBr}_3$  (Walden, Z anorg 1900, 25 211)

Very sol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1899, 20 830)

Very sol in absolute alcohol, from which it is pptd by  $\text{H}_2\text{O}$ . Easily sol in ether, decomp by oil of turpentine. Miscible with  $\text{CS}_2$  and  $\text{Br}_2$

Sol in acetone (Naumann, B 1904, 37 4328)

Sol in acetone and in methylal (Eidmann, C C 1899, II 1014)

Sol in ethyl acetone (Naumann, B 1904, 37 3601)

Distribution of  $\text{SnCl}_4$  between  $\text{H}_2\text{O}$  and xylene

n = pts by wt of Cl in 100 pts of  $\text{H}_2\text{O}$  layer

m = pts by wt of Cl in 100 pts of xylene layer

k = partition coefficient

50 cc xylene + 60 g  $\text{SnCl}_4$  5 $\text{H}_2\text{O}$

t°	n	m	k
66°	40.35	0.08	504.4
80°	39.95	0.175	228.5
97.5°	40.24	0.33	122.1
111°	40.27	0.68	59.3

(Smirnoff, Z phys Ch 1907, 58 377)

50 cc xylene + 60 g  $\text{SnCl}_4$  4 $\text{H}_2\text{O}$

t°	n	m	k
66°	41.905	0.925	45.3
80°	41.915	1.555	27.0
100°	41.845	2.515	16.7
111°	41.68	3.235	12.9

(Smirnoff)

50 cc xylene + 60 g  $\text{SnCl}_4$  3 $\text{H}_2\text{O}$

t	n	m	k
80°	43.205	9.95	4.4
94°	42.545	9.325	4.6
100°	42.645	10.56	5.1
111°	42.31	10.03	4.2

(Smirnoff)

+2 $\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$

+3 $\text{H}_2\text{O}$  Tr pt 83° (Meyerhoffer, Bull Soc 1891 (3) 6, 85)

+4 $\text{H}_2\text{O}$  Tr pt 63° (Meyerhoffer)

+5 $\text{H}_2\text{O}$  Very deliquescent, and sol in  $\text{H}_2\text{O}$ . Decomp by alcohol. Sol in  $\text{HCl} + \text{Aq}$

Tr pt 56° (Meyerhoffer)

+8 $\text{H}_2\text{O}$  More deliquescent than the 5 $\text{H}_2\text{O}$  salt. Tr pt 19° (Meyerhoffer)

+9 $\text{H}_2\text{O}$  (Nollner, Z Ch 1866 45)

(b) *Metastannic chloride*—Sol in cold  $H_2O$ , solution coagulates on boiling. Conc  $HCl$  + Aq ppts from  $SnCl_4$  + Aq. When solution does not contain  $HCl$ , the addition of  $HCl$  + Aq causes a ppt, which dissolves in  $H_2O$ ,  $HNO_3$ , and  $H_2SO_4$  + Aq also ppt  $K_2SO_4$ ,  $Na_2SO_4$ , and  $NaCl$  + Aq produce ppts insol in  $H_2O$ , but sol in  $HCl$  + Aq.  $NH_4Cl$  or  $KCl$  + Aq do not ppt  $KNO_3$  + Aq ppts slowly (Rose)

**Tin (stannous) hydrogen chloride**,  $SnCl_2$ ,  $HCl + 3H_2O$

Decomp by  $H_2O$

Melts at  $-25^\circ$  (Engel, C R 106 1398)

**Tin (stannic) hydrogen chloride**

See Chlorostannic acid

**Tin (stannous) hydrazine chloride**,  $SnCl_2$ ,  $2N_2H_4$ ,  $HCl$

Very hygroscopic

Sol in  $H_2O$  and abs alcohol (Curtius J pr 1894, (2) 50 341)

**Tin (stannic) chloride with  $MCl$**

See Chlorostannate, M

**Tin (stannous) chloride ammonia**,  $SnCl_2$ ,  $NH_3$

(Berzelius)

$SnCl_2$ ,  $4NH_3$  Ppt (Naumann B 1904, 37 433b)

**Tin (stannic) chloride ammonia**,  $SnCl_4$ ,  $2NH_3$

Sol in cold  $H_2O$  without decomp, but decomposes by heating

**Tin (stannous) chloride arsenate**

See Arsenate chloride, stannous

**Tin (stannic) chloride cyanhydric acid**,  $SnCl_4$ ,  $2HCN$

Decomp on moist air or with  $H_2O$  (Klein, A 74 85)

**Tin (stannous) chloride hydrazine**,  $SnCl_2$ ,  $2N_2H_4$

Decomp by  $H_2O$

Insol in  $NH_4OH$  + Aq (Franzen, Z anorg 1908, 60 286)

**Tin (stannic) chloride nitrogen sulphide**,  $SnCl_4$ ,  $2N_4S_4$

Insol in most solvents

Decomp by warm  $NH_4OH$  + Aq

Decomposes in the air (Wolbling, Z anorg 1908, 57 284)

Decomp by  $H_2O$  (Davis, Chem Soc, 1906, 89 1576)

**Tin (stannic) chloride phosphine**,  $3SnCl_4$ ,  $2PH_3$

Decomp by  $H_2O$  (Rose, Pogg 24 159)

**Tin (stannous) chloride potassium stannous sulphate**

See Sulphate, potassium stannous stannous chloride

**Tin (stannic) chloride sulphur tetrachloride**,  $SnCl_4$ ,  $2SCl_4$

Very hygroscopic

Sol in  $CHCl_3$ , ligroin, petroleum ether,  $CS_2$ ,  $POCl_3$ , very sol in completely dry absolute ether, in benzene, acetic ester and in  $SCl_2$  (Ruff, B 1904, 37 4517)

**Tin (stannic) chloride sulphide**,  $2SnCl_4$ ,  $SnS_2$

See Stannic sulphochloride

**Tin (stannic) chlorobromide**,  $SnClBr_2$

Decomp by  $H_2O$  (Ladenburg, A suppl 8 60)

$SnCl_2Br_2$  Decomp by  $H_2O$  (Ladenburg)

**Tin (stannous) chloriodide**,  $SnClI$

Decomp immediately by  $H_2O$  (Henry, Phil Trans 1845 363)

**Tin (stannic) chloriodide**,  $SrCl_2I_2$

Fumes in the air

Decomp by  $H_2O$  (Lenormand, J Pharm 1898 8)

$SnClI_3$  (Lenormand, J Pharm 1899, 10 114)

**Tin (stannous) fluoride**,  $SnF_2$

Easily sol in  $H_2O$  (Berzelius, Pogg 1 34)

**Tin (stannic) fluoride**,  $SnF_4$

Very hygroscopic

Sol in  $H_2O$  Slowly decomp in aq solution with separation of  $SnO_2$  (Ruff, B 1904, 37 681)

**Tin (stannic) fluoride with MF**

See Fluostannate, M

**Tin (stannous) hydroxide**,  $2SnO$ ,  $H_2O$

Decomp to  $SnO$  when boiled with  $H_2O$ . More easily sol in acids than  $Sn$  or  $SnO$ . Sol in  $NaOH$ , and  $KOH$  + Aq, even when dil. Insol or very sl sol in  $NH_4OH$ ,  $(NH_4)_2CO_3$ , and  $K_2CO_3$  + Aq, sol in cold  $CaO_2H_2$ , and  $BaO_2H_2$  with decomposition on boiling (Fremy, A ch (3) 12 460). Only sl sol in  $NH_4Cl$  + Aq hot or cold (Brett). Sl sol in  $NaC_2H_3O_2$  + Aq (Mercer)

## Solubility in NaOH+Aq

G Na in 20 ccm	G Sn in 20 ccm
0 2480	0 1904
0 3680	0 2614
0 6394	0 4304
0 8326	0 5560
0 9661	0 7849
2 1234	1 8934

(Rubenbauer, Z anorg 1902, 30 335)

Not pptd in presence of Na citrate (Spiller)

Sol in water-glass +Aq (Ordway)

$\text{SnO}_2 \cdot \text{H}_2\text{O}$  Solubility in 1 l  $\text{H}_2\text{O}$  = 0.000135 g mol at 25° (Goldschmidt, Z phys Ch 1906, 56 389)

**in hydroxide**,  $\text{SnO}$ ,  $6\text{SnO}_2 + 5\text{H}_2\text{O}$

+  $9\text{H}_2\text{O}$  (Schiff, A 120 153)

**in sesquihydroxide**,  $\text{Sn}_2\text{O}_3 \cdot x\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH}$ +Aq (Fuchs, J pr 5 318)

**in (stannic) hydroxide****" $\alpha$ " modification**

Obtained by pptn by alkali in stannic chloride solution

Freshly pptd substance when air dried contains 73.5%  $\text{H}_2\text{O}$ , when dried over  $\text{H}_2\text{SO}_4$  r in a vacuum for 1 month 12.6%  $\text{H}_2\text{O}$ . Heated to glowing loses all  $\text{H}_2\text{O}$  and passes into the anhydride. The " $\alpha$ " form is capable of existing in all degrees of hydration (Lorenz, Z anorg 1895, 9 372-375)

" $\alpha$ " stannic hydrate is a white amorphous substance which is very sol in  $\text{HNO}_3$ , then moist, sol in  $\text{H}_2\text{SO}_4$  even dil, sol in  $\text{HCl}$  and not pptd by an excess. Very sol in  $\text{NaOH}$ +Aq and is not pptd by an excess.

A solution of  $\alpha$  stannic acid in  $\text{HCl}$  is identical with a solution of freshly prepared aqueous stannic chloride and gives no ppt with dil  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$  or arsenic acid even on long standing.

**" $\beta$ " modification**

Obtained by oxidizing and dissolving Sn in  $\text{HNO}_3$ , and from solution of sodium stannate by pptn. Freshly pptd from  $\text{HNO}_3$  when air dried contains 21.3%  $\text{H}_2\text{O}$ , and when dried over  $\text{H}_2\text{SO}_4$  or in a vacuum 11.3%,—corresponding to  $\text{Sn}(\text{OH})_4$  and  $\text{SnO}(\text{OH})_2$  respectively.

Freshly pptd from sodium stannate solution and air dried contains 22.5%  $\text{H}_2\text{O}$  and when dried over  $\text{H}_2\text{SO}_4$  or in a vacuum contains 12.1%,—corresponding to  $\text{Sn}(\text{OH})_4$  and  $\text{SnO}(\text{OH})_2$ . Passes into the anhydride when heated to glowing.

The " $\beta$ " form is capable of existing in all degrees of hydration. It is a white amorphous substance which is insol in  $\text{HNO}_3$ , in-

sol in  $\text{H}_2\text{SO}_4$  even when conc, insol in  $\text{HCl}$  but changed by contact with the acid in that when the acid has been removed the ppt is readily sol in  $\text{H}_2\text{O}$ , though pptd again from solution by addition of  $\text{HCl}$ . When freshly prepared the " $\beta$ " form is sol in  $\text{NaOH}$ +Aq but is pptd by an excess of  $\text{NaOH}$ .

A solution of " $\beta$ " stannic acid in  $\text{HCl}$  behaves quite differently from an aq solution of stannic chloride in that it ppts metastannic sulphate when treated with  $\text{H}_2\text{SO}_4$ .

This ppt dissolves when heated with dilute  $\text{HNO}_3$  or  $\text{HCl}$ , but the solution on standing spontaneously forms another ppt. A solution of " $\beta$ " stannic acid in  $\text{HCl}$  gives a ppt when treated with arsenic acid (Lorenz, Z anorg 1895, 9 372)

See also Stannic acid

**Tin hydroxyl chloride**,  $\text{SnO}(\text{OH})\text{Cl}$ 

See Chlorostannic acid

**Tin (stannous) iodide**,  $\text{SnI}_2$ , and +  $2\text{H}_2\text{O}$ 

Sl sol in cold, more abundantly in hot  $\text{H}_2\text{O}$ , without decomp

Solubility in  $\text{H}_2\text{O}$ 

t°	Pts $\text{SnI}_2$ in 100 pts solution	t°	Pts $\text{SnI}_2$ in 100 pts solution
98.5	3.43	97.3	3.70
84.9	3.05	87.4	3.24
73.9	2.56	77.6	2.75
60.1	2.09	67.5	2.34
51.5	1.79	59.7	2.03
41.0	1.50	49.5	1.72
30.5	1.21	39.4	1.38
20.8	1.03	29.6	1.11
		19.8	0.96

(Young, J Am Chem Soc 1897, 19 846)

Solubility of  $\text{SnI}_2$  in  $\text{HI}$ +Aq at t°

Pts  $\text{SnI}_2$  per 100 pts solvent

t°	5.83% HI	9.60% HI	15.20% HI	20.44% HI	24.80% HI	30.40% HI	36.82% HI
20	0.98	0.20	0.60	1.81	4.20	10.86	25.31
30	1.16	0.23	0.64	1.81	4.06	10.28	23.46
40	1.40	0.33	0.71	1.90	4.12	10.06	23.15
50	1.69	0.46	0.82	1.24	3.34	10.35	23.76
60	2.07	0.66	1.12	5.14	7.78	11.03	24.64
70	2.48	0.91	1.37	2.92	5.43	11.97	25.72
80	2.95	1.23	1.83	7.06	3.38	13.30	27.23
90	3.46	1.65	2.40	5.87	7.82	15.52	29.84
100	4.03	2.23	3.63	5.82	9.60		34.05

(Young, J Am Chem Soc 1897, 19 851)

(b) *Metastannic chloride*—Sol in cold  $\text{H}_2\text{O}$ , solution coagulates on boiling. Conc  $\text{HCl} + \text{Aq}$  ppts from  $\text{SnCl}_4 + \text{Aq}$ . When solution does not contain  $\text{HCl}$ , the addition of  $\text{HCl} + \text{Aq}$  causes a ppt, which dissolves in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4 + \text{Aq}$  also ppt  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ , and  $\text{NaCl} + \text{Aq}$  produce ppts, insol in  $\text{H}_2\text{O}$ , but sol in  $\text{HCl} + \text{Aq}$ .  $\text{NH}_4\text{Cl}$  or  $\text{KCl} + \text{Aq}$  do not ppt  $\text{KNO}_3 + \text{Aq}$  ppts slowly (Rose)

**Tin (stannous) hydrogen chloride**,  $\text{SnCl}_2$ ,  $\text{HCl} + 3\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$

Melts at  $-25^\circ$  (Engel, C R 106 1398)

**Tin (stannic) hydrogen chloride**

See Chlorostannic acid

**Tin (stannous) hydrazine chloride**,  $\text{SnCl}_2$ ,  $2\text{N}_2\text{H}_4$ ,  $\text{HCl}$

Very hygroscopic

Sol in  $\text{H}_2\text{O}$  and abs alcohol (Curtius J pr 1894, (2) 60 341)

**Tin (stannic) chloride with MCl**

See Chlorostannate, M

**Tin (stannous) chloride ammonia**,  $\text{SnCl}_2$ ,  $\text{NH}_3$

(Berzelius)

$\text{SnCl}_2$ ,  $4\text{NH}_3$  Ppt (Naumann B 1904, 37 4336)

**Tin (stannic) chloride ammonia**,  $\text{SnCl}_4$ ,  $2\text{NH}_3$

Sol in cold  $\text{H}_2\text{O}$  without decomp, but decomposes by heating

**Tin (stannous) chloride arsenate**

See Arsenate chloride, stannous

**Tin (stannic) chloride cyanhydric acid**,  $\text{SnCl}_4$ ,  $2\text{HCN}$

Decomp on moist air or with  $\text{H}_2\text{O}$  (Klein, A 74 85)

**Tin (stannous) chloride hydrazine**,  $\text{SnCl}_2$ ,  $2\text{N}_2\text{H}_4$

Decomp by  $\text{H}_2\text{O}$

Insol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Franzen, Z anorg 1908, 60 286)

**Tin (stannic) chloride nitrogen sulphide**,  $\text{SnCl}_4$ ,  $2\text{N}_4\text{S}_4$

Insol in most solvents

Decomp by warm  $\text{NH}_4\text{OH} + \text{Aq}$

Decomposes in the air (Wolbling, Z anorg 1908, 57 284)

Decomp by  $\text{H}_2\text{O}$  (Davis, Chem Soc, 1906, 89 1576)

**Tin (stannic) chloride phosphine**,  $3\text{SnCl}_4$ ,  $2\text{PH}_3$

Decomp by  $\text{H}_2\text{O}$  (Rose, Pogg 24 159)

**Tin (stannous) chloride potassium stannous sulphate**

See Sulphate, potassium stannous stannous chloride

**Tin (stannic) chloride sulphur tetrachloride**,  $\text{SnCl}_4$ ,  $2\text{SCl}_4$

Very hygroscopic

Sol in  $\text{CHCl}_3$ , ligroin, petroleum ether,  $\text{CS}_2$ ,  $\text{POCl}_3$ , very sol in completely dry absolute ether, in benzene, acetic ester and in  $\text{SCl}_2$  (Ruff, B 1904, 37 4517)

**Tin (stannic) chloride sulphide**,  $2\text{SnCl}_4$ ,  $\text{SnS}_2$

See Stannic sulphochloride

**Tin (stannic) chlorobromide**,  $\text{SnClBr}_2$

Decomp by  $\text{H}_2\text{O}$  (Ladenburg, A suppl 8 60)

$\text{SnCl}_2\text{Br}_2$  Decomp by  $\text{H}_2\text{O}$  (Ladenburg)

**Tin (stannous) chloriodide**,  $\text{SnClI}$

Decomp immediately by  $\text{H}_2\text{O}$  (Henry, Phil Trans 1845 363)

**Tin (stannic) chloriodide**,  $\text{SrCl}_2\text{I}_2$

Fumes in the air

Decomp by  $\text{H}_2\text{O}$  (Lenormand, J Pharm 1898 8)

$\text{SnClI}_2$  (Lenormand, J Pharm 1899, 10 114)

**Tin (stannous) fluoride**,  $\text{SnF}_2$

Easily sol in  $\text{H}_2\text{O}$  (Berzelius, Pogg 1 34)

**Tin (stannic) fluoride**,  $\text{SnF}_4$

Very hygroscopic

Sol in  $\text{H}_2\text{O}$ . Slowly decomp in aq solution with separation of  $\text{SnO}_2$  (Ruff, B 1904, 37 681)

**Tin (stannic) fluoride with MF**

See Fluostannate, M

**Tin (stannous) hydroxide**,  $2\text{SnO}$ ,  $\text{H}_2\text{O}$

Decomp to  $\text{SnO}$  when boiled with  $\text{H}_2\text{O}$ . More easily sol in acids than  $\text{Sn}$  or  $\text{SnO}$ . Sol in  $\text{NaOH}$ , and  $\text{KOH} + \text{Aq}$ , even when dil. Insol or very sl sol in  $\text{NH}_4\text{OH}$ ,  $(\text{NH}_4)_2\text{CO}_3$ , and  $\text{K}_2\text{CO}_3 + \text{Aq}$ , sol in cold  $\text{CaO}_2\text{H}_2$ , and  $\text{BaO}_2\text{H}_2$  with decomposition on boiling (Freymy, A ch (3) 12 460). Only sl sol in  $\text{NH}_4\text{Cl} + \text{Aq}$  hot or cold (Brett). Sl sol in  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Mercer)

## Solubility in NaOH+Aq

G Na in 20 ccm	G Sn in 20 ccm.
0 2480	0 1904
0 3680	0 2614
0 6394	0 4304
0 8326	0 5560
0 9661	0 7849
2 1234	1 8934

(Rubenbauer, Z anorg 1902, 30 335)

Not pptd in presence of Na citrate (puller)

Sol in water-glass +Aq (Ordway)

$\text{SnO}_2 \cdot \text{H}_2\text{O}$  Solubility in 1 l  $\text{H}_2\text{O}$  = 000135 g mol at 25° (Goldschmidt, Z lys Ch 1906, 56 389)

**n hydroxide**,  $\text{SnO}$ ,  $6\text{SnO}_2 + 5\text{H}_2\text{O}$ +  $9\text{H}_2\text{O}$  (Schiff, A 120 153)**n sesquihydroxide**,  $\text{Sn}_2\text{O}_3$ ,  $x\text{H}_2\text{O}$ Insol in  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH}$ +Aq (uchs, J pr 5 318)**n (stannic) hydroxide**“ $\alpha$ ” modification

Obtained by pptn by alkali in stannic loricide solution

Freshly pptd substance when air dried contains 73.5%  $\text{H}_2\text{O}$ , when dried over  $\text{H}_2\text{SO}_4$  in a vacuum for 1 month 12.6%  $\text{H}_2\text{O}$  heated to glowing loses all  $\text{H}_2\text{O}$  and passes to the anhydride. The “ $\alpha$ ” form is capable of existing in all degrees of hydration (Lorenz, anorg 1895, 9 372-375)

“ $\alpha$ ” stannic hydrate is a white amorphous substance which is very sol in  $\text{HNO}_3$  even moist, sol in  $\text{H}_2\text{SO}_4$  even dil, sol in  $\text{Cl}$  and not pptd by an excess. Very sol in  $\text{NaOH}$ +Aq and is not pptd by an excess

A solution of  $\alpha$  stannic acid in  $\text{HCl}$  is identical with a solution of freshly prepared aqueous stannic chloride and gives no ppt with dil  $\text{Cl}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$  or arsenic acid even on long standing

“ $\beta$ ” modification

Obtained by oxidizing and dissolving Sn in  $\text{NO}_3$ , and from solution of sodium stannate by pptn. Freshly pptd from  $\text{HNO}_3$  when air dried contains 21.3%  $\text{H}_2\text{O}$ , and when dried over  $\text{H}_2\text{SO}_4$  or in a vacuum 11.3%,—corresponding to  $\text{Sn}(\text{OH})_4$  and  $\text{SnO}(\text{OH})_2$  respectively

Freshly pptd from sodium stannate solution and air dried contains 22.5%  $\text{H}_2\text{O}$  and when dried over  $\text{H}_2\text{SO}_4$  or in a vacuum contains 12.1%,—corresponding to  $\text{Sn}(\text{OH})_4$  and  $\text{SnO}(\text{OH})_2$ . Passes into the anhydride when heated to glowing

The “ $\beta$ ” form is capable of existing in all degrees of hydration. It is a white amorphous substance which is insol in  $\text{HNO}_3$ , in-

sol in  $\text{H}_2\text{SO}_4$  even when conc, insol in  $\text{HCl}$  but changed by contact with the acid in that when the acid has been removed the ppt is readily sol in  $\text{H}_2\text{O}$ , though pptd again from solution by addition of  $\text{HCl}$ . When freshly prepared the “ $\beta$ ” form is sol in  $\text{NaOH}$ +Aq but is pptd by an excess of  $\text{NaOH}$

A solution of “ $\beta$ ” stannic acid in  $\text{HCl}$  behaves quite differently from an aq solution of stannic chloride in that it ppts metastannic sulphate when treated with  $\text{H}_2\text{SO}_4$ .

This ppt dissolves when heated with dilute  $\text{HNO}_3$  or  $\text{HCl}$ , but the solution on standing spontaneously forms another ppt. A solution of “ $\beta$ ” stannic acid in  $\text{HCl}$  gives a ppt when treated with arsenic acid (Lorenz, Z anorg 1895, 9 372)

See also Stannic acid

**Tin hydroxyl chloride**,  $\text{SnO}(\text{OH})\text{Cl}$ 

See Chlorostannic acid

**Tin (stannous) iodide**,  $\text{SnI}_2$ , and +  $2\text{H}_2\text{O}$ Sl sol in cold, more abundantly in hot  $\text{H}_2\text{O}$ , without decompSolubility in  $\text{H}_2\text{O}$ 

t°	Pts $\text{SnI}_2$ in 100 pts solution	t°	Pts $\text{SnI}_2$ in 100 pts solution
98.5	3.43	97.3	3.70
84.9	3.05	87.4	3.24
73.9	2.56	77.6	2.75
60.1	2.09	67.5	2.34
51.5	1.79	59.7	2.03
41.0	1.50	49.5	1.72
30.5	1.21	39.4	1.38
20.8	1.03	29.6	1.11
		19.8	0.96

(Young, J Am Chem Soc 1897, 19 846)

Solubility of  $\text{SnI}_2$  in  $\text{HI}$ +Aq at t°Pts  $\text{SnI}_2$  per 100 pts solvent

t°	53% HI	96% HI	15% HI	20% HI	44% HI	80% HI	40% HI	36% HI
20	0.98	0.20	0.60	1.81	4.20	10.86	25.31	
30	1.16	0.23	0.64	1.81	4.06	10.28	23.46	
40	1.40	0.33	0.71	1.90	4.12	10.06	23.15	
50	1.69	0.46	0.82	2.12	4.34	10.35	23.76	
60	2.07	0.66	1.11	2.51	4.78	11.03	24.64	
70	2.48	0.91	1.37	2.92	5.43	11.97	25.72	
80	2.95	1.23	1.83	3.70	6.38	13.30	27.23	
90	3.46	1.65	2.40	4.87	7.82	15.52	29.84	
100	4.03	2.23	3.63	5.82	9.60		34.05	

(Young, J Am Chem Soc 1897, 19 851)



Solubility of  $\text{SnI}_2$  at low temp in 29 95%  
 $\text{HI} + \text{Aq}$ 

Temp	Pts in 100 pts solution	Pts in 100 pts solvent
1 5	12 96	14 89
1 5	13 15	15 14
6 0	12 35	14 09
10 5	11 01	12 36
15 2	10 48	11 70
24 8	9 36	10 33
30 7	8 78	9 62
34 8	8 70	9 50
40 3	9 51	10 50

(Young, J Am Chem Soc 1897, **19** 854 )Solubility of  $\text{SnI}_2$  at low temp in 39 6%  
 $\text{HI} + \text{Aq}$ 

Temp	Pts in 100 pts of solution		Pts in 100 pts of solvent
	I	II	
0°	13 52	13 56	15 66
5 7°	16 44	16 37	19 71
10 5°	19 47	19 60	24 27
15 7°	23 56	23 68	30 92
20 3°	25 50	25 60	34 30

(Young, J Am Chem Soc 1897, **19** 852-853 )

Sol in  $\text{SnCl}_2 + \text{Aq}$  Sol in warm alkali chlorides or iodides + Aq, also in dil  $\text{HCl} + \text{Aq}$  Very sl sol in  $\text{CHCl}_3$ ,  $\text{CS}_2$ , or  $\text{C}_6\text{H}_6$  (Personne, C R **54** 216)

Sol in  $\text{KOH} + \text{Aq}$  (Rose)Sol in acetone (Naumann, B 1904, **37** 4328 )**Tin (stannic) iodide,  $\text{SnI}_4$** Decomp by  $\text{H}_2\text{O}$  into  $\text{SnO}_2$  and  $\text{HI}$   
Very sol in  $\text{PCl}_3$  (Beckmann, Z anorg 1906, **51** 110)Sol in  $\text{POCl}_3$  (Walden, Z anorg 1900, **25** 212)Easily sol in  $\text{PCl}_5$  and  $\text{PBr}_3$  (Walden, Z anorg 1900, **25** 211)Sol in liquid  $\text{AsBr}_3$  forming a solution with sp gr = 3.731 at 15° (Retgers, Z phys Ch 1893, **11** 342)Sol in  $\text{SOCl}_2$ ,  $\text{S}_2\text{Cl}_2$  and  $\text{SO}_2\text{Cl}_2$  (Walden, Z anorg 1900, **25** 215)Sol in  $\text{SnCl}_4$  (Walden)Sol in anhydrous alcohol, ether, and benzene 1 pt  $\text{CS}_2$  dissolves 1.45 pts  $\text{SnI}_4$  at ordinary temp (Schneider, Pogg **127** 624)100 pts methylene iodide,  $\text{CH}_2\text{I}_2$ , dissolve 22.9 pts  $\text{SnI}_4$  at 10° Sp gr of solution = 3.481 (Retgers, Z anorg **3** 343)

## Solubility in organic solvents at t°

Solvent	t°	G $\text{SnI}_4$ in 100 g of the sat solution	Sp gr of the sat solution
$\text{CCl}_4$	22 4	5 25	1 59
$\text{CCl}_4$	50 0	12 50	1 63
$\text{CHCl}_3$	28 0	8 21	1 50
$\text{C}_6\text{H}_6$	20 2	12 65	0 95

(McDermott, J Am Chem Soc 1911, **33** 1964 )Sol in methyl acetate (Naumann, B 1909, **42** 3790 )Sol in acetone (Eidman, C C **1899**, **II** 1014)Solubility in  $\text{CS}_2$   
100 g of the sat solution contain at  
-58° -84° -89° -94° -114 5°  
16 27 10 22 9 68 10 65 9 41 g  $\text{SnI}_4$   
(Arcetowski, Z anorg 1896, **11** 274)Sol in allyl mustard oil (Mathews, J phys Ch 1905, **9** 647)**Tin (stannous) hydrogen iodide,  $\text{SnI}_2$ ,  $\text{HI}$** Not obtained in pure state (Young, J Am Chem Soc 1897, **19** 856)**Tin (stannous) iodide ammonia,  $\text{SnI}_2$ ,  $2\text{NH}_3$**   
(Ephraim and Schmidt, B 1909, **42** 3857)  
 $\text{SnI}_4$ ,  $8\text{NH}_3$  (Ephraim and Schmidt)**Tin (stannic) iodide ammonia,  $\text{SnI}_4$ ,  $3\text{NH}_3$** (Personne, C R **54** 218) $\text{SnI}_4$ ,  $4\text{NH}_3$  (Personne) $\text{SnI}_4$ ,  $8\text{NH}_3$  (Rammelsberg, Pogg **48** 169)**Tin iodosulphide,**

See Tin sulphuride

**Tin monoxide (Stannous oxide),  $\text{SnO}$** Insol in  $\text{H}_2\text{O}$  Sol in acids Very sl sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rose) Insol in  $\text{NaOH}$  or  $\text{KOH} + \text{Aq}$ Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, **20** 830)Insol in acetone (Naumann, B 1904, **37** 4329)**Tin dioxide (Stannic oxide),  $\text{SnO}_2$** Insol in  $\text{H}_2\text{O}$  or conc acids except conc  $\text{H}_2\text{SO}_4$  Insol in conc alkalis or  $\text{NH}_4\text{OH} + \text{Aq}$ Not absolutely insol in dil  $\text{HNO}_3 + \text{Aq}$  (Mulder)Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, **20** 830)Min *Cassiterite* (Tin stone) Not attacked by acids

**Tin sesquioxide,  $\text{Sn}_2\text{O}_3$** 

While moist, easily sol in  $\text{NH}_4\text{OH} + \text{Aq}$   
sl sol in dil, more easily in conc  $\text{HCl} + \text{Aq}$   
(Berzelius)

**Tin (stannic) oxybromide,  $\text{Sn}_2\text{Br}_2\text{O} + 12\text{H}_2\text{O}$** 

Decomp by  $\text{H}_2\text{O}$  into  $\text{SnBr}_2$  and  $\text{H}_2\text{SnO}_3$ ,  
 $\text{Sn}_2\text{Br}_2\text{O}_3$ . As above (Preis and Rav-  
nann, C C 1882 773)

**Tin (stannic) oxybromide nitrogen pent-oxide,  $\text{SnO}_2, 3\text{Br}_2, \text{N}_2\text{O}_5$** 

Decomp by  $\text{H}_2\text{O}$  (Thomas, C R 1896,  
22 33)

**Tin (stannous) oxychloride,  $\text{SnO}, \text{SnCl}_2 + 3\text{H}_2\text{O}$** 

Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , and  
dil  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  (J Davy, Schw  
10 325)

$\text{Sn}_2\text{Cl}_4\text{O}_8 + 10\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  or  
alcohol

Can be recrystallized from alcohol but  
not from  $\text{H}_2\text{O}$  (Tschermak, W A B 44  
736)

$3\text{SnO}_2, 2\text{SnCl}_2 + 6\text{H}_2\text{O}$  Very sl sol in  
 $\text{H}_2\text{O}$  Sol in dil acids (Ditte, A ch 1882,  
5) 27 146)

$4\text{SnO}, \text{SnCl}_2 + 6\text{H}_2\text{O}$  (Ditte)

**Tin (stannic) oxychloride,  $\text{SnO}_2, \text{SnCl}_4$** 

Sol in  $\text{H}_2\text{O}$  (Scheurer-Kestner, A ch  
3) 47 6)

**Tin (metastannic) oxychloride,  $3\text{SnO}_2, \text{SnCl}_4 + 3\text{H}_2\text{O}$** 

Sol in little, decomp by much  $\text{H}_2\text{O}$   
Weber, Pogg 122 368)

$4\text{SnO}, \text{SnCl}_4 + 7\text{H}_2\text{O}$  (Weber)

"Metastannyl chloride  $\beta$ ,"  $\text{Sn}_5\text{O}_5\text{Cl}_2$  De-  
iquescent Sol without decomp in a small  
amount of  $\text{H}_2\text{O}$  or in a large amount of  $\text{H}_2\text{O}$   
containing a few drops  $\text{HCl}$

Sol in abs alcohol (Engel, C R 1897,  
24 767)

$+4\text{H}_2\text{O}$  and  $+9\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  acidified  
with one drop of  $\text{HCl}$  Pptd by excess  $\text{HCl}$   
Engel, C R 1897, 124 768)

"Parastannyl chloride,"  $\text{Sn}_5\text{O}_5\text{Cl}_2 + 2\text{H}_2\text{O}$   
Decomp by excess  $\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , pptd by  $\text{HCl}$  (Engel, C R  
1897, 125 465)

**Tin (stannic) oxychloride nitrogen pent-oxide,  $\text{SnOCl}_2, 3\text{SnCl}_4, \text{N}_2\text{O}_5$** 

Hydroscopic, sol in  $\text{H}_2\text{O}$

Decomp by heat (Thomas, C R 1896,  
122 32)

**Tin (stannous) oxyiodide,  $\text{SnO}, 3\text{SnI}_2, 2\text{SnO}, 3\text{SnI}_2, \text{SnO}, \text{SnI}_2$ , and  $2\text{SnO}, \text{SnI}_2$** 

Decomp by much  $\text{H}_2\text{O}$  (Personne, C R  
4 216)

**Tin oxysulphide,  $\text{Sn}_2\text{S}_3\text{O} + 11\text{H}_2\text{O}$** 

Very sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , slowly sol  
in  $\text{H}_2\text{O}$  (Schmidt, B 1894, 27 2739)

**Tin phosphide,  $\text{Sn}_3\text{P}$** 

(Ragg, C C 1898, II 170)

$\text{SnP}$  Sol in  $\text{HCl} + \text{Aq}$  Insol in  $\text{HNO}_3$   
 $+ \text{Aq}$

$\text{SnP}_2$  Not attacked by  $\text{HCl}$  Easily at-  
tacked by aqua regia (Emmerling, B 1879,  
12 155)

$\text{SnP}_3$  Insol in  $\text{HCl}$  Slowly attacked by  
dil  $\text{HNO}_3$  at  $50^\circ$  Oxidized by fuming  $\text{HNO}_3$   
with ignition (Jolibois, C R 1909, 148  
638)

$\text{Sn}_3\text{P}_2$  Insol in mercury

Decomp by  $\text{HCl}$  (Stead, J Soc Chem  
Ind 1897, 16 206)

$\text{Sn}_4\text{P}_3$  Attacked by  $\text{HCl}$ ,  $\text{HNO}_3$  and al-  
kalies (Jolibois, C R 1909, 148 637)

The only true compounds are  $\text{Sn}_4\text{P}_3$  and  
 $\text{SnP}_3$  (Jolibois, C R 1909, 148 637)

**Tin phosphochloride,  $\text{Sn}_3\text{P}_2\text{Cl}_4$** 

(Mahn, Jena Zeit 5 1660)

**Tin (stannous) selenide,  $\text{SnSe}$** 

Decomp by boiling  $\text{HCl} + \text{Aq}$  Slowly  
oxidised by boiling  $\text{HNO}_3 + \text{Aq}$ , and easily  
dissolved in aqua regia (Schneider, Pogg  
127 624) Easily sol in alkalies  $+ \text{Aq}$   
(Uelsmann, A 116 122), or scarcely even on  
boiling (Schneider), according to method  
of preparation Sol in alkali sulphides or  
selenides  $+ \text{Aq}$

**Tin (stannic) selenide,  $\text{SnSe}_2$** 

Not attacked by  $\text{H}_2\text{O}$  or dil acids, scarcely  
attacked by boiling conc  $\text{HCl} + \text{Aq}$ , gradu-  
ally decomp by hot  $\text{HNO}_3 + \text{Aq}$ , easily dis-  
solved by warm aqua regia, and hot conc  
 $\text{H}_2\text{SO}_4$

Sol in cold, more easily in warm  $\text{KOH}$ ,  
 $\text{NaOH}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  (Uelsmann, A  
116 122)

**Tin (stannous) sulphide,  $\text{SnS}$** 

1 l  $\text{H}_2\text{O}$  dissolves  $0.14 \times 10^{-6}$  mols  $\text{SnS}$   
at  $18^\circ$  (Weigel, Z phys Ch 1907, 53 294)

Insol in dil, sol in conc  $\text{HCl} + \text{Aq}$  Sl  
sol in hot conc  $\text{HNO}_3 + \text{Aq}$  Insol in  $\text{KOH}$   
 $+ \text{Aq}$

$+ \text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{S} + \text{Aq}$ , or dil  
acids, sol with decomp in conc acids,  
easily sol in hot conc  $\text{HCl} + \text{Aq}$  Insol  
in  $\text{H}_2\text{SO}_3 + \text{Aq}$  Insol in  $\text{NH}_4\text{OH} + \text{Aq}$   
Insol in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  Scarcely  
sol in  $(\text{NH}_4)_2\text{S} + \text{Aq}$ , but easily sol in the  
same on addition of S (Rose)

10%  $\text{NaOH} + \text{Aq}$  dissolves  $\text{SnS}$  by violent  
boiling

Insol in cold, sl sol in hot  $\text{Na}_2\text{SO}_3 + \text{Aq}$   
(Materne, C C 1906, II 557)

Sol in alkali polysulphides  $+ \text{Aq}$

Insol in acetone (Eidmann, C C 1899,

II 1014), (Naumann, B 1904, **37** 4329), ethyl acetate (Naumann, B 1910, **43** 314)

### Tin (stannic) sulphide, $\text{SnS}_2$

*Anhydrous (Moscow gold)* Insol in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ , but decomp by aqua regia. Sol in hot  $\text{KOH} + \text{Aq}$  or  $\text{K}_2\text{CO}_3 + \text{Aq}$ , also in hot  $\text{K}_2\text{S}$ ,  $\text{Na}_2\text{S} + \text{Aq}$ , and  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . 1 l  $\text{H}_2\text{O}$  dissolves  $1.13 \times 10^{-6}$  mols  $\text{SnS}_2$  at  $18^\circ$  (Weigel, Z phys Ch 1907, **58** 294) +  $x\text{H}_2\text{O}$ . Sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$ , but readily in  $\text{KOH}$ ,  $\text{K}_2\text{S}$ , or  $\text{Na}_2\text{S} + \text{Aq}$ , also in hot conc  $\text{HCl} + \text{Aq}$ . Decomp by hot  $\text{HNO}_3 + \text{Aq}$ . Insol in  $\text{KHSO}_3 + \text{Aq}$ . Sol in  $\text{K}_2\text{CO}_3 + \text{Aq}$ . Insol in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett)

Pptd  $\text{SnS}_2$  is insol in cold, sol in hot  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$ . Sol in  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . Very sol in  $\text{NaOH} + \text{Aq}$  (Materne, C C 1906, II 557)

Sol in boiling conc  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  (Clarke, C N **21** 124)

Insol in methyl acetate (Naumann, B 1909, **42** 3790), ethyl acetate (Naumann, B 1910, **43** 314), acetone (Naumann, B 1904, **37** 4329, Eidmann, C C 1899, II 1014)

### Tin sesquisulphide, $\text{Sn}_2\text{S}_3$

Sol in moderately conc  $\text{HCl}$  (Antony and Niccoli, Gazz ch it 1892, **22** (2) 408)

### Iphochloride, $\text{SnS}_2 \cdot 2\text{SnCl}_4$

J dissolves out  $\text{SnCl}_4$  (Dumas, Schw **409**)

$\text{Sn}_2\text{S}_3 \cdot 12\text{SnCl}_4 = \text{SnCl}_4 \cdot 2\text{SnCl}_4$ . Sol in  $\text{H}_2\text{O}$  with separation of S

Gradually sol in dil  $\text{HNO}_3 + \text{Aq}$

Sol in  $\text{POCl}_3$  (Casselmann, A **83** 267)

### Tin sulphoiodide, $\text{SnS}_2\text{I}_4$

Decomp by  $\text{H}_2\text{O}$  into  $\text{SnO}_2$ , S, and HI, by cold conc  $\text{HCl} + \text{Aq}$  with separation of S, also by aqua regia, and  $\text{HNO}_3 + \text{Aq}$

Cold  $\text{KOH} + \text{Aq}$  separates S and  $\text{SnO}_2$

Completely sol in hot  $\text{KOH} + \text{Aq}$

Sol in cold, more easily in hot  $\text{CS}_2$  or  $\text{CHCl}_3$

Decomp by alcohol (Schneider, Pogg **111** 249)

### Tin sulphophosphide, $\text{Sn}_3\text{P}_2\text{S}_3$

Insol in  $\text{HCl}$ ,  $\text{HNO}_3$ , and aqua regia

Sol in aq alkali hydroxides, containing  $\text{Cl}_2$  or  $\text{Br}_2$  in solution (Granger, C R 1896, **122** 322)

### Tin (stannous) telluride, $\text{SnTe}$

Not attacked by conc  $\text{HCl} + \text{Aq}$  (Ditte, C R **97** 42)

### Titanic acid, $\text{TiO}_2 \cdot x\text{H}_2\text{O}$

*$\alpha$ -Titanic acid*—Insol in  $\text{H}_2\text{O}$  or alcohol. When dried in the cold, is completely sol in

acids, especially  $\text{HCl}$ , or dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but when the solution in acids is boiled, it is converted into  $\beta$ -titanic acid. Very sl sol even when moist in  $\text{H}_2\text{SO}_3 + \text{Aq}$  (Berthier). Sl sol in alkali carbonates +  $\text{Aq}$ . A complete solution in an alkali carbonate +  $\text{Aq}$  can only be obtained by adding a Ti salt drop by drop to the alkaline solution, and allowing the ppt to dissolve entirely before adding more Ti salt. On boiling the solution in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (or in  $\text{K}_2\text{CO}_3$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$  with  $\text{NH}_4\text{Cl}$ ) the titanic acid is pptd

Relatively easily sol in mineral acids, decreasing in the following order  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ . Insol in perchloric acid (Landecker, Z anorg 1909, **64** 67)

Sol in dil  $\text{H}_2\text{SO}_4$ . 40 g  $\text{H}_2\text{O} + 70$  g  $\text{H}_2\text{SO}_4$  (sp gr 1.145) dissolves 0.33 g  $\text{TiO}_2$  in 15 min (Hall and Smith, Proc Am Phil Soc 1905, **44** 193)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, **20** 830)

*$\beta$ -Titanic acid, Metatitanic acid*—Insol in  $\text{H}_2\text{O}$ , acids except  $\text{HF}$ , or alkali hydrates or carbonates +  $\text{Aq}$ . When digested with conc  $\text{H}_2\text{SO}_4$  until acid is evaporated, the residue is sol in  $\text{H}_2\text{O}$  (Berzelius)

*$\gamma$ -Titanic acid*—Sol in pure  $\text{H}_2\text{O}$ , but  $\beta$ -acid is pptd by boiling (Knop, A **123** 351)

Colloidal  $\text{TiO}_2 \cdot x\text{H}_2\text{O} + \text{Aq}$  has been prepared by Graham (Chem Soc **17** 325)

### Barium titanate, $2\text{BaO} \cdot 3\text{TiO}_2$

(Bourgeois, C R **103** 141)

### Barium pertitanate peroxide

See Pertitanate, barium peroxide

### Calcium titanate, $\text{CaTiO}_3$

(Ebelmen, C R **32** 711)

Min *Perofskite*. Scarcely attacked by  $\text{HCl} + \text{Aq}$  or other acids, except hot  $\text{H}_2\text{SO}_4$ , which decomposes it

$\text{CaO} \cdot 2\text{TiO}_2$ . Min *Titanomorphite*. Partially decomp by  $\text{HCl} + \text{Aq}$ , completely by  $\text{H}_2\text{SO}_4$

### Cobaltous titanate, $\text{CoTiO}_3$

(Bourgeois, C C **1893**, I 226)

### Ferrous orthotitanate, $\text{Fe}_2\text{TiO}_4$

(Hautefeuille, C R **59** 733)

### Ferroferric titanate, $\text{FeTiO}_3 \cdot x\text{Fe}_2\text{O}_3$

Min *Menaccanite*. Very sl sol in  $\text{HCl}$  or aqua regia with separation of  $\text{TiO}_2$

### Ferric titanate

Not attacked by boiling  $\text{H}_2\text{SO}_4$ , or conc  $\text{HCl} + \text{Aq}$  (Wohler and Liebig, Pogg **21** 578)

**Magnesium titanate,  $MgTiO_3$** 

Insol in  $H_2O$  and acids (Hautefeuille, A h (4) 4 169)

Min *Gelehrte*

When finely powdered, is easily sol in hot  $HCl$ , or in cold  $HF$  in a few hours (Dick, Miner, Mag 1894, 10 146)

$Mg_2TiO_4$ . Slowly decomp by boiling with  $HNO_3 + Aq$  (Hautefeuille, A ch (4) 1 169)

**Potassium titanate,  $K_2TiO_3$** 

*Anhydrous* Decomp with  $H_2O$   
 $+4H_2O$  Deliquescent Very sol in  $H_2O$   
 Precipitated from aqueous solution by alcohol  
 Demolv, Compt chim 1849 325)

**Potassium titanate, acid,  $K_2O, 3TiO_2 + 2H_2O$** 

Insol in  $H_2O$  (Demolv)  
 $K_2O, 6TiO_2 + 2H_2O$  (Demolv)  
 $K_2O, 3TiO_2 + 3H_2O$  Insol in  $H_2O$  Completely sol in  $HCl + Aq$  if only cold  $H_2O$  is used for washing When heated to  $100^\circ$ , no longer completely sol in  $HCl + Aq$  (Rose, Pogg 74 563)  
 $K_2O, 12TiO_2$  (Rose, Gilb Ann 73 78)

**Sodium titanate,  $Na_2TiO_3$** 

*Anhydrous* Decomp by  $H_2O$  into  $NaOH$ , and an acid titanate, insol in  $H_2O$   
 $+4H_2O$  Deliquescent Very sol in  $H_2O$   
 Precipitated from aqueous solution by alcohol (Demolv)

**Sodium titanate, acid,  $2Na_2O, 9TiO_2 + 5H_2O$** 

If not heated to  $100^\circ$ , is sol in cold  $HCl + Aq$  (Rose, Gilb Ann 73 78)  
 $2Na_2O, 3TiO_2$  Insol in  $H_2O$ , slowly sol in cold, easily in hot  $HCl + Aq$  (Cormmucœuf, C R 115 823)  
 $Na_2O, 2TiO_2$  As above (C)  
 $Na_2O, 3TiO_2$  Insol in  $H_2O$ , and nearly so in boiling  $HCl + Aq$  (C)

**Strontium titanate,  $2SrO, 3TiO_2$** 

(Bourgeois, C R 103 141)

**Zinc titanate,  $ZnO, TiO_2(?)$** 

(Lévy, A ch (6) 24 456)  
 $2ZnO, 1TiO_2(?)$  (Lévy)  
 $3ZnO, 2TiO_2$  Slowly attacked by warm  $H_2SO_4$  or  $HNO_3 + Aq$ , and by  $H_2SO_4 + HF$  Wholly sol in cold  $HCl + Aq$  (Lévy)  
 $4ZnO, 5TiO_2$  Not attacked by cold conc acids, but sol by boiling except in  $HCl + Aq$  (Lévy)  
 $ZnO, 3TiO_2$  Insol in  $H_2O$ , alcohol, or ether Dil  $HNO_3, H_2SO_4$ , or  $HCl + Aq$  do not attack even on boiling, boiling  $H_2SO_4$  dissolves with difficulty, not attacked by conc boiling alkalis  $+ Aq$  (Lévy A ch (6) 25 471)

**Perititanic acid**

See Perititanic acid

**Titanium,  $Ti$** 

Decomp  $H_2O$  even under  $100^\circ$  (Wöhler), not attacked by  $H_2O$  under  $500^\circ$  (Kern, C N 33 57)

Does not decomp  $H_2O$  at  $100^\circ$  (Schneider, Z anorg 1894, 8 85)

Sol in  $HCl + Aq$  if warmed Rapidly sol in  $HF + Aq$  Sol in cold dil  $H_2SO_4 + Aq$ ,  $HNO_3 + Aq$ , or  $HC_2H_3O_2 + Aq$  Dissolves almost instantaneously in  $HF + Aq$  (Merz)

Sol in molten lead and iron, sol in  $HCl$ ,  $HNO_3$  and aqua regia (Moissan, C R 1895, 120 293)

*Amorphous* Loses its spontaneous inflammability when left for a time in contact with  $H_2O$  (Schneider, Z anorg 1895, 8 85)

**Titanium amide,  $Ti(NH_2)_4$** 

Violently attacked by  $H_2O$  (Stähler, B 1905, 38 2629)

**Titanium tribromide,  $TiBr_3 + 6H_2O$** 

Very hygroscopic (Stähler, B 1904, 37 4409)

**Titanium tetrabromide,  $TiBr_4$** 

Deliquescent Decomp by  $H_2O$  (Duppa, C R 42 352)

Sol in absolute alcohol and in dry ether (Rosenheim and Schutte, Z anorg 1900, 24 238)

**Titanium bromonitride,  $TiNBr$** 

Decomp by a small amount of  $H_2O$  On addition of more  $H_2O$ , a part dissolves forming a solution which decomp on warming with separation of titanic acid It behaves similarly toward dil  $HNO_3$ , dil  $HCl$  and dil  $H_2SO_4$  Completely sol in warm dil  $H_2SO_4$  (Ruff, B 1908, 41 2262)

**Titanium carbide,  $TiC$** 

Sol in  $HNO_3 + Aq$  (Shimer, C N 55 71)  
 Insol in  $HCl$  Slowly sol in aqua regia (Moissan, C R 1895, 120 295)

**Titanium carbide nitride,  $Ti_{10}C_2N_8 = Ti(CN)_2, 3Ti_3N_2$** 

Insol in, and not attacked by boiling  $HNO_3$  or  $H_2SO_4$  (Wollaston), but sol in  $HNO_3 + HF$  (Berzelius)

**Titanium dichloride,  $TiCl_2$** 

Very deliquescent Decomposes  $H_2O$  with violence Insol in ether,  $CS_2$ , or  $CHCl_3$  Decomp by 99.5% alcohol

**Titanium trichloride,  $TiCl_3$** 

Deliquescent Sol in  $H_2O$  with evolution of heat

$+4H_2O$  (Glatzel, B 9 1829)

$+6H_2O$  Very sol in  $H_2O$  (Polidori, Z anorg 1898, 19 307)

**Titanium tetrachloride,  $TiCl_4$** 

Anhydrous Sol in  $H_2O$  with evolution of much heat  
 $+5H_2O$  Deliquescent

**Titanium sulphuryl chloride,  $TiCl_4SO_3 = TiCl_3OSO_2Cl$** 

Deliquesces gradually in moist air (Clausnitzer, B 11 2011)

**Titanium chloride ammonia,  $TiCl_4 \cdot 4NH_3$** 

Deliquescent Solution in  $H_2O$  is not quite clear (Rose)

According to Persoz (A ch 46 315), is  $TiCl_4 \cdot 6NH_3$

$TiCl_4 \cdot 6NH_3$  and  $TiCl_4 \cdot 4NH_3$   
 Both compounds are unstable in moist air, insol in ether (Rosenheim, Z anorg 1901, 26 245)

$TiCl_4 \cdot 8NH_3$  Violently decomp by  $H_2O$  (Stahler, B 1905, 38 2627)

**Titanium tetrachloride cyanobromide,  $TiCl_3 \cdot NCClBr$** 

(Schneider, Z anorg 1894, 8 92)

**Titanium chloride cyanhydric acid,  $TiCl_4 \cdot 2HCN$** 

Deliquescent Sol in  $H_2O$  with evolution of heat (Wohler, A 73 228)

**Titanium trichloride nitrogen sulphide,  $2TiCl_3 \cdot N_4S_4$** 

Decomp rapidly in air (Davis, Chem Soc 1906, 89 (2) 1576)

**Titanium tetrachloride nitrogen sulphide,  $TiCl_4 \cdot N_4S_4$** 

Hydroscopic

Decomp by  $H_2O$ ,  $HNO_3$ ,  $HCl$ ,  $KOH$  and alcohol (Wolbling, Z anorg 1908, 57 282)

**Titanium chloride phosphine**

Decomp by  $H_2O$ ,  $HCl + Aq$ ,  $KOH + Aq$ ,  $K_2CO_3 + Aq$ , or  $(NH_4)_2CO_3 + Aq$  (Rose)

**Titanium tetrachloride phosphoryl chloride,  $TiCl_4 \cdot 2POCl_3$** 

(Ruff, B 1903, 36 1783)

**Titanium chloronitride,  $TiNCl$** 

Decomp by small amount cold  $H_2O$  On the addition of more  $H_2O$  it is only partially decomp For complete solution, the addition of dil  $HCl$  or a mixture of warm dil  $H_2SO_4$  and  $HF$  is necessary Easily sol in conc  $HNO_3$  and in conc  $H_2SO_4$  (Ruff, B 1908, 41 2259)

**Titanium difluoride**

(Hautefeuille, C R 57 151)

Probably sesquifluoride

**Titanium sesquifluoride,  $Ti_2F_3$** 

Appears to be two modifications, one sol in  $H_2O$ , and the other insol in  $H_2O$  (Hautefeuille, C R 59 189)

Insol in  $H_2O$  (Weber, Pogg 120 292)

**Titanium tetrafluoride,  $TiF_4$** 

Decomp by  $H_2O$  (Unverdorben)

Sol in  $H_2O$ , but solution decomp upon evaporation (Marignac, Ann Min (5) 15 258)

Sol in  $H_2O$  (Emich, M 1904, 25 910)

Very hydroscopic

Sol in  $H_2O$  Sl sol in conc  $HF + Aq$

Sol in cold  $POCl_3$  without decomp De-comp in warm  $POCl_3$

Sol in alcohol and dry pyridine

Insol in ether,  $CS_2$ ,  $CCl_4$ ,  $SiCl_4$ ,  $SiBr_4$ ,  $SO_2Cl_2$ ,  $SOCl_2$ ,  $SCl_2$ ,  $AsCl_3$ ,  $SO_3$ ,  $CrO_3$ ,  $PCl_3$  (Ruff, B 1903, 36 1780)

$+2H_2O$  Sol in  $H_2O$  (Ruff, B 1903, 36 1780)

**Titanium hydrogen fluoride,  $2HF, TiF_4 = H_2TiF_6$** 

Sol in  $H_2O$  with decomposition and separation of a basic salt Corresponds to fluosilicic acid, and may be considered as fluotitanic acid  $H_2TiF_6$

**Titanium fluoride with MF**

See Fluotitanate, M

**Titanium tetrafluoride ammonia,  $TiF_4 \cdot 2NH_3$** 

Sol in  $H_2O$ , decomp in aq solution on boiling (Ruff, B 1903, 36 1781)

**Titanium monohydroxide,  $TiO_2H_2$** 

Ppt (Wohler, A 73 49)

$Ti_2O_4H$  Not attacked by cold conc acids, sl attacked on warming Insol in cold or hot  $KOH + Aq$  (Winkler, B 1890, 23 2659)

**Titanium sequihydroxide,  $Ti_2O_3 \cdot xH_2O$** 

Decomposes very quickly with  $H_2O$ , forming titanium dihydroxide

$Ti_2O_3H_2$  (Polidori, Z anorg 1899, 19 306)

**Titanium dihydroxide**

See Titanic acid

**Titanium hydroxychloride,  $TiCl_3(OH)$** 

Deliquescent Easily sol in  $H_2O$  and alcohol Sol in ether

$TiCl_2(OH)_2 + 1\frac{1}{2}H_2O$  Deliquescent Sol in  $H_2O$ , alcohol, and ether Aqueous solution decomp by boiling

$TiCl(OH)_3 + H_2O$  Nearly insol in  $H_2O$  Insol in alcohol and ether (König and v der Pfordten, B 21 1708)

See also Titanium oxychloride

**Titanium diiodide,  $TiI_2$** 

Very hydroscopic, insol in organic solvents, sol in conc  $HF$  and boiling  $HCl$ , decomp by

$\text{H}_2\text{O}$ , alkalis,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  (Defacqz, C R 1908, 147 66)

**Titanium triiodide,  $\text{TiI}_3 + 6\text{H}_2\text{O}$**

Very hygroscopic (Stahler, B 1904, 37 4410)

**Titanium tetraiodide,  $\text{TiI}_4$**

Fumes on air, and dissolves rapidly in  $\text{H}_2\text{O}$  with evolution of heat. Solution decomposes on standing (Weber)

**Titanium nitride,  $\text{Ti}_3\text{N}_4$**

Difficultly sol in warm  $\text{HNO}_3 + \text{Aq}$ . More easily sol in aqua regia (Rose)

Insol in dil acids. Decomp by hot conc  $\text{H}_2\text{SO}_4$  and by conc  $\text{HNO}_3$ , especially when  $\text{HF}$  is added, and by boiling  $\text{KOH} + \text{Aq}$  (Ruff and Eisner, B 1908, 41 2252)

Decomp by  $\text{H}_2\text{O}$  and dil acids

Insol in all ordinary indifferent organic solvents (Ruff, B 1912, 45 1369)

$\text{TiN}_2$  Insol in  $\text{H}_2\text{O}$  (Wohler)

Is  $\text{TiN}$ , according to Guerin (C R 82 972)

**Titanium monoxide,  $\text{TiO}$**

(Moissan, C R 1895, 120 290)

**Titanium sesquioxide,  $\text{Ti}_2\text{O}_3$**

Insol in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . Difficultly sol in  $\text{H}_2\text{SO}_4$  (Ebelmen, A ch (3) 20 392)

When moist, insol in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ , but quickly decomp to  $\text{TiO}_2$ . Sol in oxygen acids, but quickly decomp (Berzelius)

**Titanium dioxide,  $\text{TiO}_2$**

*Amorphous* Insol in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ , even when heated for a long time

Sol in conc  $\text{H}_2\text{SO}_4$  by long digestion.  $\text{TiO}_2$ , strongly ignited at 1000°, is practically insol in conc  $\text{H}_2\text{SO}_4$  and  $\text{HF}$

When less strongly ignited (by heating ortho or metatitanic acid to 700°) it is easily sol therein (Bornemann and Schürmeister, C C 1910, II 1870)

Ignited  $\text{TiO}_2$  is very difficultly sol in  $\text{HCl}$  (Pennington, J Am Chem Soc 1896, 18 56)

The solubility of ignited  $\text{TiO}_2$  in  $\text{H}_2\text{SO}_4$  is helped by  $\text{H}_2\text{O}_2$  (Weiss and Landecker, Z anorg 1909, 64 71)

The solubility in  $\text{H}_2\text{SO}_4$  is increased by addition of  $\text{H}_2\text{O}_2$ .  $\text{H}_2\text{O}_2$  brings  $\text{TiO}_2$  quickly and completely into solution in the presence of  $\text{NH}_4\text{OH}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{NaOH}$ ,  $\text{Na}_2\text{CO}_3$  and  $\text{Na}_2\text{HPO}_4$  (Weiss and Landecker, Z anorg 1909, 64 71)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 830)

*Crystalline* Min Rutile, Brookite, and Anatase. Solubility as above. See also Titanic acid

**Titanium oxide,  $\text{Ti}_2\text{O}_3$**

(Deville, C R 53 163)

True formula is  $\text{Ti}_3\text{O}_5$  (v der Pfordten, A 237 201)

**Titanium peroxide,  $\text{TiO}_2$**

Sol in acids. Solution in  $\text{H}_2\text{SO}_4$  is very stable, but the  $\text{HCl}$  solution decomposes very easily (Weber, B 15 2599, Piccini, B 15 2221, Classen, B 21 370)

**Titanium oxychloride,  $\text{TiO}_2, \text{TiOCl}_2 + 8\text{H}_2\text{O}$**

Sol in much  $\text{H}_2\text{O}$  (Merz, Bull Soc 1867 401)

$\text{Ti}_2\text{O}_2\text{Cl}_2$  Insol in  $\text{H}_2\text{O}$ . Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  with separation of  $\text{TiO}_2$

See also Titanium hydroxychloride

**Titanium oxyfluoride**

Insol in  $\text{H}_2\text{O}$  (Berzelius)

**Titanium oxyfluoride with MF**

See Fluoxypertitanate, M

**Titanium phosphide,  $\text{TiP}$**

Sl sol in boiling aqua regia

Insol in dil or conc acids and alkalis

Sl attacked by fuming  $\text{HNO}_3$  in sealed tube at 250°–300° (Gewecke, A 1908, 361 84)

**Titanium phosphochloride**

See Phosphorus titanium chloride

**Titanium silicide,  $\text{TiSi}_2$**

Sol in  $\text{HF}$ , insol in other min acids

Slowly sol in 10%  $\text{KOH} + \text{Aq}$  (Hönigschmid, C R 1906, 143 226)

**Titanium monosulphide,  $\text{TiS}$**

Insol in alkalis. Difficultly sol in nitric acid and aqua regia

Insol in  $\text{HF}$  (v der Pfordten, A 234 257)

**Titanium disulphide,  $\text{TiS}_2$**

Decomp slowly on moist air. Insol in  $\text{HCl}$  or dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Ebelmen)

Sol in aqua regia or  $\text{HNO}_3 + \text{Aq}$ . Decomp by  $\text{KOH} + \text{Aq}$  or  $\text{NaOH} + \text{Aq}$ . Insol in  $\text{KSH} + \text{Aq}$  (Rose)

Sol in  $\text{HF}$  at 100° (v der Pfordten, A 234 257)

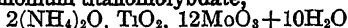
**Titanium sesquisulphide,  $\text{Ti}_2\text{S}_3$**

Insol in caustic alkalis +  $\text{Aq}$ . Sol in  $\text{HF}$  at a high temp. Insol in aqua regia (v der Pfordten, A 234 257)

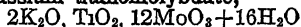
**Titanomolybdic acid,  $\text{TiO}_2, 12\text{MoO}_3 + 22\text{H}_2\text{O}$**

Very sol in  $\text{H}_2\text{O}$

Sol in ether (Pèchard, C R 1893, 117 790)

**Ammonium titanomolybdate,**

Sol in  $\text{H}_2\text{O}$  and acids, completely insol in solutions of ammonium salts (Pécharé)

**Potassium titanomolybdate,**

Efflorescent

Sol in  $\text{H}_2\text{O}$  (Pécharé)

**Titanodecitungstic acid,  $\text{H}_5\text{TiW}_{10}\text{O}_{38} + x\text{H}_2\text{O}$** 

(Lecarme, Bull Soc (2) 36 17)

**Titanotungstic acid or Titanododecitungstic acid,  $\text{H}_5\text{TiW}_{12}\text{O}_{42} + x\text{H}_2\text{O}$** 

(Lecarme, Bull Soc (2) 36 17)

**Titanous acid****Sodium titanate,  $\text{Na}_3\text{TiO}_3 = 3\text{Na}_2\text{O}, \text{Ti}_2\text{O}_3$** 

Sol in dil acids (Koenig and v der Pfordten, B 22 2075)

**Titanyl compounds**

See Titanium oxy-compounds

**Triamine cobaltic compounds**

See Dichrocoaltic compounds

**Trithionic acid,  $\text{H}_2\text{S}_3\text{O}_6$** 

Known only in aqueous solution

Solution in  $\text{H}_2\text{O}$  gradually decomposes in the cold, rapidly at  $80^\circ$ . Not decomp if very dilute or in presence of acids, except  $\text{HNO}_3$ ,  $\text{HClO}_3$ , and  $\text{HIO}_3$  (Fordos and Gélis, A ch (3) 28 451)

**Trithionates**

The trithionates are all sol in  $\text{H}_2\text{O}$ , and very easily decomposed

**Ammonium trithionate,  $(\text{NH}_4)_2\text{S}_3\text{O}_6$** 

Very deliquescent and unstable

Very sol in  $\text{H}_2\text{O}$

Insol in abs alcohol (Divers and Ogawa, Chem Soc 1900, 77 337)

**Barium trithionate,  $\text{BaS}_3\text{O}_6 + 2\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  Precipitated from aqueous solution by large excess of alcohol Aqueous solution is very unstable (Kessler, Pogg 74 250)

**Lead trithionate,  $\text{PbS}_3\text{O}_6$** 

Very sl sol in  $\text{H}_2\text{O}$  Sol in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Fogh, C R 110 524)

**Potassium trithionate,  $\text{K}_2\text{S}_3\text{O}_6$** 

Sol in  $\text{H}_2\text{O}$  Insol in alcohol (Kessler, Pogg 74 270)

Sol in  $\text{H}_2\text{O}$  with decomp

Insol in alcohol (Langlois, A 1841, 40 102)

**Sodium trithionate,  $\text{Na}_2\text{S}_3\text{O}_6$** 

Very sol in  $\text{H}_2\text{O}$

+  $3\text{H}_2\text{O}$  (Villiers, C R 106 1356)

**Thalious trithionate,  $\text{Ti}_2\text{S}_3\text{O}_6$** 

Sol in  $\text{H}_2\text{O}$  (Bevan, C N 38 294)

**Zinc trithionate**

Sol in  $\text{H}_2\text{O}$ , but decomposes upon warming the solution (Fordos and Gélis, C R 16 1070)

**Tungsten, W**

*Metallic* Not attacked by heating with fuming  $\text{HNO}_3$ , aqua regia, or other acids, or by boiling  $\text{KOH} + \text{Aq}$  Sol in  $\text{KOH} + \text{Aq}$  and  $\text{NaClO} + \text{Aq}$  (v Uslar, A 94 255)

Not easily acted upon by moist air, if no  $\text{CO}_2$  present Sol in a mixture of  $\text{HF}$  and  $\text{HNO}_3$  Very slowly sol in  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and  $\text{HF}$  (Moissan, C R 1896, 123 15)

Very slowly attacked by  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and even  $\text{CrO}_3$  A mixture of  $\text{CrO}_3$  and  $\text{H}_2\text{SO}_4$  dissolved 1.67 g in 16 hrs from a fine wire and 1.36 g in 14 hours (Fink, Met Chem Eng 1910, 8 341)

Compact tungsten is not attacked by dil, and only sl dissolved by conc  $\text{H}_2\text{SO}_4$  Not attacked by dil or conc  $\text{HCl}$   $\text{HNO}_3$  and  $\text{HNO}_3 + \text{HCl}$  attack slowly by long heating, forming thin layer of  $\text{WO}_3$  Slowly sol in  $\text{HNO}_3 + \text{HF}$  (Weiss Z anorg 1910, 65 339)

Aluminothermic tungsten is insol in acids and in aqua regia Sol in fused  $\text{KOH}$  (Stavenhagen, B 1899, 32 1515)

Insol in  $\text{HCl}$  of any concentration at room temp and only very sl sol at  $110^\circ$  After being in contact with hot conc  $\text{HCl}$  (sp gr 1.15) for 175 hrs the metal lost 0.5% of its weight Sl sol in dil  $\text{HCl}$  at  $110^\circ$

Insol in conc  $\text{H}_2\text{SO}_4$  at room temp and in dil  $\text{H}_2\text{SO}_4$  at  $110^\circ$  Somewhat sol in conc  $\text{H}_2\text{SO}_4$  at high temp

Insol in conc  $\text{HNO}_3$ , and hot or cold  $\text{HF}$

Sl sol in aqua regia

Very sol in  $\text{HF} + \text{HNO}_3$  (Ruder, J Am Chem Soc 1912, 34 387)

Insol in aqua regia and acids sol in fused  $\text{KOH}$  (Stavenhagen, B 1899, 32 1514)

Insol in  $\text{KOH} + \text{Aq}$

Sol in fused  $\text{KOH}$

Slowly sol in fused  $\text{Na}_2\text{CO}_3$ ,  $\text{K}_2\text{CO}_3$  or mixture of the two

Somewhat sol in  $\text{NaOCl} + \text{Aq}$  (Ruder, J Am Chem Soc 1912, 34 388)

Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 830)

*Crystalline* Insol in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4$  Oxidised by  $\text{HNO}_3$  or aqua regia (D'Elhujar)

Sol in boiling  $\text{KOH} + \text{Aq}$  (Riche, A ch (3) 50 5)

*Amorphous* Easily oxidised by  $\text{HNO}_3 + \text{Aq}$  (Zettnow)

**Tungsten amide**

See Tungsten nitride

**Tungsten arsenide,  $WAs_2$** 

Insol in  $H_2O$  and other solvents Not attacked by boiling  $HF$  or  $HNO_3$  Sol in old  $HF + HNO_3$  and in hot aqua regia Not attacked by hot  $KOH + Aq$  or  $NaOH + Aq$  Decomp by fused  $KOH$  or  $NaOH$  (Defacqz, C R 1901, 132 139)

**Tungsten boride,  $WB_2$** 

Slowly attacked by conc acids, vigorously attacked by aqua regia (Tucker and Moody, Chem Soc 1902, 81 16)

**Tungsten dibromide,  $WBr_2$** 

Partly sol in  $H_2O$ , the rest decomposing to  $WO_2$  and  $HBr$

**Tungsten pentabromide,  $WBr_5$** 

Decomp by moist air or  $H_2O$  Sol in austic alkalis +  $Aq$

Very hygroscopic Fumes in the air

Decomp by  $H_2O$

Sol in  $HF$ , or conc  $HCl$  Sl sol in fuming  $HBr$  Decomp by dil  $HCl$ , conc  $HNO_3$  or dil  $H_2SO_4$  Readily attacked by fused alkalis or alkalis +  $Aq$  Sol in  $CCl_4$ ,  $CHCl_3$ ,  $CHBr_3$ , abs alcohol, ether, essence of tereenthine and benzene (Defacqz, C R 899, 128 1232)

**Tungsten hexabromide,  $WBr_6$** 

Decomp by  $H_2O$  and in the air

Sol in  $NH_4OH + Aq$  (Smith, J Am Chem Soc 1897, 18 1100)

**Tungsten bromochloride,  $WCl_5, WBr_5$** 

Decomp by  $H_2O$  Sol in  $HF$  Decomp by  $HNO_3$  or  $H_2SO_4$  Violently attacked by used alkali or alkali +  $Aq$  Sol in most organic solvents

$WCl_5, 3WBr_5$  Properties like those of  $WCl_6, WBr_6$  (Defacqz, C R 1899, 129 516)

Decomp by  $H_2O$  Sol in 40%  $HF + Aq$  2° B  $HCl + Aq$  gives a sl ppt of  $WO_3$  Decomp by  $HNO_3$  and by  $H_2SO_4$  Sol in abs alcohol, ether,  $CS_2$ ,  $C_6H_6$  and glycerine Sol in  $CCl_4$  only on warming Nearly insol in oil of turpentine (Defacqz)

**Tungsten bronze**

See—

Tungstate tungsten oxide, barium

Tungstate tungsten oxide, barium potassium

Tungstate tungsten oxide, barium sodium

Tungstate tungsten oxide, calcium potassium

Tungstate tungsten oxide, calcium sodium

Tungstate tungsten oxide, lithium

Tungstate tungsten oxide, lithium potassium

Tungstate tungsten oxide, potassium

Tungstate tungsten oxide, potassium sodium

Tungstate tungsten oxide, potassium strontium

Tungstate tungsten oxide, sodium

Tungstate tungsten oxide, sodium strontium

**Tungsten carbide,  $W_2C$** 

Sol in boiling  $HNO_3$ , very slowly acted upon by other acids (Moissan, C R 1896, 123 16)

$WC$  Insol in dil acids, only sl sol in  $H_2SO_4$  and conc  $HNO_3$ , sol in fused  $KClO_3$  and  $KNO_3$  (Williams, C R 198, 126 1724)

**Tungsten dichloride,  $WCl_2$** 

Decomp on the air or with  $H_2O$  (Roscoe)

**Tungsten tetrachloride,  $WCl_4$** 

Deliquescent Partly sol in  $H_2O$ , with subsequent decomposition (Roscoe)

**Tungsten pentachloride,  $WCl_5$** 

Very deliquescent Decomp with  $H_2O$  with hissing and evolution of heat and separation of  $W_2O_5$

Very sl sol in  $CS_2$  (Roscoe)

**Tungsten hexachloride,  $WCl_6$** 

Not decomp by moist air or  $H_2O$  Decomp by alcohol Very sol in  $CS_2$  (Roscoe)

Easily sol in  $PCl_3$  (Teclu, A 187 255)

**Tungsten chloride nitrogen sulphide,  $WCl_4, N_4S_4$** 

(Davis, Chem Soc 1906, 89 (2) 1575)

**Tungsten chloroarsenide,  $W_2AsCl_5$** 

Hygroscopic, decomp by  $H_2O$  and acids, sol in aq solution of alkalis, insol in anhydrous organic solvents (Defacqz, C R 1901, 132 139)

**Tungsten chlorosulphide,  $W_2S_7Cl_8$** 

Decomp by  $H_2O$

Sol in  $S_2Cl_2$  (Smith and Oberholtzer, Z anorg 1894 5 68)

$WCl_5, 3WS_2$  Decomp by  $H_2O$  Insol in  $CS_2$  alcohol and  $C_6H_6$  (Defacqz, A ch 1901, (7) 22 266)

**Tungsten hexafluoride,  $WF_6$** 

Fumes in the air

Decomp by  $H_2O$  Easily sol in aq alkalis (Ruff, B 1905, 38 747)

**Tungsten duodide,  $WI_2$** 

Not decomp by  $H_2O$  (Roscoe, A 162 366)

Insol in  $H_2O$ ,  $CS_2$  and alcohol Decomp by boiling  $H_2O$ ,  $HNO_3$ ,  $H_2SO_4$  and aqua regia, sol in fused  $KOH$ , and alkali carbonates (Defacqz, C R 1898, 126 936)



**Tungsten tetraiodide,  $WI_4$** 

Insol in  $H_2O$ , ether, chloroform and turpentine, sol in abs alcohol, decomp when boiled with  $H_2O$ , sol with decomp in dil HCl and  $H_2SO_4$ , in  $HNO_3$  and aqua regia, and in alkali hydroxides and carbonates fused or in aq solution (Defacqz, C R 1898, **127 511**)

**Tritungsten nitride,  $W_3N_2$** 

(Uhrlaub)

$W_2N_3$  Insol in  $HNO_3$ , dil  $H_2SO_4$  and  $NaOH$ +Aq (Rideal, Chem Soc 1889, **55 44**)

**Tungsten nitride amide,  $W_3N_6H_4=2WN_2, W(NH_2)_2$** 

Not attacked by acids or caustic alkalis + Aq (Wohler, A **73 191**)

**Tungsten nitride amide oxide,  $W_7N_2H_4O_4=3WN_2, W_2(NH_2)_2, 2WO_3$** 

Not attacked by acids or alkalis (Wohler)

**Tungsten monoxide,  $WO$** 

Insol in  $H_2O$ . Not attacked by HCl, HF,  $H_2SO_4$ , or  $KOH$ +Aq.  $HNO_3$ +Aq or aqua regia convert it into  $WO_3$  (Headden, Sil Am J **145 280**)

in the dry way, is at a regia, which oxidises to

when moist, is sol in HCl or  $H_2SO_4$  + Aq in  $KOH$ +Aq. Insol in  $NH_4OH$ +Aq (Riche, A ch (3) **50 5**)

Insol in HCl,  $H_2SO_4$  and conc aq, sol in  $HNO_3$  (Hallopeau, C R **27 135**)

**Tungsten oxide, blue**

$W_2O_5$  (Riche, A ch (3) **50 33**),  $W_3O_8$  (v Uslar),  $W_4O_{11}$  (Gmeln)

All are probably the same substance. Not attacked by boiling  $HNO_3$  or aqua regia. Slowly sol in boiling  $KOH$ +Aq

**Tungsten trioxide,  $WO_3$** 

Insol in  $H_2O$  or acids. Sl sol in dil  $KOH$ +Aq,  $NaOH$ +Aq,  $Na_2CO_3$ +Aq, or  $H_2CO_3$ +Aq, but easily sol in conc boiling solutions of same.  $NH_4OH$ +Aq when boiling has a solvent action

Insol in conc and dil  $H_2SO_4$  (Desi, J Am Chem Soc 1897, **19 214**)

Min Tungstate Insol in acids. Sol in  $NH_4OH$ +Aq

**Tungsten oxide,  $W_2O_5$** 

Sol in alkalis (Desi, J Am Chem Soc 1897, **19 214**)

$W_3O_8$  Insol in acids and alkalis (Desi, J Am Chem Soc 1897, **19 228**)

+ $H_2O$  Like  $W_5O_{14}+H_2O$  (Allen and Gottschalk, Am Ch J 1902, **27 336**)

$W_4O_3$  (Desi, J Am Chem Soc 1897, **19 219**)

$W_5O_9$  (Desi)

$W_5O_{14}+H_2O$  Insol in  $H_2O$  containing a little HCl

Slowly attacked by cold, conc  $MOH$ +Aq (Allen and Gottschalk, Am Ch J 1902, **27 333**)

**Tungsten trioxide ammonia,  $WO_3, 3NH_3$** 

(Rosenheim and Jacobsohn, Z anorg 1906, **50 306**)

**Tungsten oxybromide, etc**

See Tungstyl bromide, etc

**Tungsten monophosphide,  $WP$** 

Not attacked by HF or HCl

Sol in warm  $HNO_3$ +HF. Slowly attacked by hot  $HNO_3$

Not attacked by  $KOH$ +Aq or  $NaOH$ +Aq (Defacqz, C R 1901, **132 34**)

**Tungsten diphosphide,  $WP_2$** 

Insol in  $H_2O$  and in most organic solvents, insol in HCl and HF, sol in a mixture of HF and  $HNO_3$  in the cold, and in aqua regia on warming (Defacqz, C R 1900, **130 916**)

**Tungsten phosphide,  $WP_3$** 

Not attacked by any acid, not even by aqua regia (Wohler and Wright, A **79 244**)

$W_3P_4$  (Wohler and Wright)

**Tungsten diselenide,  $WSe_2$** 

(Uelsmann)

**Tungsten triselenide,  $WSe_3$** 

Easily sol in alkali sulphides or selenides +Aq (Uelsmann, Jahrb f Ch **1860 92**)

**Tungsten silicide**

Sol in HF

Only very sl sol in other acids (Warren, C N 1898, **78 319**)

$WSi_2$  Not attacked by ordinary acids and scarcely by warm aqua regia, but violently attacked by  $HNO_3$ +HF. Sl attacked by 10% alkalis+Aq (Honigschmid, M 1907, **28 1017**)

Not attacked by dil or conc HCl, HF,  $HNO_3$  or  $H_2SO_4$ , nor by hot aqua regia

Attacked by  $HNO_3$ +HF or by fused alkalis (Defacqz, C R 1907, **144 850**)

$WSi_3$  Violently attacked by  $HNO_3$ +HF. Not attacked by  $HNO_3$ ,  $H_2SO_4$ , HCl or HF (Frlley, Rev Mét 1911, **8 509**)

$W_2Si_3$  Insol in acids including HF, sol in a mixture of HF and  $HNO_3$ , sol in fused alkali hydroxides and carbonates (Vigouroux, C R 1898, **127 394**)

**Tungsten disulphide, WS<sub>2</sub>**

Oxidised by HNO<sub>3</sub>+Aq (Berzelius)  
 Insol in min acids  
 Sol in a mixture of HF and HNO<sub>3</sub> and in  
 used alkalis and alkali carbonates (De-  
 acqz, C R 1899, 128 611)

**Tungsten trisulphide, WS<sub>3</sub>**

Somewhat sol in cold, abundantly in hot  
 H<sub>2</sub>O, but separated out by the addition of  
 salts, especially NH<sub>4</sub>Cl, or acids Sol in  
 alkali sulphides, and hydrosulphides+Aq  
 Sol in caustic alkalis, and alkali carbonates  
 +Aq Slowly sol in NH<sub>4</sub>OH+Aq in the  
 cold

**Tungstic acid, H<sub>2</sub>WO<sub>4</sub>**

Insol in H<sub>2</sub>O Sol in HF Insol in tung-  
 states+Aq

44 7% H<sub>2</sub>WO<sub>4</sub> is sol in 50% HF+Aq at  
 25°

55 3% H<sub>2</sub>WO<sub>4</sub> is sol in 50% HF +Aq at  
 50°

100 g sat H<sub>2</sub>WO<sub>4</sub>+HCl+Aq contain  
 68 g H<sub>2</sub>WO<sub>4</sub> at 80°

9 8 % H<sub>2</sub>WO<sub>4</sub> is sol in sat alcoholic HCl  
 at 75°

Insol in alcoholic solutions of HBr and HI  
 Rosenheim, Chem Soc 1911 100 (2) 402)

Freshly pptd tungstic acid dissolves in  
 H<sub>2</sub>O<sub>2</sub> (Kellner, Dissert 1909)

Insol in liquid NH<sub>3</sub> (Gore, Am Ch J  
 1898, 20 830)

H<sub>2</sub>WO<sub>5</sub> Precipitate Sl sol in H<sub>2</sub>O and  
 aqueous solutions of the tungstates Sol in  
 50-300 pts H<sub>2</sub>O When frshly pptd, sol  
 in alkali hydrides or carbonates+Aq (An-  
 hon, J pr 9 6)

**Metatungstic acid, H<sub>2</sub>W<sub>2</sub>O<sub>7</sub>+9H<sub>2</sub>O**

Sol in H<sub>2</sub>O Solution may be boiled and  
 vaporated to a syrupy consistency, when it  
 suddenly gelatinises and ordinary tungstic  
 acid is precipitated

Sol in H<sub>2</sub>O When heated to 50°, it be-  
 comes insol in H<sub>2</sub>O (Soboleff, Z anorg  
 896, 12 28)

**Solubility in H<sub>2</sub>O at t°**

t°	100 ccm H <sub>2</sub> O dis- solve g. of the cryst acid	Sp gr of the solution
0	41 46	1 6025
22	88 57	2 5239
43 5	111 87	3 6503

(Soboleff)

Sp gr of solution of metatungstic acid at  
 7 5° containing

2 79 12 68 27 61 43 75% WO<sub>3</sub>

1 0257 1 1278 1 3274 1 6343

(Scheibler, J pr 83 273)

Sp gr of aqueous solution calculated by  
 M=Mendelejeff, and G=(Gerlach (Z anal  
 27 300), containing

	5	10	15	20	25% WO <sub>3</sub>
M	1 047	1 098	1 153	1 214	1 285
G	1 0469	1 0980	1 1544	1 2172	1 2873

	30	35	40	45	50% WO <sub>3</sub>
M	1 366	1 458	1 555	1 581 (?)	
G	1 3660	1 4540	1 5527	1 6630	1 7860

**Solubility in ether at t°**

t°	100 ccm ether dissolve g of the cryst acid
0	83 456
7 8	88 389
18 2	99 66
24 3	110 76

(Soboleff, Z anorg 1896, 12 32)

*Colloidal* Sol in H<sub>2</sub>O Not precipitated  
 by acids or alcohol Can be evaporated to  
 dryness and heated to 200°, and still remains  
 sol in H<sub>2</sub>O Sol in  $\frac{1}{4}$  pt of H<sub>2</sub>O

Sp gr of aqueous solution containing

	5	20	50	66 5	79 8% WO <sub>3</sub>
1 0475	1 2168	1 8001	2 596	3 243	

(Graham, Chem Soc 17 318)

Perhaps *paratungstic acid*, H<sub>10</sub>W<sub>12</sub>O<sub>41</sub>  
 (Klein, Bull Soc (2) 36 547)

**Tungstates**

Few normal tungstates are sol in H<sub>2</sub>O,  
 even some of the K and NH<sub>4</sub> salts are very  
 sl sol Most of the metatungstates however,  
 are easily sol in H<sub>2</sub>O

Tungstates insol in H<sub>2</sub>O are usually insol  
 in dil acids

**Aluminum tungstate, Al<sub>2</sub>(WO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O**

Precipitate Insol in H<sub>2</sub>O and Na<sub>2</sub>WO<sub>4</sub>+  
 Aq Sol in (NH<sub>4</sub>)<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq, NaOH+Aq,  
 NH<sub>4</sub>OH+Aq

Easily sol in H<sub>3</sub>PO<sub>4</sub>, H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>, and  
 H<sub>2</sub>C<sub>4</sub>H<sub>4</sub>O<sub>6</sub>+Aq (Lotz, A 83 65)

Sol in 1500 pts H<sub>2</sub>O at 15° (Lefort, C R  
 87 748)

Al<sub>2</sub>O<sub>3</sub>, 4WO<sub>3</sub>+9H<sub>2</sub>O Sol in 400 pts H<sub>2</sub>O  
 at 15° (Lefort, C R 87 748)

Al<sub>2</sub>O<sub>3</sub>, 5WO<sub>3</sub>+6H<sub>2</sub>O Sol in H<sub>2</sub>O, from  
 which it is pptd by alcohol (Lefort)

Formula according to Lefort is Al<sub>2</sub>O<sub>3</sub>, 3WO<sub>3</sub>  
 +3H<sub>2</sub>O, 2WO<sub>3</sub>

See also **Aluminoctungstic acid**

**Aluminum paratungstate**, 5Al<sub>2</sub>O<sub>3</sub>, 36WO<sub>3</sub>+  
 46H<sub>2</sub>O=Al<sub>2</sub>O<sub>3</sub>, 7WO<sub>3</sub>+9H<sub>2</sub>O (?)

Easily sol in an alum solution (Lotz, A  
 83 65)

**Aluminum ammonium tungstate**, 3(NH<sub>4</sub>)<sub>2</sub>O,  
 Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+4H<sub>2</sub>O

Sol in conc HNO<sub>3</sub> and in conc HCl  
 (Balke and Smith, J Am Chem Soc 1903,  
 25 1230)

**Aluminum ammonium antimony tungstate**

See *Aluminicoantimoniotungstate, ammonium*

**Aluminum antimony tungstate**

See *Aluminicoantimoniotungstic acid*

**Aluminum zinc tungstate,  $Al_2O_3$ ,  $ZnO$ ,  $9WO_3$ ,  $+20H_2O$** 

Very sol in  $H_2O$  (Daniels, J Am Chem Soc 1908, 30 1850)

$2Al_2O_3$ ,  $3ZnO$ ,  $18WO_3+16H_2O$  Sol in much  $H_2O$

Sol in very dil mineral acids or in acetic acid (Daniels)

**Ammonium tungstate,  $(NH_4)_2WO_4$** 

Known only in solution

$(NH_4)_4W_3O_{11}+3H_2O=2(NH_4)_2O$ ,  $3WO_3+3H_2O$  Sol in  $H_2O$  with decomp Decomp on air with evolution of  $NH_3$ , and formation of *paratungstate* Sol in  $NH_4OH+Aq$  (Marignac, A ch (3) 69 23)

$(NH_4)_4W_3O_{17}+5H_2O=2(NH_4)_2O$ ,  $5WO_3+5H_2O$  Sol at ordinary temp in 26-29 pts  $H_2O$  with partial decomposition (Marignac)  $+2\frac{1}{2}H_2O$ ,  $+3H_2O$ ,  $+4H_2O$ ,  $+4\frac{1}{2}H_2O$ , and  $+5H_2O$  (Pinagel, Dissert, 1904)

$(NH_4)_6W_3O_{27}+8H_2O=3(NH_4)_2O$ ,  $8WO_3+8H_2O$  Sol in  $H_2O$  (Marignac)

*Colloidal*  $(NH_4)_2O$ ,  $6WO_3+4$  or  $6H_2O$  Miscible with water in nearly all proportions (Taylor, J Am Chem Soc 1902, 24 632)

**Ammonium metatungstate,  $(NH_4)_2W_4O_{13}$** 

$+6H_2O$  (Marignac, A ch (4) 3 74)  
 $+8H_2O$  Efflorescent Very sol in  $H_2O$   
1 pt dissolves at  $15^\circ$  in 0.84 pt  $H_2O$  (Lotz)  
1 pt dissolves at ordinary temp in 0.35 pt  $H_2O$  (Riche)

Solubility increases rapidly with the temperature

Saturated solution at  $40^\circ$  is solid on cooling  
Sl sol in ordinary, insol in absolute alcohol (Lotz) Insol in ether (Riche)

$[(NH_4)_2W_3O_{10}+5H_2O \text{ of } \text{Marignac}]$   
 $(NH_4)_6W_3O_{21}+17H_2O=3(NH_4)_2O$ ,  $16WO_3+17H_2O$  Very efflorescent Decomp by dissolving in pure  $H_2O$  (Marignac, A ch (4) 3 75)

**Ammonium paratungstate,  $(NH_4)_{10}W_{12}O_{41}=5(NH_4)_2O$ ,  $12WO_3$** 

(Marignac, A ch (3) 69 25)  
According to Lotz (A 91 49) and Scheibler (J pr 80 208), formula is  $(NH_4)_6W_7O_{24}=3(NH_4)_2O$ ,  $7WO_3$

$+5H_2O$  (Scheibler J pr 48 232)  
 $+11H_2O$  Sol in 25-28 pts cold  $H_2O$  (Anthon)

Sol in 26.1 pts  $H_2O$  at  $107^\circ$ , and 5.8 pts at  $100^\circ$  (Lotz)

Sol in 33.3 pts cold  $H_2O$ , and 9.6 pts at  $100^\circ$  (Riche)

Sol in 22-38 pts  $H_2O$  at  $15-18^\circ$  The solution gradually decomposes, with the formation of a more soluble salt (Marignac)

Not much more sol in  $NH_4OH+Aq$  than in  $H_2O$  Insol in alcohol (Anthon)

Sol in  $H_2O_2$  (Kellner Dissert, 1909)

**Ammonium bismuth tungstate**

See *Bismuthicotungstate, ammonium*

**Ammonium cadmium paratungstate,  $3(NH_4)_2O$ ,  $12CdO$ ,  $35WO_3+35H_2O$** 

Ppt Sol in  $H_2O$  acidulated with  $HNO_3$  (Lotz, A 91 49)

**Ammonium cerium tungstate**

See *Cericotungstate, ammonium*

**Ammonium cobaltous tungstate,  $8(NH_4)_2O$ ,  $2CoO$ ,  $15WO_3+3H_2O$** 

(Carnot, C R 109 147)

**Ammonium hydroxylamine tungstate,  $NH_4OWO_4NH_4$** 

Sol in  $H_2O$  (Hofmann, Z anorg 1898, 16 465)

**Ammonium iron (ferric) tungstate,  $5(NH_4)_2O$ ,  $Fe_2O_3$ ,  $5WO_3+5H_2O$** 

Sol in  $H_2O$  (Borck)

**Ammonium lanthanum tungstate**

See *Lanthanicotungstate, ammonium*

**Ammonium magnesium paratungstate,  $2(NH_4)_2O$ ,  $3MgO$ ,  $12WO_3+24H_2O$** 

Very slightly sol in  $H_2O$  (Marignac, A ch (3) 69 58)

$(NH_4)_2O$ ,  $2MgO$ ,  $7WO_3+10H_2O$  Very sl sol in  $H_2O$ , sol in  $H_2O$  acidulated with  $HNO_3$  (Lotz)

**Ammonium mercuric tungstate,  $(NH_4)_2WO_4$ ,  $HgWO_4+H_2O$** 

Insol in  $H_2O$  Decomp by acids or alkalis (Anthon)

**Ammonium neodymium tungstate**

See *Neodymicotungstate, ammonium*

**Ammonium nickel tungstate**

See *Nickelicotungstate, ammonium*

**Ammonium potassium paratungstate,  $5K(NH_4)O$ ,  $12WO_3+11H_2O$** 

Sol in boiling  $H_2O$ , sl sol in cold  $H_2O$  (Hallopeau, C R 1896, 123 180)

**Ammonium potassium sodium paratungstate,  $5(K, Na, NH_4)_2O$ ,  $12WO_3+13H_2O$ , where  $K, Na, NH_4=3, 3, 4$** 

$10(K, Na, NH_4)_2O$ ,  $24WO_3+26H_2O$ , where  $K, Na, NH_4=3, 3, 14$  (Laurent)

**Ammonium sodium paratungstate**,  $4(\text{NH}_4)_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $12\text{WO}_3+5\text{H}_2\text{O}$ 

Can be crystallised from  $\text{H}_2\text{O}$  without decomp (Lotz, A 91 57)

+ $14\text{H}_2\text{O}$  Sol in warm  $\text{H}_2\text{O}$  (Hallopeau, C R 1896, 123 181)

$(\text{NH}_4)_2\text{O}$ ,  $4\text{Na}_2\text{O}$ ,  $12\text{WO}_3+25\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Hallopeau, C R 1895, 120 1344)

$5\text{Na}_2\text{O}$ ,  $15(\text{NH}_4)_2\text{O}$ ,  $48\text{WO}_3+48\text{H}_2\text{O}$  (Marignac, A ch (3) 69 53)

$2\text{Na}_2\text{O}$ ,  $3(\text{NH}_4)_2\text{O}$ ,  $12\text{WO}_3+15\text{H}_2\text{O}$  (Marignac)

$3(\text{NH}_4)_2\text{O}$ ,  $2\text{Na}_2\text{O}$ ,  $12\text{WO}_3+15\text{H}_2\text{O}$   
 $3(\text{NH}_4)_2\text{O}$ ,  $3\text{Na}_2\text{O}$ ,  $16\text{WO}_3+22\text{H}_2\text{O}$  Sol

in  $\text{H}_2\text{O}$  without decomp (Hallopeau, C R 1896, 123 181)

$3\text{Na}_2\text{O}$ ,  $4(\text{NH}_4)_2\text{O}$ ,  $16\text{WO}_3+18\text{H}_2\text{O}$  (Gibbs, Am Ch J 7 236)

Is  $2\text{Na}_2\text{O}$ ,  $3(\text{NH}_4)_2\text{O}$ ,  $12\text{WO}_3+13\text{H}_2\text{O}$ , according to Knorre (B 19 823)

Very sol in hot  $\text{H}_2\text{O}$  (Knorre, B 1886, 19 823)

$(\text{NH}_4)_2\text{O}$ ,  $3\text{Na}_2\text{O}$ ,  $16\text{WO}_3+38\text{H}_2\text{O}$  (Wyrouboff, Bull Soc Min 1892, 15 85)

$6(\text{NH}_4)_2\text{O}$ ,  $2\text{Na}_2\text{O}$ ,  $20\text{WO}_3+24\text{H}_2\text{O}$  Can be cryst from boiling  $\text{H}_2\text{O}$  (Baragiola, Dissert, 1902)

$4\text{Na}_2\text{O}$ ,  $16(\text{NH}_4)_2\text{O}$ ,  $50\text{WO}_3+50\text{H}_2\text{O}$  Sl scl in cold  $\text{H}_2\text{O}$  (Gibbs, Proc Am Acad 15 12)

**Ammonium zinc paratungstate**,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{ZnO}$ ,  $7\text{WO}_3+13\text{H}_2\text{O}$ 

Sl sol in boiling  $\text{H}_2\text{O}$ , but more easily on addition of oxalic tartaric, phosphoric, or dil nitric acids, or of ammonium tungstate (Lotz, A 91 49)

**Ammonium zirconium tungstate**

See Zirconotungstate, ammonium

**Ammonium metatungstate nitrate**

See Nitrate metatungstate, ammonium

**Ammonium tungstate vanadate**

See Vanadiotungstate, ammonium

**Antimony tungstate**,  $\text{Sb}_2\text{O}_3$ ,  $5\text{WO}_3+4\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  without decomp (Lefort)

$\text{Sb}_2\text{O}_3$ ,  $6\text{WO}_3+8\text{H}_2\text{O}$  Ppt

See also Antimoniotungstic acid

**Barium tungstate**,  $\text{BaWO}_4$ 

Anhydrous Insol in  $\text{H}_2\text{O}$  Decomp by boiling  $\text{HNO}_3+\text{Aq}$  (Geuther and Forsberg, A 120 270)

+ $\frac{1}{2}\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  or boiling  $\text{H}_3\text{PO}_4+\text{Aq}$  Sol in boiling, less sol in cold  $\text{H}_2\text{C}_2\text{O}_4+\text{Aq}$  (Anthon)

+ $2\frac{1}{2}\text{H}_2\text{O}$  Insol precipitate (Scheibler)

Pptd  $\text{BaWO}_4$  is attacked by dil acids More sol in  $\text{NH}_4\text{NO}_3+\text{Aq}$  than in  $\text{H}_2\text{O}$  (Smith and Bradbury, B 24 2930)

**Barium ditungstate**,  $\text{BaW}_2\text{O}_7+\text{H}_2\text{O}$  (?)

Nearly insol in  $\text{H}_2\text{O}$  100 ccm  $\text{H}_2\text{O}$  dissolve about 0.05 g at  $15^\circ$  (Lefort, A ch (5) 15 325)

**Barium tritungstate**,  $\text{BaW}_3\text{O}_{10}+4\text{H}_2\text{O}$  (?)

Sol in about 300 pts  $\text{H}_2\text{O}$  at  $15^\circ$  Decomp by boiling  $\text{H}_2\text{O}$  into an insol salt (Lefort, C R 88 798)

+ $6\text{H}_2\text{O}$  (Scheibler)

**Barium metatungstate**,  $\text{BaW}_4\text{O}_{13}+9\text{H}_2\text{O}$ 

Efflorescent Quite sol in hot  $\text{H}_2\text{O}$  Partly decomp by cold  $\text{H}_2\text{O}$  into  $\text{BaW}_3\text{O}_{10}$  and  $\text{WO}_3$ , which recombine on heating (Scheibler, J pr 80 204)

**Barium tungstate**,  $\text{BaW}_2\text{O}_8+8\text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$  or  $\text{HCl}+\text{Aq}$  (Zettnow)  
 $\text{BaW}_5\text{O}_{15}$  Barium bronze (Hallopeau, A ch 1900, (7) 19 121)

**Barium paratungstate**,  $\text{Ba}_5\text{W}_{12}\text{O}_{41}+14\text{H}_2\text{O}$ , or  $\text{Ba}_3\text{W}_7\text{O}_{24}+8\text{H}_2\text{O}$ 

Insol in cold  $\text{H}_2\text{O}$ , when freshly pptd is sl sol in  $\text{HNO}_3+\text{Aq}$  (Lotz, A 91 60)  
Sol in  $\text{NH}_4\text{Cl}+\text{Aq}$  (Wackenroder)  
+ $27\text{H}_2\text{O}=\text{Ba}_3\text{W}_7\text{O}_{24}+16\text{H}_2\text{O}$  Insol in cold, sl sol in hot  $\text{H}_2\text{O}$  (Knorre, B 18 327)

**Barium potassium tungstate tungsten oxide**,

$\text{BaW}_4\text{O}_{12}$ ,  $5\text{K}_2\text{W}_4\text{O}_{12}$

(Engels, Z anorg 1903, 37 136)

**Barium silver metatungstate**

(Scheibler)

**Barium sodium paratungstate**,  $2\text{BaO}$ ,  $3\text{Na}_2\text{O}$ ,  $12\text{WO}_3+24\text{H}_2\text{O}$  (Marignac), or  $\text{BaO}$ ,  $2\text{Na}_2\text{O}$ ,  $7\text{WO}_3+14\text{H}_2\text{O}$  (Scheibler)

Insol in  $\text{H}_2\text{O}$

**Barium sodium tungstate tungsten oxide**,  $2\text{BaW}_4\text{O}_{12}$ ,  $3\text{Na}_2\text{W}_5\text{O}_{15}$ 

$\text{BaW}_4\text{O}_{12}$ ,  $5\text{Na}_2\text{W}_5\text{O}_{15}$  (Engels, Z anorg 1903 37 131)

**Bismuth tungstate**,  $\text{Bi}_2\text{O}_3$ ,  $6\text{WO}_3+8\text{H}_2\text{O}$ 

Very sol in  $\text{H}_2\text{O}$  with decomp Pptd by alcohol from aqueous solution (Lefort, C R 87 748)

**Cadmium tungstate**,  $\text{CdWO}_4$ 

Anhydrous

+ $\text{H}_2\text{O}$  Sol in about 2000 pts  $\text{H}_2\text{O}$  (Lefort)

+ $2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in hot phosphoric or oxalic acids, or in  $\text{NH}_4\text{OH}+\text{Aq}$  (Anthon, J pr 9 341)

Sol in  $\text{KCN}+\text{Aq}$  (Smith and Bradbury, B 24 2390)

**Lead tungstate,  $\text{PbWO}_4$** 

Insol in  $\text{H}_2\text{O}$  or cold  $\text{HNO}_3 + \text{Aq}$  Sol in  $\text{KOH} + \text{Aq}$  Decomp by hot  $\text{HNO}_3 + \text{Aq}$  (Anthon, J pr 9 342)

Sol in about 4000 pts  $\text{H}_2\text{O}$  (Lefort)  
Min *Scheelenate, Stolzite* Sol in  $\text{KOH} + \text{Aq}$ , decomp by  $\text{HNO}_3$

Absolutely insol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Smith and Bradbury, B 24 2930)

**Lead ditungstate,  $\text{PbW}_2\text{O}_7 + 2\text{H}_2\text{O}$  (?)**

Sol in about 80 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Lefort)

**Lead tritungstate,  $\text{PbW}_3\text{O}_{10} + 2\text{H}_2\text{O}$  (?)**

Ppt (Lefort)

**Lead metatungstate,  $\text{PbW}_4\text{O}_{13} + 5\text{H}_2\text{O}$** 

Sl sol in cold, more in hot  $\text{H}_2\text{O}$  Sol in hot  $\text{HNO}_3 + \text{Aq}$  (Scheibler, J pr 83 318)

**Lead paratungstate,  $\text{Pb}_3\text{W}_7\text{O}_{24}$** 

Insol in  $\text{H}_2\text{O}$ , dil  $\text{HNO}_3 + \text{Aq}$ ,  $(\text{NH}_4)_2\text{WO}_4 + \text{Aq}$ , or  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  Sol in  $\text{NaOH} + \text{Aq}$  or boiling  $\text{H}_3\text{PO}_4 + \text{Aq}$  (Lotz, A 91 49)

**Lead sodium paratungstate,  $\text{PbO}$ ,  $4\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 28\text{H}_2\text{O}$** 

(Gonzalez)

**Lithium tungstate,  $\text{Li}_2\text{WO}_4$** 

Rather easily sol in  $\text{H}_2\text{O}$  (Gmelin)

**Lithium metatungstate,  $\text{Li}_2\text{W}_4\text{O}_{13}$** 

Insol in  $\text{H}_2\text{O}$  (Knorre, J pr (2) 27 94)  
 $+x\text{H}_2\text{O}$  Syrup (Scheibler)

**Lithium paratungstate,  $\text{Li}_{10}\text{W}_{12}\text{O}_{41} + 33\text{H}_2\text{O}$  (or  $\text{Li}_6\text{W}_7\text{O}_{24} + 19\text{H}_2\text{O}$ )**

According to Scheibler, more sol than the paratungstates of the other alkali metals

**Lithium tungstate tungsten oxide,  $\text{Li}_2\text{W}_5\text{O}_{15}$** 

*Lithium bronze* Insol in  $\text{H}_2\text{O}$

**Lithium potassium tungstate tungsten oxide,  $\text{Li}_2\text{W}_8\text{O}_{18}$ ,  $3\text{K}_2\text{W}_4\text{O}_{12}$** 

*Lithium potassium bronze* Insol in  $\text{H}_2\text{O}$  (Feit, B 21 135)

**Lithium sodium tungstate,  $\text{Li}_2\text{WO}_4 + 3\text{H}_2\text{O}$ ,  $3(\text{Na}_2\text{WO}_4 + 3\text{H}_2\text{O})$** 

(Traube, N Jahrb Miner, 1894, I 190)

**Magnesium tungstate,  $\text{MgWO}_4$** 

*Anhydrous* Insol in  $\text{H}_2\text{O}$  Gradually decomp by boiling conc  $\text{HNO}_3 + \text{Aq}$  (Geuther and Forsberg, A 120 272)

$+3\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$ , nearly insol in alcohol (Lefort, A ch (5) 15 329)

$+7\text{H}_2\text{O}$  Slowly sol in cold, very easily in hot  $\text{H}_2\text{O}$  (Ullik, W A B 56 2 152)

**Magnesium ditungstate,  $\text{MgW}_2\text{O}_7 + 8\text{H}_2\text{O}$  (?)**

Sol in about 100 pts  $\text{H}_2\text{O}$  (Lefort)

**Magnesium tritungstate,  $\text{MgW}_3\text{O}_{10} + 4\text{H}_2\text{O}$  (?)**

Easily sol in  $\text{H}_2\text{O}$  with gradual decomp (Lefort)

**Magnesium metatungstate,  $\text{MgW}_4\text{O}_{13} + 8\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Scheibler)

**Magnesium paratungstate,  $\text{Mg}_3\text{W}_7\text{O}_{24} + 24\text{H}_2\text{O}$** 

Very difficultly sol in cold, somewhat sol in hot  $\text{H}_2\text{O}$  (Knorre, B 19 825)

**Magnesium potassium tungstate,  $\text{MgWO}_4$ ,  $\text{K}_2\text{WO}_4$** 

$+2\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  (Ullik)  
 $+6\text{H}_2\text{O}$  Precipitate

**Magnesium potassium paratungstate,  $5(\frac{2}{3}\text{K}_2\text{O}, \frac{1}{3}\text{MgO}), 12\text{WO}_3 + 24\text{H}_2\text{O}$** 

Insol in cold, sol in hot  $\text{H}_2\text{O}$  (Hallepeau, C R 1898, 127 621)

**Magnesium sodium paratungstate,  $3\text{MgO}$ ,  $3\text{Na}_2\text{O}$ ,  $14\text{WO}_3 + 33\text{H}_2\text{O}$** 

Nearly insol in  $\text{H}_2\text{O}$  (Knorre, B 19 825)

**Manganous tungstate,  $\text{MnWO}_4$** 

Min *Hubnerite* Partially sol in  $\text{HCl} + \text{Aq}$

$+2\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , sol in warm  $\text{H}_3\text{PO}_4$  and  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ , sl sol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  Insol in cold  $\text{HCl} + \text{Aq}$  (Anthon)

$+ \text{H}_2\text{O}$  Sol in about 2500 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Lefort)

**Manganous ditungstate,  $\text{MnW}_2\text{O}_7 + 3\text{H}_2\text{O}$  (?)**

Sol in about 450 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Lefort, A ch (5) 15 333)

**Manganous tritungstate,  $\text{MnW}_3\text{O}_{10} + 5\text{H}_2\text{O}$  (?)**

Decomp by  $\text{H}_2\text{O}$  into  $\text{MnW}_2\text{O}_7$  and  $\text{MnW}_4\text{O}_{13}$  (Lefort, A ch (5) 17 480)

**Manganous metatungstate,  $\text{MnW}_4\text{O}_{13} + 10\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  (Wyruboff, Bull Soc Min 1892, 15 82)

**Manganous paratungstate,  $5\text{MnO}$ ,  $12\text{WO}_3 + 34\text{H}_2\text{O}$** 

(Gonzalez, J pr (2) 36 44)

$\text{Mn}_3\text{W}_7\text{O}_{24} + 11\text{H}_2\text{O}$  When recently pptd, sol in a small amt of  $\text{H}_2\text{O}$  acidulated with  $\text{HNO}_3$  (Lotz)

**Manganous potassium tungstate,  $2\text{MnO}$ ,  $3\text{K}_2\text{O}$ ,  $12\text{WO}_3 + 16\text{H}_2\text{O}$** 

Completely insol in  $\text{H}_2\text{O}$  (Hallepeau Bull Soc 1898, (3) 19 955)

**Manganous sodium paratungstate**,  $3\text{Na}_2\text{O}$ ,  $3\text{MnO}$ ,  $14\text{WO}_3 + 36\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  (Knorre, B 19 826)**Manganic sodium tungstate**

See Permanganotungstate, sodium

**Mercurous tungstate**,  $\text{Hg}_2\text{WO}_4$ Insol in  $\text{H}_2\text{O}$  (Anthon)

Impossible to obtain pure, as it is decomp into—

 $2\text{Hg}_2\text{O}$ ,  $3\text{WO}_3 + 8\text{H}_2\text{O}$  Sol in 100 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Lefort)**Mercurous metatungstate**,  $\text{Hg}_2\text{W}_4\text{O}_{18} + 25\text{H}_2\text{O}$ 

Ppt (Scheibler, J pr 83 319)

**Mercuric tungstate**,  $\text{HgWO}_4$ Sl sol in  $\text{H}_2\text{O}$  and very unstable (Lefort, A ch (5) 15 356) $3\text{HgO}$ ,  $2\text{WO}_3$  Insol in  $\text{H}_2\text{O}$  (Anthon) $2\text{HgO}$ ,  $3\text{WO}_3$  Insol in  $\text{H}_2\text{O}$  (Anthon) $3\text{HgO}$ ,  $5\text{WO}_3 + 5\text{H}_2\text{O}$  Sol in about 250 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Lefort) $2\text{HgO}$ ,  $5\text{WO}_3 + 7\text{H}_2\text{O}$  Decomp by hot or cold  $\text{H}_2\text{O}$  (Lefort, C R 88 798)**Mercuric tritungstate**,  $\text{HgW}_3\text{O}_{10} + 7\text{H}_2\text{O}$  (?)Sol in about 120 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Lefort, A ch (5) 15 360)**Molybdenum tungstate**Easily sol in  $\text{H}_2\text{O}$  Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$  or in alcohol of 0.87 sp gr (Berzelius)**Neodymium tungstate**,  $\text{Nd}_2(\text{WO}_4)_3$ Very sl sol in  $\text{H}_2\text{O}$  1 pt is sol in 52630 pts  $\text{H}_2\text{O}$  at  $22^\circ$ , 59580 pts at  $65^\circ$ , 66040 pts at  $98^\circ$  (Hitchcock, J Am Chem Soc 1895, 17 532)**Nickel tungstate**,  $\text{NiWO}_4$  $+3\text{H}_2\text{O}$  Sol in about 1000 pts  $\text{H}_2\text{O}$  at  $15^\circ$  (Lefort) $+6\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  Sol in boiling  $\text{H}_3\text{PO}_4 + \text{Aq}$ ,  $\text{HCl}_2\text{H}_3\text{O}_2 + \text{Aq}$ , or in warm  $\text{Ni}_4\text{OH} + \text{Aq}$  (Anthon)**Nickel ditungstate**,  $\text{NiW}_2\text{O}_7 + 5\text{H}_2\text{O}$  (?)Sol in about 240 pts  $\text{H}_2\text{O}$  (Lefort)**Nickel tritungstate**,  $\text{NiW}_3\text{O}_{10} + 4\text{H}_2\text{O}$  (?)Sol in  $\text{H}_2\text{O}$  Pptd by alcohol Decomp by cold or warm  $\text{H}_2\text{O}$  after above pptn (Lefort)**Nickel metatungstate**,  $\text{NiW}_4\text{O}_{18} + 8\text{H}_2\text{O}$ Sol in  $\text{H}_2\text{O}$  (Scheibler, J pr 83 273)**Nickel paratungstate**,  $\text{Ni}_3\text{W}_7\text{O}_{24} + 14\text{H}_2\text{O}$ Insol in  $\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  Completely sol in warm  $\text{H}_3\text{PO}_4$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Anthon)**Potassium tungstate**,  $\text{K}_2\text{WO}_4$ *Anhydrous* Rather deliquescent Easily sol in  $\text{H}_2\text{O}$  $+ \text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  Insol in alcohol $+ 2\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  with absorption of heat1 pt dissolves in 194 pts cold, and 0.66 pt boiling  $\text{H}_2\text{O}$  Alcohol does not mix with conc aq solution, but slowly separates out the salt from it Acids, even  $\text{H}_2\text{SO}_3$ ,  $\text{HC}_2\text{H}_3\text{O}_2$  or  $\text{H}_2\text{C}_2\text{O}_4$ , separate out  $\text{WO}_3$  from solution (Riche, A ch (3) 50 45)**Potassium ditungstate**,  $\text{K}_2\text{W}_2\text{O}_7 + 2\text{H}_2\text{O}$ Sol in about 8 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , but on heating is converted into— $+ 3\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  dissolve only 2-3 pts at  $15^\circ$  (Lefort, A ch (5) 9 102)**Potassium tritungstate**,  $\text{K}_2\text{W}_3\text{O}_{10} + 2\text{H}_2\text{O}$ Sol in 5-6 pts  $\text{H}_2\text{O}$  at  $15^\circ$  Can be recryst from hot  $\text{H}_2\text{O}$  (Lefort, A ch (5) 9 105)**Potassium metatungstate**,  $\text{K}_2\text{W}_4\text{O}_{18} + 5\text{H}_2\text{O}$ Not efflorescent Easily sol in  $\text{H}_2\text{O}$  (Marignac) $(\text{K}_4\text{W}_6\text{O}_{17} + 8\text{H}_2\text{O})$  of Margueritte) $+ 8\text{H}_2\text{O}$  Extremely efflorescent (Scheibler)**Potassium octotungstate**,  $\text{K}_3\text{W}_8\text{O}_{28}$ Insol in  $\text{H}_2\text{O}$  (Knorre, J pr (2) 27 49)**Potassium tungstate**,  $\text{K}_2\text{W}_{10}\text{O}_{34} + 9\text{H}_2\text{O} = 4\text{K}_2\text{O}$ ,  $10\text{WO}_3 + 9\text{H}_2\text{O}$ 

Properties resemble the paratungstate (Gibbs, Proc Am Acad 15 11)

 $+ 8\text{H}_2\text{O} = \text{K}_4\text{W}_8\text{O}_{17} + 4\text{H}_2\text{O}$  Sol in 15 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , but decomposed by heating into  $\text{K}_2\text{W}_2\text{O}_7$  and  $\text{K}_2\text{W}_3\text{O}_{10}$  (Lefort, A ch (5) 9 104) $\text{K}_{10}\text{W}_{14}\text{O}_{47}$  Very difficulty sol in cold, appreciably sol in hot  $\text{H}_2\text{O}$ , probably with decomposition (Knorre)**Potassium paratungstate**,  $\text{K}_{10}\text{W}_{12}\text{O}_{41} + 11\text{H}_2\text{O}$  (or  $\text{K}_4\text{W}_7\text{O}_{24} + 6\text{H}_2\text{O}$ , according to Lotz and Scheibler)Much more sol in hot than cold  $\text{H}_2\text{O}$  (Anthon)Sol in 100 pts  $\text{H}_2\text{O}$  at  $16^\circ$  in 8.5 pts at  $100^\circ$  (Anthon)Sol in 46.5 pts cold and 15.15 pts boiling  $\text{H}_2\text{O}$  (Riche)By shaking the crystals several days at  $20^\circ$ , 1 pt dissolves in 71 pts  $\text{H}_2\text{O}$  If the salt is treated with boiling water, more goes into solution the longer it is boiled, until after several days' boiling 1 pt of the salt dissolved in 552 pts  $\text{H}_2\text{O}$  at  $18^\circ$  Kept in a closed flask, this solution contained after 26 days 1 pt of salt to 11.9 pts  $\text{H}_2\text{O}$ , after 153 days, 1 pt of salt to 15.6 pts  $\text{H}_2\text{O}$ , after 334 days, 1 pt of salt to 15.6 pts  $\text{H}_2\text{O}$  Insol in alcohol (Marignac) $+ 8\text{H}_2\text{O}$

**Potassium sodium tungstate,  $K_2WO_4$ ,  $2Na_2WO_4 + 14H_2O$** 

Easily sol in hot and cold  $H_2O$  (Ullik, W A B 56 2 150)  
 Deliquescent Sol in 1 pt cold, and  $\frac{1}{2}$  pt hot  $H_2O$  (Anthon)

**Potassium sodium paratungstate,  $Na_2O$ ,  $4K_2O$ ,  $12WO_3 + 15H_2O$** 

Sol in  $H_2O$  (Marignac)  
 $\frac{8}{11}Na_2O$ ,  $\frac{3}{11}K_2O$ ,  $12WO_3 + 25H_2O$  Sol in  $H_2O$  (Marignac)

**Potassium strontium tungstate tungsten oxide,  $5K_2W_4O_{12}$ ,  $SrW_4O_{12}$** 

(Engels, Z anorg 1903, 37 143)

**Potassium uranous tungstate**

See Uranosotungstate, potassium

**Potassium zirconium tungstate**

See Zirconotungstate, potassium

**Potassium tungstate tungsten oxide,  $K_2WO_4$ ,  $W_2O_5$** 

Potassium tungsten bronze (Scheibler, J pr 83 321)

$_{12}$  Not attacked by  
 1 by alkalies (Knorre,

$\frac{4}{2}WO_3$  Not attacked by acids,  
 or by alkalies + Aq Insol in  
 (Zettnow, Pogg, 130 262)  
 a not exist (Knorre)

**Potassium sodium tungstate tungsten oxide,  $5K_2W_4O_{12} + 2Na_2W_5O_{15}$** 

Potassium sodium tungsten bronze Properties as potassium bronze

$3K_2W_4O_{12}$ ,  $2Na_2W_5O_{15}$  As above (Knorre, J pr (2) 27 49)

**Praseodymium tungstate,  $Pr_2(WO_4)_3$** 

Very sl sol in  $H_2O$

Insol in  $H_2O$  at  $20^\circ$ , at  $75^\circ$ , 1 pt is sol in 23,300 pts  $H_2O$  (Hitchcock, J Am Chem Soc 1895, 17 529)

**Rubidium metatungstate,  $Rb_2O$ ,  $4WO_3 + 8H_2O$** 

Sol in about 10 pts cold  $H_2O$   
 Moderately sol in warm  $H_2O$  (Wyrzboff, Bull Soc Min 1892, 15 69)

**Rubidium pentatungstate,  $Rb_2W_5O_{15}$** 

Almost insol in hot  $H_2O$  When finely powdered, it is sol in alkali carbonates + Aq (Schaeffer, Z anorg 1904, 38 163)

**Rubidium octotungstate,  $Rb_2W_8O_{25}$** 

Insol in  $H_2O$ , acids, and alkalies (Schaeffer, Z anorg 1904, 38 103)

**Rubidium paratungstate,  $5Rb_2O$ ,  $12WO_3 + 18H_2O$** 

Very sl sol in  $H_2O$  (Schaeffer, Z anorg 1904, 38 173)

**Samarium metatungstate,  $Sm_2O_3$ ,  $12WO_3 + 35H_2O$** 

Easily sol in  $H_2O$  (Cleve)

**Samarium sodium tungstate,  $Na_3Sm_4(WO_4)_9$** 

Insol in  $H_2O$  Slowly sol in dil acids, easily in conc  $HCl$  + Aq (Hogbom, Bull Soc (2) 42 2)

**Silver (argentous) tungstate,  $Ag_2O$ ,  $2WO_3$** 

$HNO_3$  + Aq separates  $WO_3$   $KOH$  + Aq dissolves out  $WO_3$  and separates  $Ag_2O$  (Wohler and Rautenberg, A 114 120)

Does not exist (Muthmann, B 20 983)

**Silver tungstate,  $Ag_2WO_4$** 

Sol in about 2000 pts  $H_2O$  at  $15^\circ$  Easily decomp by  $NaCl$  + Aq or  $BNO_3$  + Aq (Lefort)

$Ag_2W_2O_7$  Insol in  $H_2O$  Nearly insol in  $HC_2H_3O_2$  or  $H_3PO_4$  + Aq More sol in  $KOH$ ,  $NH_4OH$  + Aq, or  $H_2C_2O_4$  + Aq (Anthon, J pr 9 347)

+  $H_2O$  Sol in about 5000 pts  $H_2O$  at  $15^\circ$  (Lefort)

**Silver metatungstate,  $Ag_2W_4O_{13} + 3H_2O$** 

Sl sol in  $H_2O$  (Scheibler, J pr 83 318)

Nearly insol in  $H_2O$  (Rosenheim, Z anorg 1911, 69 250)

**Silver paratungstate,  $Ag_{10}W_{12}O_{41} + 8H_2O$** 

(Gonzalez, J pr (2) 36 44)

**Silver tungstate ammonia,  $Ag_2WO_4$ ,  $4NH_3$** 

Sol in  $H_2O$  with rapid decomp (Widmann, Bull Soc (2) 20 64)

**Sodium tungstate,  $Na_2WO_4 + 2H_2O$** 

Sol in 4 pts cold, and 2 pts boiling  $H_2O$  (Vauquelin and Hecht)

Sol in 1 l pts cold, and 0.5 pt boiling  $H_2O$  (Anthon)

Sol in 244 pts  $H_2O$  at  $0^\circ$ , 1.81 pts at  $15^\circ$ , 0.81 pt at  $100^\circ$  (Riche)

Solubility in  $H_2O$  at  $t^\circ$

$t^\circ$	% $Na_2WO_4$	Mols $H_2O$ to 1 mol $Na_2WO_4$	Mols of anhydrous salt to 100 mols $H_2O$
-3 5	41 67	22 87	4 37
+0 5	41 73	22 80	4 39
21 0	42 27	22 30	4 48
43 5	43 98	20 80	4 81
80 5	47 65	17 95	5 57
100 0	49 31	16 79	5 95

(Funk, B 1900, 33 3701)

See also +10 $H_2O$

# TUNGSTATE, SODIUM

Sp gr of $\text{Na}_2\text{WO}_4 + \text{Aq}$ at 24.5° containing			
5	10	15 %	$\text{Na}_2\text{WO}_4 + 2\text{H}_2\text{O}$
036	1 075	1 119	
20	25	30 %	$\text{Na}_2\text{WO}_4 + 2\text{H}_2\text{O}$
166	1 215	1 274	
35	40	44 %	$\text{Na}_2\text{WO}_4 + 2\text{H}_2\text{O}$
349	1 430	1 492	

(Franz, J pr (2) 4. 238)

Sp gr of  $\text{Na}_2\text{WO}_4 + \text{Aq}$  at 25°

Sp gr at 20°	Per cent $\text{Na}_2\text{WO}_4$	Per cent $\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$
1 02016	2 21	2 48
1 03945	4 26	4 78
1 04292	4 59	5 15
1 05831	6 25	7 01
1 07449	7 83	8 79
1 08209	8 61	9 66
1 09687	10 08	11 31
1 12114	12 30	13 81
1 13036	13 16	14 77
1 14392	14 44	16 21
1 16896	16 56	18 62
1 19154	18 52	20 79
1 19938	19 10	21 44
1 20787	19 74	22 16
1 21720	20 59	23 11
1 25041	23 16	25 99
1 25083	23 30	26 15
1 26234	24 05	27 00
1 28143	25 46	28 58
1 33993	29 50	33 11
1 38826	32 68	36 68
1 41072	33 91	38 06
1 47193	37 30	41 87
1 48481	38 20	42 87
1 48595	38 43	43 14

(Pawlewski, B 1900, 33 1224)

$\text{Na}_2\text{WO}_4 + \text{Aq}$  is pptd by  $\text{HCl}$   $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but not by  $\text{H}_2\text{SO}_3$   $\text{HI}$ ,  $\text{HCN}$  oxalic, or tartaric acids +  $\text{Aq}$  but pptn by the former acids is not prevented by presence of the latter, but when heated with  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , or in presence of  $\text{H}_3\text{PO}_4 + \text{Aq}$ , mineral acids cause no ppt (Zettnow, Pogg, 130 16)

Much more sol in  $\text{H}_2\text{O}_2$  than in  $\text{H}_2\text{O}$  (Kellner, Dissert, 1909)

Sl sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 829)

Insol in alcohol (Riche, A ch (3) 50 52)

Insol in methyl acetate (Naumann, B 1909, 42 3790)

+10 $\text{H}_2\text{O}$

## Solubility in $\text{H}_2\text{O}$ at t°

t°	$\text{Na}_2\text{WO}_4$	Mols $\text{H}_2\text{O}$ to 1 mol $\text{Na}_2\text{WO}_4$	Mols from 100 gm
-5	30 60	37 04	2
-4 0	31 87	34 92	2
-3 5	32 98	33 19	2
-2 0	34 52	30 90	3
0 0	36 54	28 37	3
+3 0	39 20	25 33	3
+5 0	41 02	23 48	4

(Funk, B 1900, 33 3701)

### Sodium ditungstate, $\text{Na}_2\text{W}_2\text{O}_7$

Sol in  $\text{H}_2\text{O}$  by heating several h 130-150° (Knorre, J pr (2) 27 80)  
+6 $\text{H}_2\text{O}$  Sol in 13 pts  $\text{H}_2\text{O}$  at 15 fort, C R 88 798)

### Sodium tritungstate, $\text{Na}_2\text{W}_3\text{O}_{11} + 4\text{H}_2\text{O}$

Sol in 1 pt  $\text{H}_2\text{O}$  Decomp on s into sol tetraungstate and insol state (Lefort, C R 88 798)

Neither this nor the other tritungstates Lefort exist, according to Knorre (J 27 49)

### Sodium neotungstate, $\text{Na}_2\text{W}_4\text{O}_{13}$

Anhydrous Insol in  $\text{H}_2\text{O}$   
+10 $\text{H}_2\text{O}$  Sol at 13° in 0.935 pt form a solution of 3.02 sp gr (Scheer)  
Sol at 19° in 0.195 pt  $\text{H}_2\text{O}$  F  
Precipitated by alcohol

### Sodium pentatungstate, $\text{Na}_2\text{W}_5\text{O}_{17}$

Sl sol in  $\text{H}_2\text{O}$  by heating 3 hours (Knorre J pr 2 27 49)

### Sodium octatungstate, $\text{Na}_2\text{W}_8\text{O}_{26}$

Insol in  $\text{H}_2\text{O}$  Verv difficult by acids and alkalies Knorre  
+12 $\text{H}_2\text{O}$  Easily sol in cold  $\text{H}_2\text{O}$  be recryst without decomp (J 56, 2 157)

3 $\text{Na}_2\text{O}$ , 8 $\text{WO}_3 + 17\text{H}_2\text{O}$  Verv eff  
Verv sol in hot  $\text{H}_2\text{O}$  We  
Chem Soc 1907 29 112

### Sodium tungstate, $\text{Na}_2\text{WO}_4$

+10 $\text{H}_2\text{O}$  (Marignac A ch (3) 50 52)

+21 $\text{H}_2\text{O}$  (Marignac) Much more more rapidly than the p rate - rignac

$\text{Na}_2\text{W}_3\text{O}_{11} + 7\text{H}_2\text{O}$  Mixture and  $\text{Na}_2\text{WO}_4$  (Knorre, J pr 2 27 80)

$\text{Na}_4\text{W}_3\text{O}_{11} + 11\text{H}_2\text{O}$  Ffiroresce  $\text{H}_2\text{O}$  (Marignac)

100 pts  $\text{H}_2\text{O}$  dissolve 10 pts fort, A ch (3) 9 97

Formula is 4 $\text{Na}_2\text{O}$  10 $\text{WO}_3 + 2$  according to Gibbs (Proc Am Ac



**Sodium paratungstate**,  $\text{Na}_{10}\text{W}_{12}\text{O}_{41} + 21\text{H}_2\text{O}$   
 $+ 25\text{H}_2\text{O}$   
 $+ 28\text{H}_2\text{O} = 3\text{Na}_2\text{W}_2\text{O}_7 + 16\text{H}_2\text{O}$ , according  
 to Lotz and Scheibler

Sol in 8 pts cold  $\text{H}_2\text{O}$  (Anthon) in 12 6 pts at 22°  
 (Forcher)

Sol in about 12 pts  $\text{H}_2\text{O}$  (Marignac)  
 The aqueous solution saturated at 35–40°  
 contained to 1 pt of the salt, after

1	12	77	227	410 days,
at 18°	18°	18°	16°	20°
9 25	11 26	10 92	11 90	11 74 pts $\text{H}_2\text{O}$

The solution saturated by very long boiling,  
 after a part of the salt had crystallised out,  
 contained, after

1	2	12 days,
0 68	0 91	2 59 pts $\text{H}_2\text{O}$ to 1 pt salt,
72	222	405 days,
6 88	9 75	8 80 pts $\text{H}_2\text{O}$ to 1 pt salt

(Marignac)

Decomp by boiling with  $\text{H}_2\text{O}$  (Knorre,  
 B 18 2362)

**Sodium strontium paratungstate**,  $\text{Na}_2\text{O}$ ,  
 $4\text{SrO}$ ,  $12\text{WO}_3 + 29\text{H}_2\text{O}$   
 (Gonzalez, J pr (2) 36 44)

**Sodium strontium tungstate tungsten oxide**,  
 $5\text{Na}_2\text{W}_2\text{O}_7$ ,  $\text{SrW}_4\text{O}_{12}$   
 $12\text{Na}_2\text{W}_2\text{O}_7$ ,  $\text{SrW}_4\text{O}_{12}$  (Engels, Z anorg  
 1903, 37 138)

**Sodium thorium tungstate**,  $\text{Na}_4\text{Th}(\text{WO}_4)_4$   
 Insol in  $\text{H}_2\text{O}$  Slowly sol in dil acids,  
 easily in conc  $\text{HCl} + \text{Aq}$  (Hogbom, Bull  
 Soc (2) 42 2)

**Sodium ytterbium tungstate**,  $\text{Yb}_2\text{O}_3$ ,  $9\text{Na}_2\text{O}$ ,  
 $12\text{WO}_3$   
 Insol in  $\text{H}_2\text{O}$  (Cleve, Z anorg 1902, 32  
 154)

$2\text{Yb}_2\text{O}_3$ ,  $4\text{Na}_2\text{O}$ ,  $7\text{WO}_3$  Ppt (Cleve)

**Sodium yttrium tungstate**,  $\text{Na}_3\text{Y}_2(\text{WO}_4)_7$   
 Insol in  $\text{H}_2\text{O}$ , and very slowly attacked by  
 dil acids (Hogbom, Bull Soc (2) 42 2)

**Sodium zinc paratungstate**,  $\text{Na}_2\text{O}$ ,  $2\text{ZnO}$ ,  
 $7\text{WO}_3 + 15\text{H}_2\text{O}$   
 Difficultly sol in cold, more sol in hot  $\text{H}_2\text{O}$   
 (Knorre, B 19 823)  
 $+ 21\text{H}_2\text{O}$  (Knorre)

**Sodium tungstate tungsten oxide**,  $\text{Na}_2\text{WO}_4$   
 $\text{W}_2\text{O}_5$

*Yellow tungsten bronze* Gradually de-  
 huesces on air Not decomp by any acid,  
 even aqua regia, except  $\text{Hf}$ , or by alkalis  
 (Wohler, Pogg 2 350)

Correct formula is  $\text{Na}_5\text{W}_6\text{O}_{18}$ , according  
 to Phillip (B 15 499)

Sol in ammoniacal silver solution with  
 separation of Ag Easily sol in boiling  
 alkaline potassium ferricyanide + Aq  
 (Phillip, B 12 2234)

$\text{Na}_2\text{WO}_4$ ,  $2\text{W}_2\text{O}_5$  *Blue tungsten bronze*  
 Not attacked by acids or alkalis (Scheibler)  
 Correct formula is  $\text{Na}_2\text{W}_6\text{O}_{18}$ , according  
 to Phillip (B 15 506)

Sol in ammoniacal silver solution with  
 separation of Ag

$\text{Na}_2\text{W}_6\text{O}_{18}$  Properties as above (Phillip,  
 B 15 499)

$\text{Na}_2\text{W}_3\text{O}_9$  Properties as above (Phillip)

**Strontium tungstate**,  $\text{SrWO}_4$

Precipitate (Schultze)

Sol in about 700 pts  $\text{H}_2\text{O}$  (Lefort)

**Strontium ditungstate**,  $\text{SrW}_2\text{O}_7 + 3\text{H}_2\text{O}$  (?)

100 ccm  $\text{H}_2\text{O}$  dissolve 0 35 g at 15° (Le-  
 fort, A ch (5) 15 326)

**Strontium tritungstate**,  $\text{SrW}_3\text{O}_{10} + 5\text{H}_2\text{O}$  (?)

Sol in  $\text{H}_2\text{O}$  with decomp into  $\text{SrW}_2\text{O}_7$  and  
 $\text{SrW}_4\text{O}_{13}$  (Lefort, A ch (5) 17 477)

**Strontium metatungstate**,  $\text{SrW}_4\text{O}_{13} + 8\text{H}_2\text{O}$

Solubility as calcium metatungstate  
 (Scheibler)

Extraordinarily sol in  $\text{H}_2\text{O}$  (Wyruboff,  
 Bull Soc Min 1892, 15 63)

**Strontium paratungstate**,  $\text{Sr}_3\text{W}_7\text{O}_{24} + 16\text{H}_2\text{O}$ ,  
 or  $\text{Sr}_7\text{W}_{12}\text{O}_{41} + 27\text{H}_2\text{O}$

Insol in cold, sl sol in hot  $\text{H}_2\text{O}$  (Knorre,  
 B 18 327)

**Thalious tungstate**,  $\text{Th}_2\text{WO}_4$

Very sl sol in  $\text{H}_2\text{O}$  Sol in hot  $\text{Na}_2\text{CO}_3 +$   
 Aq (Flemming, J B 1868 250)

**Thalious metatungstate**,  $\text{Th}_2\text{W}_4\text{O}_{13} + 3\text{H}_2\text{O}$

Nearly insol in  $\text{H}_2\text{O}$  (Rosenheim, Z  
 anorg 1911, 69 251)

**Thalious paratungstate**,  $5\text{Th}_2\text{O}_3$ ,  $12\text{WO}_3$

Insol in  $\text{H}_2\text{O}$

Sol in  $\text{Na}_2\text{CO}_3 + \text{Aq}$  and  $\text{KOH} + \text{Aq}$   
 decomposed by mineral acids (Schaeffer, Z  
 anorg 1904, 38 171)

**Thalious hydrogen tungstate**,  $\text{ThHWO}_4$

Insol in  $\text{H}_2\text{O}$  Difficultly sol in  $\text{NH}_4\text{OH} +$   
 Aq Easily sol in boiling alkali carbonates  
 or hydrates + Aq (Oettinger, J B 1864  
 254)

**Thorium tungstate**

Precipitate (Berzelius)

Insol in  $\text{H}_2\text{O}$

**Tin (stannous) tungstate**,  $\text{SnWO}_4 + 6\text{H}_2\text{O}$

Insol in  $\text{H}_2\text{O}$  Sol in oxalic acid and in  
 $\text{KOH} + \text{Aq}$  Slowly sol in hot  $\text{H}_3\text{PO}_4 + \text{Aq}$   
 (Anthon, J pr 9 341)

**Tin (stannic) tungstate**,  $9\text{SnO}_2 \cdot 13\text{WO}_3$ 

Insol in ammonium tungstate + Aq Sol in tin salts + Aq, also in phosphoric, oxalic, or tartaric acids + Aq (Lotz, A 91 49)

**Tungsten tungstate**,  $\text{WO}_2 \cdot \text{WO}_3 = \text{W}_2\text{O}_5$ 

See Tungsten oxide,  $\text{W}_2\text{O}_5$

**Uranous tungstate**,  $\text{UO}_2 \cdot 3\text{WO}_3 + 6\text{H}_2\text{O}$ 

Decomp by  $\text{NaOH} + \text{Aq}$  or  $\text{HNO}_3 + \text{Aq}$  Sol in  $\text{HCl} + \text{Aq}$ , but not in  $\text{H}_2\text{SO}_4$  (Ram-melsberg)

**Uranyl tungstate**,  $\text{UO}_3 \cdot \text{WO}_3 + 2\text{H}_2\text{O}$ 

Sol in about 100 pts  $\text{H}_2\text{O}$  (Lefort, C R 87 748)

$\text{UO}_3 \cdot 3\text{WO}_3 + 5\text{H}_2\text{O}$  (?) Sol in about 200 pts  $\text{H}_2\text{O}$  (Lefort)

**Vanadium tungstate**

Sl sol in  $\text{H}_2\text{O}$

**Ytterbium tungstate basic**,  $(\text{YbO})_2\text{WO}_4$ 

Ppt (Cleve, Z anorg 1902, 32 153)

**Ytterbium metatungstate**,  $\text{Yb}_2\text{O}_3 \cdot 12\text{WO}_3 + 35\text{H}_2\text{O}$ 

Very sol in  $\text{H}_2\text{O}$  (Cleve)

**Yttrium tungstate**,  $\text{Y}_2(\text{WO}_4)_3 + 6\text{H}_2\text{O}$ 

Very sl sol in  $\text{H}_2\text{O}$ , but more sol in  $\text{Na}_2\text{WO}_4 + \text{Aq}$  (Berlin)

**Zinc tungstate**,  $\text{ZnWO}_4$ 

Insol in  $\text{H}_2\text{O}$  (Geuther and Forsberg, A 120 270)

+  $\text{H}_2\text{O}$  Sol in 500 pts  $\text{H}_2\text{O}$

**Zinc ditungstate**,  $\text{ZnW}_2\text{O}_7 + 3\text{H}_2\text{O}$  (?)

Sol in 10 pts  $\text{H}_2\text{O}$  at  $15^\circ$ , but solution soon decomposes (Lefort)

**Zinc tritungstate**,  $\text{ZnW}_3\text{O}_{10} + 5\text{H}_2\text{O}$ 

Insol in boiling  $\text{H}_2\text{O}$  Sol in  $\text{ZnSO}_4 + \text{Aq}$ , or  $\text{Na}_4\text{W}_6\text{O}_{17} + \text{Aq}$  (Gibbs)

**Zinc metatungstate**,  $\text{ZnW}_4\text{O}_{13} + 10\text{H}_2\text{O}$ 

Easily sol in  $\text{H}_2\text{O}$  Loses crystal  $\text{H}_2\text{O}$  by ignition, and becomes insol in  $\text{H}_2\text{O}$  (Scheibler, J pr 83 273)

+  $8\text{H}_2\text{O}$  More sol in  $\text{H}_2\text{O}$  than magnesian comp (Wyruboff, Bull Soc Min 1892, 15 72)

**Zinc tungstate**,  $\text{Zn}_4\text{W}_{10}\text{O}_{34} + 18\text{H}_2\text{O} = 4\text{ZnO} \cdot 10\text{WO}_3 + 18\text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$  Sol in excess of zinc sulphate or of sodium tungstate + Aq (Gibbs, Proc Am Acad 15 14)

+  $29\text{H}_2\text{O}$  (Gibbs)

**Zinc paratungstate**,  $5\text{ZnO} \cdot 12\text{WO}_3 + 37\text{H}_2\text{O}$ 

(Gonzalez, J pr (2) 36 44)

**Zinc tungstate**,  $\text{Zn}_3\text{W}_{12}\text{O}_{41} + 66\text{H}_2\text{O} = 9\text{ZnO} \cdot 22\text{WO}_3 + 66\text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$  (Gibbs)

**Zinc tungstate ammonia**,  $\text{ZnWO}_4 \cdot 4\text{NH}_3 + 3\text{H}_2\text{O}$ 

Decomp in the air (Briggs Chem Soc 1904, 85 677)

**Pertungstic acid**

See Pertungstic acid.

**Tungstoarsenic acid**

See Arsenotungstic acid.

**Tungstoboric acid**

See Borotungstic acid.

**Tungstocyanhydric acid**,  $\text{H}_4\text{W}(\text{CN})_8 + 6\text{H}_2\text{O}$ 

Hydroscopic

Sol in  $\text{H}_2\text{O}$  and abs alcohol Insol in ether, benzene etc (Olsson Z anorg 1914, 88 71)

**Ammonium tungstocyanide**,  $(\text{NH}_4)_4\text{W}(\text{CN})_8$ 

Easily sol in  $\text{H}_2\text{O}$  Aqueous solution decomp slowly

Insol in organic solvents Olsson, Z anorg 1914, 88 62

**Cadmium tungstocyanide**,  $\text{Cd}_2\text{W}(\text{CN})_8 + 8\text{H}_2\text{O}$ 

Nearly insol in  $\text{H}_2\text{O}$  Sl sol in dil  $\text{HCl}$  Sol in conc  $\text{NH}_4\text{OH} + \text{Aq}$  Insol in organic solvents (Olsson, Z anorg 1914, 88 68)

**Cæsium tungstocyanide**,  $\text{Cs}_4\text{W}(\text{CN})_8$ 

Easily sol in  $\text{H}_2\text{O}$  forming stable solutions Insol in alcohol and other organic solvents (Olsson)

**Calcium tungstocyanide**,  $\text{Ca}_4\text{W}(\text{CN})_8 \cdot 4\text{H}_2\text{O}$ 

Easily sol in  $\text{H}_2\text{O}$  Aqueous solution decomp slowly

Insol in organic solvents (Olsson)

**Lead tungstocyanide**,  $\text{Pb}_4\text{W}(\text{CN})_8 \cdot 4\text{H}_2\text{O}$ 

Sol in  $\text{H}_2\text{O}$  Solution decomposes on standing

Insol in organic solvents (Olsson)

**Magnesium tungstocyanide**,  $\text{Mg}_4\text{W}(\text{CN})_8 \cdot 6\text{H}_2\text{O}$ 

Easily sol in  $\text{H}_2\text{O}$  Aqueous solution decomp on heating

Insol in organic solvents (Olsson)

**Manganous tungstocyanide**,  $\text{Mn}_4\text{W}(\text{CN})_8 \cdot 8\text{H}_2\text{O}$ 

Insol in  $\text{H}_2\text{O}$  and in acids

Insol in organic solvents (Olsson)

**Potassium tungstocyanide**,  $K_4W(CN)_8 + 2H_2O$

Easily sol in  $H_2O$  from which it can be cryst 10 ccn  $H_2O$  dissolve 13-14 g salt at 18°

Insol in alcohol, ether and other organic solvents (Olsson)

**Rubidium tungstocyanide**,  $Rb_4W(CN)_8 + 3H_2O$

Easily sol in  $H_2O$  Can be cryst from  $H_2O$   
Insol in alcohol and other organic solvents (Olsson)

**Silver tungstocyanide**,  $Ag_4W(CN)_8$

Insol in  $H_2O$

Insol in acids Decomp by dil HCl

Sol in hot conc  $NH_4OH + Aq$

Insol in organic solvents (Olsson)

**Sodium tungstocyanide**,  $Na_4W(CN)_8 + 2\frac{1}{2}H_2O$

Hydroscopic

Easily sol in  $H_2O$

Insol in organic solvents (Olsson)

**Strontium tungstocyanide**,  $Sr_2W(CN)_8 + 8H_2O, +9H_2O$

Easily sol in  $H_2O$  Aqueous solution decomp on standing

Insol in organic solvents (Olsson)

**Thallium tungstocyanide**,  $Tl_4W(CN)_8$

Difficultly sol in cold  $H_2O$ , more sol in hot  $H_2O$

Insol in organic solvents (Olsson)

**Zinc tungstocyanide**,  $Zn_2W(CN)_8 + 4H_2O$

Insol in  $H_2O$ , and acids

Sol in conc  $NH_4OH + Aq$  (Olsson)

**Metatungstioiodic acid**

**Ammonium metatungstioiodate**,  
 $2(NH_4)_2O, 2I_2O_5, 4WO_3 + 12H_2O$

Very sl sol in  $H_2O$  (Chrétien, A ch 1898, (7) 15 431)

**Potassium tungstioiodate**,  $K_2H_3WIO_5$

(Blomstrand, J pr (2) 40 327)

$2H_2O, 2I_2O_5, 4WO_3 + 8H_2O$

5 13 g are sol in 1 l  $H_2O$  at 15°, 8 25 g at 100° (Chrétien, A ch 1898, (7) 15 431)

**Tungstoperiodic acid**

**Ammonium sodium tungstoperiodate**,  
 $2(NH_4)_2O, Na_2O, I_2O_7, 2WO_3 + 16H_2O$

Ppt (Rosenheim, A 1899, 308 64)

**Barium tungstoperiodate**,  
 $5BaO, I_2O_7, 12WO_3 + 12H_2O$

Ppt (Rosenheim)

**Potassium tungstoperiodate**,  
 $5K_2O, I_2O_7, 12WO_3 + 8H_2O$

Sol in  $H_2O$  (Rosenheim)

**Sodium tungstoperiodate**,  
 $3Na_2O, I_2O_7, 2WO_3 + 4H_2O$

Ppt

$5Na_2O, I_2O_7, 12WO_3 + 16H_2O$  Sol in  $H_2O$  (Rosenheim)

**Strontium tungstoperiodate**,  
 $5SrO, I_2O_7, 12WO_3 + 28H_2O$

Sol in  $H_2O$  (Rosenheim)

**Tungstophosphoric acid**,

See Phosphotungstic acid

**Tungstosilicic acid**,

See Silicotungstic acid

**Tungstotungstic acid**

**Lithium tungstotungstate**,  $Li_2O, WO_3 + WO_3, 3WO_3$

Insol in boiling  $H_2O$  and conc HCl (Hallepeau, C R 1898, 127 514)

**Potassium tungstotungstate**,  $K_2O, WO_3 + WO_3, 3WO_3$

Insol in hot  $H_2O$ , and conc HCl (Hallepeau, Bull Soc 1899, (3) 21 267)

**Tungstous acid**

**Sodium tungstate**,  $Na_2W_2O_5$

See Tungstate tungsten oxide, sodium

**Tungstovanadic acid**

See Vanadotungstic acid

**Tungstyl dibromide**,  $WO_2Br_2$

Not decomp by cold  $H_2O$  (Roscoe)

**Tungstyl tetrabromide**,  $WObBr_4$

Extremely deliquescent Decomposes at once in moist air or with  $H_2O$

**Tungstyl dichloride**,  $WO_2Cl_2$

Not decomp by cold, and but slowly by boiling  $H_2O$  Sol in alkalis and ammoni

**Tungstyl tetrachloride**,  $WOCl_4$

Easily decomp by  $H_2O$  or moist air

Very sol in  $CS_2$  and  $S_2Cl_2$  Sl sol in benzene (Smith, J Am Chem Soc 1899, 21 1008)

**Tungstyl tetrafluoride**,  $WOF_4$

Sol in  $H_2O$  with decomp Very hydroscopic

Insol in carbon tetrachloride

Sl sol in carbon bisulphide, dry benzene and ether

Easily sol in chloroform and absolute alcohol (Ruff, Z anorg 1907, 52 265)

**Tungstyl tetrafluoride ammonia**,  $2\text{WOF}_4$ ,  $\text{NH}_3$

Sol in  $\text{H}_2\text{O}$  with decomp  
Insol in liquid  $\text{NH}_3$  (Ruff, Z anorg 1907, 52 266)

**Ultramarine blue**,  $2\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_8$ ,  $\text{Na}_2\text{S}_2$  (?)

Not attacked by solutions of alkalis or  $\text{NH}_4\text{OH} + \text{Aq}$  Decomp by acids or acid salts  $+ \text{Aq}$  Decomp by alum  $+ \text{Aq}$

**Ultramarine green**,  $\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_8$ ,  $\text{Na}_2\text{S}$  (?)

Decomp by mineral acids Not attacked by alkalis Decomp by alum  $+ \text{Aq}$

**Ultramarine white**,  $2\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_8$ ,  $\text{Na}_2\text{S}$  (?)

**Uranic acid**,  $\text{H}_2\text{UO}_4$

Insol in  $\text{H}_2\text{O}$  Sol in acids Very sol in cold dil  $\text{HNO}_3 + \text{Aq}$  Sl sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$  Insol in  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$  Easily sol in  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{KHCO}_3$ , and  $\text{NaHCO}_3 + \text{Aq}$ , less in  $\text{KCO}_3 + \text{Aq}$  (Ebelmen)

Easily sol in malic and tartaric acids to form complex compds (Itzig, B 1901, 34 3822)

$\text{H}_4\text{UO}_6$  Insol in  $\text{H}_2\text{O}$ , sol in acids (Ebelmen)

## Uranates

Insol in  $\text{H}_2\text{O}$ , sol in acids

### Ammonium uranate

Sl sol in pure  $\text{H}_2\text{O}$ , insol in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{OH}$

Sol in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Peligot, A ch (3) 5 11)

$(\text{NH}_4)_2\text{O}$ ,  $4\text{UO}_3 + 7\text{H}_2\text{O}$  (Grubler, Dis sert, 1908)

$(\text{NH}_4)_2\text{O}$ ,  $6\text{UO}_3 + 10\text{H}_2\text{O}$  Insol in cold and hot  $\text{H}_2\text{O}$  and alkalis  $+ \text{Aq}$  Verv sol in  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and acetic acid  $+ \text{Aq}$  (Zehenter, M 1900, 21 235)

**Barium uranate**,  $\text{BaUO}_4$

Insol in  $\text{H}_2\text{O}$  Sol in dil acids  
 $\text{BaU}_2\text{O}_7$  As above (Ditte, C R 95 988)

$\text{Ba}_2\text{U}_3\text{O}_{10} + 4\frac{1}{2}\text{H}_2\text{O}$  Nearly insol in  $\text{H}_2\text{O}$ ,  $\text{KOH} + \text{Aq}$  and alcohol

Easily sol in cold dil  $\text{HCl}$  or  $\text{HNO}_3$  and in hot acetic acid (Zehenter, M 1904, 25 200)

$\text{Ba}_2\text{U}_3\text{O}_{17} + 8\text{H}_2\text{O}$  Nearly insol in hot or cold  $\text{H}_2\text{O}$ ,  $\text{KOH} + \text{Aq}$  and alcohol

Easily sol in cold dil  $\text{HCl}$  or  $\text{HNO}_3$  and in hot acetic acid (Zehenter)

$\text{Ba}_2\text{U}_7\text{O}_{23} + 11\text{H}_2\text{O}$  Same properties as  $\text{BaU}_3\text{O}_{10}$  (Zehenter)

**Bismuth uranate**,  $\text{Bi}_2\text{O}_3$ ,  $\text{UO}_3 + \text{H}_2\text{O}$

Min *Uranosphæerite*

**Calcium uranate**,  $\text{CaUO}_4$

Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Ditte, C R 95 988)

$\text{CaU}_2\text{O}_7$  Insol in  $\text{H}_2\text{O}$ , sol in dil acids (Ditte)

**Cobalt uranate**

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  (Persoz, J pr 3 216)

Sol in  $\text{HNO}_3 + \text{Aq}$ , insol in  $\text{KNO}_3 + \text{Aq}$  (Ebelmen, A ch (3) 5 222)

**Cupric uranate**,  $\text{CuU}_2\text{O}_7$

Insol in  $\text{H}_2\text{O}$  (Debray, A ch (3) 61 451)

**Lead uranate**,  $\text{PbUO}_4$

If ignited, very difficultly sol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Wertheim, J pr 29 228)

Insol in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  (Persoz)

$3\text{PbO}$ ,  $2\text{UO}_3$  Sol in dil  $\text{HNO}_3 + \text{Aq}$

(Ditte, A ch (6) 1 338)

$\text{PbU}_{10}\text{O}_{10}$  Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$ , Insol in  $\text{KOH} + \text{Aq}$ ,  $\text{NH}_4\text{OH}$  and cold acetic acid Sol in hot acetic acid (Zehenter, M 1904, 25 210)

$\text{Pb}_2\text{U}_3\text{O}_{19} + 4\text{H}_2\text{O}$  Insol in hot or cold  $\text{H}_2\text{O}$  Sol in  $\text{HNO}_3$  Insol in  $\text{KOH} + \text{Aq}$ ,  $\text{NH}_4\text{OH}$ , alcohol and ether Sl sol in cold, more easily sol in hot acetic acid (Zehenter)

**Lithium uranate**,  $\text{Li}_2\text{UO}_4$

Insol in  $\text{H}_2\text{O}$ , but decomp thereby sol in dil acids

**Magnesium uranate**,  $\text{MgUO}_4$

Insol in  $\text{H}_2\text{O}$  Nearly insol in cold  $\text{HCl} + \text{Aq}$  Slowly sol in  $\text{HCl} + \text{Aq}$  on warming and more rapidly by addition of a little  $\text{HNO}_3 + \text{Aq}$  (Ditte)

$\text{MgUO}_4$  Ppt Berzelius

**Neodymium uranate**,  $\text{Nd}_2\text{UO}_7 - 10\text{H}_2\text{O}$

Ppt (Orloff Ch Z 1907 31 119)

**Potassium uranate**,  $\text{K}_2\text{UO}_4$

Insol in  $\text{H}_2\text{O}$  sol in dil acids as  $\text{NaUO}_4$  (Ditte)

$\text{K}_2\text{UO}_4 - 6\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  sol in dil acids even acetic acid (Zehenter, B 14 440)

Insol in  $\text{KCO}_3 + \text{Aq}$  but in alkali hydrogen carbonate  $+ \text{Aq}$

$\text{HCl} + \text{Aq}$  (Ebelmen, A ch (3) 5 222)

$\text{K}_2\text{O}$ ,  $4\text{UO}_3 - 5\text{H}_2\text{O}$  (Zehenter, M 1900 21 235)

$\text{K}_2\text{O}$ ,  $6\text{UO}_3 + 6\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Drenckmann Zeit ges Nat 17 115)

$+ 10\text{H}_2\text{O}$  Nearly insol in cold  $\text{H}_2\text{O}$  Sol in hot acetic acid and  $\text{HNO}_3$

$\text{HCl}$  and  $\text{HNO}_3$  Insol in  $\text{KOH} + \text{Aq}$ , alcohol and ether (Zehenter M 1900 21 235)

**Potassium uranylamine uranate,**

Sl sol in  $\text{H}_2\text{O}$ , insol in alcohol (Hofmann, A 1899, 307 318)

**Rubidium uranate,  $\text{RbUO}_4$** 

Insol in  $\text{H}_2\text{O}$  (Ditte, A ch (6) 1 338)

**Silver uranate,  $\text{Ag}_2\text{U}_2\text{O}_7$** 

Insol in  $\text{H}_2\text{O}$  Easily sol in acids (Alibegoff, A 233 117)

**Sodium uranate,  $\text{Na}_2\text{UO}_4$  (?)**

Insol in  $\text{H}_2\text{O}$ , sol in dil acids Sol in alkali carbonates + Aq (Ditte)

$\text{Na}_2\text{U}_2\text{O}_7+6\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  Sol in dil acids (Stolba, Z anal 3 74)

$\text{Na}_2\text{O}$ ,  $3\text{UO}_3$  Insol in  $\text{H}_2\text{O}$  Easily sol in very dil acids (Drenckmann)

$\text{Na}_2\text{O}$ ,  $5\text{UO}_3+5\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$ , alcohol,  $\text{NH}_4\text{OH}$   $\text{KOH}+\text{Aq}$  Sol in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  Sl sol even on boiling in conc acetic acid (Zehenter, M 1900, 21 235)

**Sodium hydroxylamine uranate,**

Sol in  $\text{H}_2\text{O}$  (Hofmann, A 1899, 307 319)  
 $\text{UO}_4(\text{NH}_3\text{ONa})_2+6\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Hofmann)

**Strontium uranate,  $\text{SrUO}_4$** 

Insol in  $\text{H}_2\text{O}$  Sol in dil acids  
 $\text{SrU}_2\text{O}_7$  As above (Ditte, C R 95 988)

Very sl sol in  $\text{H}_2\text{O}$  Sol in all acids especially oxalic

$+\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  Sol in all acids especially oxalic (J, C C 1896, II 512)

**Thallous uranate**

Ppt (Bolton, Am Chemist, 1872, 2 456)

**Zinc uranate**

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2+\text{Aq}$  (Persoz, J pr 3 216) Sol in  $\text{HNO}_3+\text{Aq}$ , insol in  $\text{KNO}_3$ , and  $\text{NH}_4\text{NO}_3+\text{Aq}$  (Ebelmen A ch (3) 5 221)

**Peruranic acid**

See Peruranic acid

**Uranium, U**

Not attacked by  $\text{H}_2\text{O}$  Slowly decomp by cold dil  $\text{H}_2\text{SO}_4+\text{Aq}$ , rapidly on warming Easily sol in dil or conc  $\text{HCl}+\text{Aq}$  Fused U is slightly attacked by conc or fuming  $\text{HNO}_3$ , or conc  $\text{H}_2\text{SO}_4$  Amorphous U, however, is easily attacked thereby Not attacked by acetic acid,  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{NH}_4\text{OH}+\text{Aq}$  (Zimmermann, B 15 849)

When finely divided, it is decomp by  $\text{H}_2\text{O}$  slowly at ordinary temps and rapidly at  $100^\circ$  (Moissan, C R 1896, 122 1091)

**Uranium antimonide,  $\text{U}_3\text{Sb}_2$** 

Violently attacked by conc  $\text{HNO}_3$  (Colani, C R 1903, 137 383)

**Uranium arsenide,  $\text{U}_3\text{As}_2$** 

Violently attacked by conc  $\text{HNO}_3$  (Colani, C R 1903 137 383)

**Uranium boride,  $\text{UB}_2$** 

Sol in  $\text{HNO}_3$  and  $\text{HF}$  Decomp by fused alkalis (Wedekind, B 1913, 46 1204)

**Uranium tribromide,  $\text{UBr}_3$** 

Very hygroscopic Sol in  $\text{H}_2\text{O}$  with hissing (Alibegoff, A 233 117)

**Uranium tetrabromide,  $\text{UBr}_4$** 

Anhydrous Very deliquescent Sol in  $\text{H}_2\text{O}$  with hissing (Hermann)

Insol in alcohol (v Unruh, Dissert, 1909)

Sol in acetone (Eidmann, C C 1899, II 1014), methyl acetate (Naumann, B 1909, 42 3790), ethyl acetate (Naumann, B 1904, 37 3601)

$+8\text{H}_2\text{O}$  Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Uranium carbide,  $\text{UC}_2$** 

(Ruff and Heinzelmann, Z anorg 1911, 71 72)

Attacked slowly by  $\text{H}_2\text{O}$  Slowly attacked by cold dil  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3+\text{Aq}$  Conc acids, except  $\text{HNO}_3$ , react sl in the cold, violently on heating (Moissan, Bull Soc 1897, (3) 17 12)

Sol in fused  $\text{KNO}_3$  and  $\text{KClO}_3$ , sol in dil acids in the cold and in conc acids on heating, decomp by  $\text{H}_2\text{O}$  (Moissan, C R 1896, 122 276)

**Uranium trichloride,  $\text{UCl}_3$** 

Very sol in  $\text{H}_2\text{O}$  (Peligot)

Very unstable (Zimmermann)

Very hygroscopic Sol in  $\text{H}_2\text{O}$  with decomp Sol in conc  $\text{HCl}$  and solution is much more stable than aqueous one (Rosenheim and Loebel, Z anorg 1908, 57 234)

**Uranium tetrachloride,  $\text{UCl}_4$** 

Anhydrous Extremely deliquescent

Sol in  $\text{H}_2\text{O}$  with evolution of heat Decomp on boiling Sol in  $\text{NH}_4\text{Cl}+\text{Aq}$  without decomp

$\text{HCl}$  increases its solubility in  $\text{H}_2\text{O}$  (Aloy, Dissert 1901)

Sol in alcohol, acetone, acetic ether, benzoic ether Insol in ether,  $\text{CHCl}_3$  and  $\text{C}_6\text{H}_6$  (Loebel)

Sol in ethyl acetate (Naumann, B 1904, 37 3601)

**Uranium pentachloride,  $\text{UCl}_5$** 

Deliquescent Sol in  $\text{H}_2\text{O}$  with evolution of heat and decomposition (Roscoe, B 7 1131)

Sol in acetic acid, acetic ether, benzaldehyde, glycerine, benzyl alcohol (trace), nitrobenzene (trace), xylidine and p-toluidine (on warming)

Insol in aniline, ligroin, pyridine, quinoline, phioethyl ether, thioamyl ether and  $\text{CS}_2$  (Pummer, Dissert 1904)

Sol in abs alcohol Insol in ether,  $\text{C}_6\text{H}_6$ , nitrobenzene, ethylene bromide Sl sol in  $\text{CCl}_4$  and  $\text{CHCl}_3$  Sol in benzoic ether, acetone and trichloroacetic acid Best solvents are ethyl acetate and benzonitrile Sol in many organic compounds containing oxygen (Loebel, Dissert 1907)

### Uranum difluoride, $\text{UF}_2 + 2\text{H}_2\text{O}$

Ppt (Giulitti and Agamennone, C C 1905, I 1130)

### Uranum tetrafluoride, $\text{UF}_4$

Insol in  $\text{H}_2\text{O}$  Very sl sol in dil acids Sol in hot conc  $\text{H}_2\text{SO}_4$ , and slowly in warm conc  $\text{HNO}_3 + \text{Aq}$  (Bolton, J B 1866 209)

### Uranum hexafluoride, $\text{UF}_6$

Very sol in  $\text{H}_2\text{O}$  (Ditte, A ch (6) 1 339)

Fumes in the air

Very hygroscopic, sol in  $\text{H}_2\text{O}$  (Ruff, B 1909, 42 495)

Very hygroscopic Sol in  $\text{H}_2\text{O}$  Nearly insol in  $\text{CS}_2$  Insol in paraffine oil Sol in symmetrical tetrachlorethane (best solvent),  $\text{CHCl}_3$ ,  $\text{CCl}_4$  and nitrobenzene (v Unruh, Dissert 1909)

Decomp by  $\text{H}_2\text{O}$ , alcohol and ether Nearly insol in  $\text{CS}_2$

Sol in  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , nitrobenzene and  $\text{C}_2\text{H}_5\text{Cl}_4$  (Ruff, Z anorg 1911, 72 81)

### Uranum hydrogen fluoride, $\text{UF}_6 \cdot 8\text{HF}$ (?)

Sol in  $\text{H}_2\text{O}$  (Ditte)

Is  $\text{UO}_2\text{F}_2 \cdot \text{HF} + \text{H}_2\text{O}$  (Smithells)

### Uranous hydroxide, $\text{UO}_2 \cdot x\text{H}_2\text{O}$

Easily sol in dil acids

Insol in alkali hydrates and carbonates + Aq (Berzelius)

Sol in alkali carbonates + Aq (Rammelsberg)

$\text{U}(\text{OH})_4$  Sol in dil acids (Aloy, Bull Soc 1899, (3) 21 613)

### Uranouranic hydroxide, $\text{U}_3\text{O}_8 \cdot 6\text{H}_2\text{O}$ (?)

Easily sol in acids

Decomp by  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , which dissolves out  $\text{UO}_3$  (Berzelius)

### Uranic hydroxide

See Uranic acid

### Uranum tetraiodide, $\text{UI}_4$

Sol in  $\text{H}_2\text{O}$  (Guichard, C R 1907, 145 921)

### Uranum iodide

Sol in ethyl acetate (Naumann, B 1904 37 3601)

### Uranum nitride, $\text{U}_3\text{N}_4$

(Colani, C R 1903 137 383)

### Uranum suboxide, $\text{UO}$ (?)

(Guyard, Bull Soc (2) 1 89)

Does not exist (Zimmermann, A 213 301)

$\text{U}_2\text{O}_3$  (?) Ppt Decomp by  $\text{H}_2\text{O}$  and in the air (Peligot)

### Uranum dioxide (Uranous oxide), $\text{UO}_2$

Insol in dil HCl or  $\text{H}_2\text{SO}_4 + \text{Aq}$

Sol in conc  $\text{H}_2\text{SO}_4$ , and easily in  $\text{HNO}_3 + \text{Aq}$  (Peligot)

Insol in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Rose)

Only sl sol in  $\text{H}_2\text{SO}_4$ , but a considerable amount is converted into the sulphate which is nearly insol in  $\text{H}_2\text{SO}_4$

Slowly sol in HCl, the amount dissolved in a given time varying widely with the method of preparation of the oxide (Colani, C R 1912, 155 1251)

Sl more sol in  $\text{HNO}_3$  than in aqua regia. (Raynaud, Bull Soc 1912, (4) 11 802)

Very sol in conc  $\text{HNO}_3$ , less sol in dil  $\text{HNO}_3$  1 gram is sol in 3100 grams HCl (1 17) at  $17^\circ$ , 4650 grams  $\text{HBr}$  (1 52) at  $17^\circ$ , 2200 grams  $\text{H}_2\text{SO}_4$  (1 79) at  $17^\circ$ , 12,000 grams acetic acid at  $19^\circ$  (Raynaud, C R 1911, 153 1481)

Sl attacked by liquid  $\text{NH}_3$  (Gore, Am Ch J 1898, 20 830)

Min Uraninite Easily sol in warm  $\text{HNO}_3 + \text{Aq}$  Not attacked by  $\text{HCl} + \text{Aq}$

### Uranum trioxide (Uranic oxide), $\text{UO}_3$

Sol in  $\text{HNO}_3 + \text{Aq}$  (Peligot)

Insol in boiling K tartrate + Aq Fah lenberg and Hillver, Am Ch J 1894, 16 102

Sol in oleic acid (Gibbons, Arch Pharm 1883, 221 621)

See Uranic acid

### Uranum tetroxide, $\text{UO}_4$

Decomp by  $\text{HCl} + \text{Aq}$  (Fairley Chem Soc 31 133)

+  $2\text{H}_2\text{O}$  Very hygroscopic (Zimmermann)

+  $3\text{H}_2\text{O}$

### Uranum pentoxide, $\text{U}_2\text{O}_5$

Sol in acids (Peligot)

Mixture of  $\text{UO}_3$  and  $\text{U}_2\text{O}_5$  (Rammelsberg, Pogg 59 5)

Mixture of  $\text{UO}$  and  $\text{U}_3\text{O}_8$  (Zimmermann A 232 273)

### Uranouranic oxide, $\text{U}_3\text{O}_8$

Green uranium oxide Very slowly and slightly sol in dil HCl or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , more easily when conc Completely sol in boiling  $\text{H}_2\text{SO}_4$  Easily sol in  $\text{HNO}_3 + \text{Aq}$

Solubility in salts + Aq at t°		
Salt solution	t°	Solubility mol per litre
0.05-N NH <sub>4</sub> Cl + Aq	18	0.01419
	25	0.02246
	35	0.04445
	45	0.07575
	55	0.09544
0.1-N NH <sub>4</sub> Cl + Aq	18	0.00356
	25	0.00995
	35	0.02347
	45	0.04507
	55	0.06314
0.05-N NH <sub>4</sub> NO <sub>3</sub> + Aq	18	0.01433
	25	0.02364
0.1-N NH <sub>4</sub> NO <sub>3</sub> + Aq	18	0.00497
	25	0.01050

(Meyer, Z Elektrochem, 1909, 15 267)

Insol in alcohol (v Hauer)

(b) Sol in cold H<sub>2</sub>O, from which it is pptd by alcohol (Berzelius)

**Ammonium divanadate, (NH<sub>4</sub>)<sub>2</sub>V<sub>4</sub>O<sub>11</sub> + 4H<sub>2</sub>O**

Sol in H<sub>2</sub>O, from which it is precipitated by sat NH<sub>4</sub>Cl + Aq or alcohol (v Hauer, W A B 21 337)

Correct formula is (NH<sub>4</sub>)<sub>2</sub>V<sub>7</sub>O<sub>10</sub> + 2H<sub>2</sub>O, according to Rammelsberg (B A B 1883 3) + 3H<sub>2</sub>O Very sol in H<sub>2</sub>O (Ditte, C R 102 918)

**Ammonium trivanadate, (NH<sub>4</sub>)<sub>2</sub>V<sub>6</sub>O<sub>16</sub>**

Anhydrous Nearly insol in hot or cold H<sub>2</sub>O (Norblad, B 8 126)

15 g dissolve in 1 litre of boiling H<sub>2</sub>O (Ditte, C R 102 918)

+5H<sub>2</sub>O Very sl sol in H<sub>2</sub>O (Ditte)  
+6H<sub>2</sub>O (?) Very sol in H<sub>2</sub>O (v Hauer, W A B 39 455)

Could not be obtained (Norblad, also Rammelsberg, B A B 1883 3)

**Ammonium vanadate, (NH<sub>4</sub>)<sub>3</sub>V<sub>7</sub>O<sub>10</sub> + 2H<sub>2</sub>O**

Correct formula of v Hauer's divanadate, according to Rammelsberg (B A B 1883 3)  
Sl sol in H<sub>2</sub>O

**Ammonium sesquivanadate, (NH<sub>4</sub>)<sub>4</sub>V<sub>6</sub>O<sub>17</sub> + 4 or 6H<sub>2</sub>O**

Very sol in H<sub>2</sub>O (Ditte, C R 102 918)

**Ammonium pentavanadate, (NH<sub>4</sub>)<sub>4</sub>V<sub>10</sub>O<sub>27</sub> + 10H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Rammelsberg, B A B 1883 3)

**Ammonium hydroxylamine vanadate, VO<sub>2</sub>N<sub>2</sub>H<sub>3</sub>O**

Rapidly decomp by H<sub>2</sub>O (Hofmann and Kohlschütter, Z anorg 1898, 16 472)

HVO<sub>3</sub>, 3NH<sub>3</sub>O, 2NH<sub>3</sub> = VO<sub>2</sub>N<sub>2</sub>H<sub>3</sub>O Rf  
rdly decomp by H<sub>2</sub>O (Hofmann and Kohlschütter)

**Ammonium potassium vanadate, K<sub>2</sub>V<sub>4</sub>O<sub>11</sub> (NH<sub>4</sub>)<sub>4</sub>V<sub>6</sub>O<sub>17</sub> + 9H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Ditte, C R 104 1844)

**Ammonium sodium vanadate, Na<sub>2</sub>V<sub>4</sub>O<sub>11</sub> (NH<sub>4</sub>)<sub>4</sub>V<sub>6</sub>O<sub>17</sub> + 15H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Ditte, C R 104 1841)

**Ammonium uranyl vanadate, (NH<sub>4</sub>)<sub>2</sub>O, 2UO V<sub>2</sub>O<sub>5</sub> + H<sub>2</sub>O**

Insol in H<sub>2</sub>O, NH<sub>4</sub>OH + Aq, or dil HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq (Carnot, C R 104 1850)

**Barium metavanadate, Ba(VO<sub>3</sub>)<sub>2</sub> + H<sub>2</sub>O**

Somewhat sol in H<sub>2</sub>O before ignitio  
Sol in conc H<sub>2</sub>SO<sub>4</sub> (Berzelius)

**Barium pyrovanadate, Ba<sub>2</sub>V<sub>2</sub>O<sub>7</sub>**

Somewhat sol in H<sub>2</sub>O (Roscoe)

**Barium vanadate, Ba<sub>2</sub>V<sub>6</sub>O<sub>17</sub> + 14H<sub>2</sub>O**

(Ditte, C R 104 1705)

Ba<sub>3</sub>V<sub>10</sub>O<sub>28</sub> + 19H<sub>2</sub>O 1 pt is sol in 521 pts H<sub>2</sub>O at 20-25° Much more sol in H<sub>2</sub>O but decomp by boiling H<sub>2</sub>O (v Hauer, W A B 21 344)

Sol in about 5000 pts H<sub>2</sub>O (Manasse, C 1886 773)

Ba<sub>4</sub>V<sub>10</sub>O<sub>29</sub> + 2H<sub>2</sub>O (Norblad)

**Bismuth vanadate, Bi<sub>2</sub>(VO<sub>4</sub>)<sub>2</sub>**

Min Pucheran Sol in HCl + Aq with evolution of Cl

**Cadmium vanadate, Cd(VO<sub>3</sub>)<sub>2</sub>**

(Ditte, C R 102 918)

CdV<sub>6</sub>O<sub>16</sub> + 24H<sub>2</sub>O Sl sol in H<sub>2</sub>O (Ditte, C R 104 1705)

**Cadmium potassium vanadate, CdK<sub>2</sub>V<sub>6</sub>O<sub>17</sub> + 9H<sub>2</sub>O**

(Radau, A 251 148)

Cd<sub>3</sub>V<sub>10</sub>O<sub>28</sub>, K<sub>3</sub>V<sub>10</sub>O<sub>28</sub> + 27H<sub>2</sub>O 1000 p H<sub>2</sub>O dissolve 5.4 pts at 18° (Radau)

**Cadmium vanadate bromide, 3Cd<sub>2</sub>(VO<sub>4</sub>) CdBr<sub>2</sub>**

Very sol in dil acids (de Schulten, B Soc 1900, (3) 23 160)

**Cadmium vanadate chloride, 3Cd<sub>2</sub>(VO<sub>4</sub>) CdCl<sub>2</sub>**

Very sol in dil acids (de Schulten, B Soc 1900, (3) 23 159)

**Cæsium metavanadate, CsVO<sub>3</sub>**

(Chabrie, A ch 1902, (7) 26 228)

**Calcium metavanadate**,  $\text{Ca}(\text{VO}_3)_2 + 4\text{H}_2\text{O}$

Much more sol than  $\text{Sr}(\text{VO}_3)_2$ , and solution is not precipitated by alcohol (Berzelius)

+  $3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}_2$ , insol in alcohol (Scheuer, Z anorg 1898, 16 304)

**Calcium pyrovanadate**,  $\text{Ca}_2\text{V}_2\text{O}_7 + 5\text{H}_2\text{O}$

Precipitate

+  $2\text{H}_2\text{O}$  Very sol in dil acids (Ditte C R 104 1705)

+  $2\frac{1}{2}\text{H}_2\text{O}$  (Roscoe)

**Calcium divanadate**,  $\text{Ca}_2\text{V}_4\text{O}_{11} + 9\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (v Hauer)

When fused is nearly insol in  $\text{H}_2\text{O}$  (v Hauer.)

+  $6\text{H}_2\text{O}$  (Manasse, A 240 23)

**Calcium trivanadate**,  $\text{Ca}_3\text{V}_6\text{O}_{17} + 12\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$  (Ditte, C R 104 1705)

**Calcium vanadate**,  $\text{Ca}_3\text{V}_3\text{O}_{13} + 15\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Manasse, A 204 23)

$\text{Ca}_3\text{V}_{14}\text{O}_{38} + 7\text{H}_2\text{O}$  (?) Sol in  $\text{H}_2\text{O}$   
Probably a mixture (Manasse, A 240 23)

$\text{Ca}_3\text{V}_{16}\text{O}_{43} + 26\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Manasse, A 240 23)

**Calcium copper vanadate**,  $(\text{Ca}, \text{Cu})_4\text{V}_2\text{O}_9 + \text{H}_2\text{O}$

Min *Volborthite* Sol in  $\text{HNO}_3 + \text{Aq}$

**Calcium potassium vanadate**,  $\text{CaK}_3\text{V}_{20}\text{O}_{55} + 22\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Manasse, A 240 23)

**Calcium vanadate chloride**,  $\text{Ca}_3(\text{VO}_4)_2, \text{CaCl}_2$   
(Hautefeuille, C R 77 896)

**Chromium vanadate**,  $\text{CrVO}_4$

Absolutely insol in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  and  $\text{HC}_2\text{H}_3\text{O}_2$  (Carnot, C R 104 1850)

**Cobaltous metavanadate**,  $\text{Co}(\text{VO}_3)_2 + 3\text{H}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$  (Ditte, C R 104 1705)

**Cobaltous potassium vanadate**,  $\text{CoKV}_3\text{O}_{14} + 8\text{H}_2\text{O}$

1000 pts  $\text{H}_2\text{O}$  dissolve 4 8 pts of this salt (Radau, A 251 140)

$\text{Co}_3\text{K}_2\text{V}_{14}\text{O}_{39} + 21\text{H}_2\text{O}$  (Radau)

**Cupric metavanadate**

Sol in  $\text{H}_2\text{O}$  (Berzelius)

**Cupric pyrovanadate**,  $\text{Cu}_2\text{V}_2\text{O}_7 + 3\text{H}_2\text{O}$

Sol in hot  $\text{H}_2\text{O}$  (Ditte, C R 104 1705)

Could not be obtained (Radau, A 251 150)

**Cupric lead vanadate**,  $5(\text{Cu}, \text{Pb})\text{O}, \text{V}_2\text{O}_5 + 2\text{H}_2\text{O}$

Min *Moltramite*

$3\text{CuO}, \text{V}_2\text{O}_5, 3(3\text{PbO}, \text{V}_2\text{O}_5), 6\text{CuO}_2\text{H}_2 + 12\text{H}_2\text{O}$  Min *Psittacinite*

**Cupric potassium vanadate**,  $\text{CuKV}_3\text{O}_{14} + 17\text{H}_2\text{O}$

Moderately sol in warm  $\text{H}_2\text{O}$  100 pts  $\text{H}_2\text{O}$  dissolve 11 1 pts at  $18^\circ$  (Padau, A 251 151)

**Didymium vanadate**,  $\text{Dy}_2(\text{VO}_4)_2$

Precipitate (Cleve)

$\text{Dy}_2\text{V}_{10}\text{O}_{30} + 28\text{H}_2\text{O}$  Precipitate (Cleve, Bull Soc (2) 43 365)

**Glucinum metavanadate** (?)

Difficultly sol in  $\text{H}_2\text{O}$  (Berzelius)

**Glucinum divanadate** (?)

Difficultly sol in  $\text{H}_2\text{O}$  (Berzelius)

**Indium metavanadate**,  $\text{In}(\text{VO}_3)_2 + 2\text{H}_2\text{O}$

Ppt (Renz, Dissert 1902)

**Iron (ferrous) metavanadate**

Ppt Sol in  $\text{HCl} + \text{Aq}$  (Berzelius)

**Iron (ferric) metavanadate**

Somewhat sol in  $\text{H}_2\text{O}$  (Berzelius)

**Lead metavanadate**,  $\text{Pb}(\text{VO}_3)_2$

Sol in  $\text{H}_2\text{O}$  Easily sol in warm dil  $\text{HNO}_3 + \text{Aq}$  Not completely decomp by  $\text{H}_2\text{SO}_4$  or by boiling with  $\text{K}_2\text{CO}_3 + \text{Aq}$  (Berzelius)

Min *Dechenite* Easily sol in dil  $\text{HNO}_3 + \text{Aq}$ , and decomp by  $\text{HCl} + \text{Aq}$

**Lead pyrovanadate, basic**,  $2\text{Pb}_2\text{V O}_7, \text{PbO}$

Insol in boiling  $\text{H}_2\text{O}$  or  $\text{HC}_2\text{H}_3\text{O}_2$  Decomp by  $\text{HNO}_3 + \text{Aq}$  with separation of  $\text{V O}_5$ , which dissolves on warming (Roscoe)

**Lead pyrovanadate**,  $\text{Pb}_2\text{V}_2\text{O}_7$

Sol in warm dil  $\text{HNO}_3 + \text{Aq}$  (Ditte, C R 104 1705)

Min *Desclonite* Sol in cold dil  $\text{HNO}_3 + \text{Aq}$

**Lead divanadate**,  $\text{Pb}_2\text{V}_4\text{O}_{11}$

(Ditte, C R 104 1705)

**Lead orthovanadate**,  $\text{Pb}_3(\text{VO}_4)_2$

Insol in  $\text{H}_2\text{O}$  (Roscoe, A suppl 8 109)

**Lead zinc orthovanadate**,  $4\text{Pb}_3(\text{VO}_4)_2$

$3\text{Zn}_3(\text{VO}_4)_2$

Min *Eusynchite* Easily sol in  $\text{HNO}_3 + \text{Aq}$



**Lead zinc vanadate,  $(\text{Pb}, \text{Zn})_4\text{V}_2\text{O}_9 + \text{H}_2\text{O}$** 

Min *Desclozite* Sol in excess of  $\text{HNO}_3 + \text{Aq}$

**Lead vanadate chloride,  $3\text{Pb}_3(\text{VO}_4)_2, \text{PbCl}_2$** 

Min *Vanadinite* Easily sol in  $\text{HNO}_3 + \text{Aq}$

**Lithium vanadate, basic,  $\text{Li}_3\text{V}_2\text{O}_8 + 6\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Ditte, C R 104 1168)  
 $\text{Li}_3\text{V}_2\text{O}_8 + \text{H}_2\text{O}$ , and  $14\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Ditte)

**Lithium metavanadate,  $\text{LiVO}_3$** 

Easily sol in  $\text{H}_2\text{O}$  (Berzelius)  
 $+2\text{H}_2\text{O}$  Quite easily sol in  $\text{H}_2\text{O}$  (Rammelsberg, B A B 1883 3)

**Lithium divanadate,  $\text{Li}_2\text{V}_4\text{O}_{11} + 9\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  (Norblad)  
 Correct formula is  $\text{Li}_3\text{V}_5\text{O}_{14} + 12\text{H}_2\text{O}$  (Rammelsberg)  
 $+8$ , or  $12\text{H}_2\text{O}$  (Ditte, C R 104 1168)

**Lithium orthovanadate,  $\text{Li}_3\text{VO}_4$** 

Insol in  $\text{H}_2\text{O}$  (Rammelsberg, B A B 1883 3)

**Lithium pyrovanadate,  $\text{Li}_4\text{V}_2\text{O}_7 + 4\text{H}_2\text{O}$** 

Very sol in  $\text{H}_2\text{O}$  (Rammelsberg, B 16 1676)  
 $+3\text{H}_2\text{O}$  (Ditte, C R 104 1168)

**Lithium vanadate,  $\text{Li}_3\text{V}_5\text{O}_{14} + 7\text{H}_2\text{O}$** 

Difficultly sol in  $\text{H}_2\text{O}$  (Rammelsberg)  
 $+12\text{H}_2\text{O}$  Very efflorescent Correct formula for v Hauer's divanadate (Rammelsberg)

$\text{Li}_4\text{V}_5\text{O}_{17} + 16\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Ditte, C R 104 1168)

$+15\text{H}_2\text{O}$  (Rammelsberg)

$+11\text{H}_2\text{O}$  (R)

$+3\text{H}_2\text{O}$  (R)

$\text{Li}_5\text{V}_4\text{O}_{15} + 15\text{H}_2\text{O}$  Not very easily sol in  $\text{H}_2\text{O}$  (Rammelsberg)

$\text{Li}_6\text{V}_8\text{O}_{23} + 12\text{H}_2\text{O}$  Moderately sol in  $\text{H}_2\text{O}$  (Rammelsberg)

$\text{Li}_{10}\text{V}_{12}\text{O}_{36} + 30\text{H}_2\text{O}$  Efflorescent Very sol in  $\text{H}_2\text{O}$  (Rammelsberg)

**Magnesium metavanadate,  $\text{Mg}(\text{VO}_3)_2$** 

Very easily sol in  $\text{H}_2\text{O}$  (Berzelius)  
 $+6\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$  (Ditte, C R 104 1705)

**Magnesium divanadate,  $\text{MgV}_4\text{O}_{11} + 8\text{H}_2\text{O}$** 

Difficultly sol in  $\text{H}_2\text{O}$ , but much more sol than barium divanadate (v Hauer)  
 $+9\text{H}_2\text{O}$  (Ditte, C R 104 1705)

**Magnesium trivanadate,  $\text{Mg}_2\text{V}_6\text{O}_{17} + 4\frac{1}{2}\text{H}_2\text{O}$** 

Very sl sol in  $\text{H}_2\text{O}$  (Manasse, A 240 23)

**Magnesium vanadate,  $\text{Mg}_3\text{V}_{10}\text{O}_{28} + 28\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Sugura and Baker, Chem Soc 35 715)

**Manganese metavanadate,  $\text{Mn}(\text{VO}_3)_2 + 4\text{H}_2\text{O}$** 

Very sl sol in cold, somewhat more sol in hot  $\text{H}_2\text{O}$  Easily sol in dil acids (Radau, A 251 125)

Sl sol in  $\text{H}_2\text{O}_2$ , insol in alcohol (Scheuer, Z anorg 1898, 16 304)

**Manganous pyrovanadate,  $\text{Mn}_2\text{V}_2\text{O}_7$** 

Sl sol in hot dil  $\text{HNO}_3 + \text{Aq}$  (Ditte, C R 96 1048)

**Manganous potassium vanadate,  $\text{MnKV}_5\text{O}_{14} + 8\text{H}_2\text{O}$** 

100 pts  $\text{H}_2\text{O}$  dissolve 17 pts salt at  $18^\circ$

Easily sol in acids (Radau, A 251 129)

$3\text{Mn}_3\text{V}_5\text{O}_{23}$ ,  $\text{K}_3\text{V}_5\text{O}_{23} + 54\text{H}_2\text{O}$  (Radau)

$7\text{Mn}(\text{VO}_3)_2$ ,  $2\text{KVO}_3 + 25\text{H}_2\text{O}$  (Radau)

$11\text{Mn}(\text{VO}_3)_2$ ,  $2\text{KVO}_3 + 48\text{H}_2\text{O}$  (Radau)

**Mercuric vanadate**

Sl sol in  $\text{H}_2\text{O}$

**Nickel vanadate,  $\text{Ni}(\text{VO}_3)_2$** 

Sol in  $\text{H}_2\text{O}$  (Ditte, C R 104 1705)

**Nickel orthovanadate,  $\text{Ni}_3(\text{VO}_4)_2$** 

Insol in  $\text{H}_2\text{O}$ , sol in  $\text{HNO}_3 + \text{Aq}$  (Ditte, C R 96 1049)

**Nickel divanadate,  $\text{NiV}_4\text{O}_{11} + 3\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Ditte, C R 104 1705)

**Nickel potassium vanadate,  $5\text{Ni}(\text{VO}_3)_2, 2\text{KVO}_3 + 25\text{H}_2\text{O}$** 

$\text{Ni}_3\text{K}_2\text{V}_{10}\text{O}_{28} + 17\text{H}_2\text{O}$  Very sl sol in hot  $\text{H}_2\text{O}$

$\text{NiKV}_5\text{O}_{14} + 8\text{H}_2\text{O}$

$2\text{Ni}_3\text{V}_{14}\text{O}_{38}$ ,  $\text{K}_3\text{V}_{14}\text{O}_{38} + 69\text{H}_2\text{O}$  1000 pts  $\text{H}_2\text{O}$  dissolve 17 pts of salt at  $17.5^\circ$  (Radau, A 251 137)

**Potassium vanadate, basic,  $\text{K}_3\text{V}_2\text{O}_9 + 20\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Ditte, C R 104 902)

**Potassium metavanadate,  $\text{KVO}_3$** 

*Anhydrous* Slowly sol in cold, more easily in hot  $\text{H}_2\text{O}$  Insol in alcohol (Berzelius)

Completely sol in a little cold  $\text{H}_2\text{O}$  (Norblad)

$+ \text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Rammelsberg)

$+ 1\frac{1}{2}\text{H}_2\text{O}$  (Ditte)

$+ 1\frac{1}{2}\text{H}_2\text{O}$  (Ditte)

$+ 2\text{H}_2\text{O}$  (Ditte)

$+ 3\text{H}_2\text{O}$  (Ditte, C R 104 902)

$+ 7\text{H}_2\text{O}$  (Rammelsberg)

**Potassium divanadate**,  $K_2V_4O_{11} + 4H_2O$ 

Sol in cold or lukewarm  $H_2O$  Decomp by  
 hot  $H_2O$  (Rammelsberg)  
 +  $3H_2O$  (Berzelius)  
 +  $3\frac{1}{2}H_2O$  Sol in warm  $H_2O$  (Norblad)  
 + 8 or  $10H_2O$  (Litte, C R 104 902)  
 +  $6H_2O$  (Ephraim, Z anorg 1903, 35 76)

**Potassium trivanadate**,  $K_3V_6O_{18}$ 

Anhydrous Nearly insol in  $H_2O$  (Norblad)  
 +  $6H_2O$  Insol in cold or hot  $H_2O$  (Norblad)  
 + 1, and  $5H_2O$  (Ditte, C R 104 902)

**Potassium orthovanadate**,  $K_3VO_4 + 4\frac{1}{2}$  or  $6H_2O$ 

Deliquescent Sol in  $H_2O$  (Ditte, C R 104 902)  
 Decomp by  $H_2O$  into  $K_4V_2O_7$  and KOH (Rammelsberg, B A B 1883 3)

**Potassium pyrovanadate**,  $K_4V_2O_7 + 3H_2O$ 

Deliquescent Easily sol in  $H_2O$  Insol in alcohol (Norblad)  
 +  $4H_2O$  (Ditte, C R 104 902)

**Potassium vanadate**,  $K_3V_5O_{14} + 5H_2O$ 

100 pts  $H_2O$  dissolve 19.2 pts at  $17.5^\circ$  (Radau, A 251 120)  
 +  $4\frac{1}{2}H_2O$  (Radau)  
 $K_4V_5O_{17} + 2H_2O$  Slowly sol in  $H_2O$  (Rammelsberg)  
 +  $6H_2O$  (Ditte C R 104 902)  
 +  $7H_2O$  (Friedheim B 23 1526)  
 $K_4V_{10}O_{27} + 12H_2O$  Very sol in  $H_2O$  (Manasse, A 240 42)  
 $K_{10}V_5O_{25} + 7H_2O$  Sol in  $H_2O$  (Rammelsberg)  
 $K_2V_8O_{21} + 1\frac{1}{2}H_2O$  Very sl sol in  $H_2O$  (Ephraim, Z anorg 1903, 35 75)  
 $K_4V_{18}O_{47}$  (Ephraim, Z anorg 1903, 35 78)

**Potassium sodium vanadate**,  $2(2K_2O, 3V_2O_5) + 3(2Na_2O, 3V_2O_5) + 30H_2O$ 

(Friedheim, Z anorg 1894, 5 442)  
 $2K_2O, 3V_2O_5, 4(2Na_2O, 3V_2O_5) + 35H_2O$   
 Efflorescent (Friedheim, Z anorg 1894, 5 441)

**Potassium strontium vanadate**,  $K, Sr_3V_{14}O_{39} + 20H_2O$ 

Sol in  $H_2O$  (Manasse, A 240 23)  
 $K_2Sr_3V_{14}O_{39} + 30H_2O$  As above (Manasse)  
 $K_4Sr_3V_{14}O_{39} + 18H_2O$  As above (Manasse)

**Potassium zinc vanadate**,  $KZnV_5O_{14} + 8H_2O$ 

1000 pts  $H_2O$  dissolve 4.1 pts of the salt (Radau, A 251 145)  
 $2K_2V_{14}O_{39}, 3Zn_2V_{14}O_{39} + 90H_2O$  (Radau)

**Potassium vanadate cyanide**,  $K_4V_2O_7, 4KCN + 14H_2O$ 

Easily decomp  
 Insol in alcohol (Petersen Z anorg 1904, 38 343)

**Samarium vanadate**,  $Sm_2O_3, 5V_2O_5 + 28H_2O$ 

(Cleve)  
 +  $24H_2O$  (Cleve)

**Samarium orthovanadate**

Precipitate

**Silver metavanadate**,  $AgVO_3$ 

Sol in  $HNO_3$  or dil  $NH_4OH + Aq$  (Berzelius)  
 Insol in liquid  $NH_3$  (Gore, Am Ch J 1898, 20 829)

**Silver orthovanadate**,  $Ag_3VO_4$ 

Ppt Easily sol in  $HNO_3$  or  $NH_4OH + Aq$  (Roscoe, Proc Roy Soc 18 316)

**Silver pyrovanadate**,  $Ag_4V_2O_7$ 

Ppt (Roscoe)  
 Sol in  $NH_4OH + Aq$  (Ditte C R 104 1705)

**Silver vanadate**,  $Ag_3VO_3$ 

Sol in 21.414 pts  $H_2O$  at  $14^\circ$  and 13.617 pts at  $100^\circ$  (Carnelley A 166 155)

**Silver vanadate ammonia**,  $6AgVO_3, 4NH_3 + 8H_2O$ 

(Ditte, C R 104 1705)

**Sodium vanadate, basic**,  $Na_3VO_3 + 26$  or  $30H_2O$ 

Very sol in  $H_2O$  Ditte

**Sodium metavanadate**,  $NaVO_3$ 

Anhydrous Slowly sol in cold water even in hot  $H_2O$  (Norblad)

100 g  $H_2O$  dissolve at  
 $25^\circ$   $40^\circ$   $60^\circ$  75  
 21.10 26.23 32.97 38.3 g  $NaVO_3$   
 (McAdam and Pierle J Am Chem Soc 1912, 34 606)

+  $2H_2O$  Easily sol in  $H_2O$

100 g  $H_2O$  dissolve at

$25^\circ$   $40^\circ$   $60^\circ$   
 15.23 29.93 65.36 g  $NaVO_3$

At  $75^\circ$  a value was obtained which showed that the solid phase had changed in the less sol modification (McAdam and Pierle J Am Chem Soc 1912 34 607)

+  $1\frac{1}{2}H_2O$  (Ditte C R 104 1061)  
 + 3, 4 and  $5H_2O$  (Ditte)

**Sodium divanadate**,  $Na_2V_4O_{11}$ 

Anhydrous Sl sol even in warm  $H_2O$  but easily sol on addition of acid-

+9H<sub>2</sub>O Easily sol in cold H<sub>2</sub>O Insol  
in alcohol (Norblad)  
+5H<sub>2</sub>O (Ditte, C R 104 1061)  
Not obtained by Rammelsberg (B A B  
1883 3)

**Sodium trivanadate, Na<sub>2</sub>V<sub>3</sub>O<sub>16</sub>+9H<sub>2</sub>O**

Insol in cold or hot H<sub>2</sub>O (Norblad)  
Composition is Na<sub>6</sub>V<sub>18</sub>O<sub>43</sub>+24H<sub>2</sub>O (Ram-  
melsberg)  
2H<sub>2</sub>O (Ditte, C R 104 1061)

**anadate, Na<sub>3</sub>VO<sub>4</sub>+16H<sub>2</sub>O**

in H<sub>2</sub>O, but decomp into  
KOH Precipitated by an ex-  
(Roscoe, A suppl 8 102)  
Fall, Chem Soc 51 96)  
12H<sub>2</sub>O Less sol in dil NaOH  
H<sub>2</sub>O (Baker, A 229 286)

**anadate, Na<sub>4</sub>V<sub>2</sub>O<sub>7</sub>+18H<sub>2</sub>O**

in H<sub>2</sub>O Insol in alcohol

hol (Ditte, C R 104 1061)  
Ditte)

**esquivanadate, Na<sub>4</sub>V<sub>6</sub>O<sub>17</sub>**

*anhydrous* Insol in H<sub>2</sub>O or NH<sub>4</sub>OH+Ag  
(Rammelsberg)  
+10H<sub>2</sub>O (Norblad)  
+16H<sub>2</sub>O Efflorescent (Rammelsberg)  
+18H<sub>2</sub>O (Ditte)

**Sodium pentavanadate, Na<sub>4</sub>V<sub>10</sub>O<sub>27</sub>+3½H<sub>2</sub>O**  
Scarcely sol in H<sub>2</sub>O (Rammelsberg)

**Sodium vanadate, Na<sub>6</sub>V<sub>4</sub>O<sub>13</sub>+6H<sub>2</sub>O**

Difficultly sol in cold H<sub>2</sub>O (Carnelley,  
A 166 155)  
+2H<sub>2</sub>O (Carnelley)  
Na<sub>6</sub>V<sub>16</sub>O<sub>43</sub>+24H<sub>2</sub>O Correct formula for  
Norblad's trivanadate (Rammelsberg)  
Na<sub>2</sub>O, 4V<sub>2</sub>O<sub>5</sub>+7½H<sub>2</sub>O (Baragiola, Dis-  
sert 1902)  
+8½H<sub>2</sub>O (Baragiola)  
3Na<sub>2</sub>O, 5V<sub>2</sub>O<sub>5</sub>+22H<sub>2</sub>O (Prandtl and  
Lustig, Z anorg 1907, 53 405)  
4Na<sub>2</sub>O, 7V<sub>2</sub>O<sub>5</sub>+33H<sub>2</sub>O (Friedheim, Z  
anorg 1894, 5 443)  
5Na<sub>2</sub>O, 8V<sub>2</sub>O<sub>5</sub>+39H<sub>2</sub>O Sol in H<sub>2</sub>O  
(Friedheim, Z anorg 1894, 5 441)

**Sodium vanadate fluoride, 2Na<sub>3</sub>VO<sub>4</sub>, NaF+  
19H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Rammelsberg, W Ann 20  
928)

**Strontium metavanadate, Sr(VO<sub>3</sub>)<sub>2</sub>+4H<sub>2</sub>O**

Difficultly sol in cold H<sub>2</sub>O (Norblad)

**Strontium divanadate, SrV<sub>4</sub>O<sub>11</sub>+9H<sub>2</sub>O**

Sl sol in H<sub>2</sub>O, but much more sol than  
barium divanadate (v Hauer)

Sol in H<sub>2</sub>O<sub>2</sub>+Aq free from H<sub>2</sub>SC  
Insol in alcohol (Scheuer, Z anorg 189  
16 303)

**Strontium trivanadate, SrV<sub>6</sub>O<sub>16</sub>+14H<sub>2</sub>O**

Sol in H<sub>2</sub>O, but decomposes slowly (v  
boiling Easily sol in hot H<sub>2</sub>O acidified  
with HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, and crystallizes therefro  
without decomp (v Hauer, J pr 76 156)

**Strontium tetravanadate, SrV<sub>8</sub>O<sub>21</sub>+11H<sub>2</sub>O**

Sol in hot H<sub>2</sub>O with partial decompositio  
(Manasse, A 240 34)

**Strontium vanadate, Sr<sub>3</sub>V<sub>8</sub>O<sub>28</sub>+14H<sub>2</sub>O**

Sol in H<sub>2</sub>O (Manasse, A 240 23)  
Sr<sub>4</sub>V<sub>14</sub>O<sub>39</sub>+30H<sub>2</sub>O Sol in H<sub>2</sub>O (No  
blad)

**Thallous metavanadate, TlVO<sub>3</sub>**

Sol in 11,534 pts H<sub>2</sub>O at 11°, and 47  
pts at 100° (Carnelley)

**Thallous orthovanadate, Tl<sub>3</sub>VO<sub>4</sub>**

Sl sol in H<sub>2</sub>O Sol in 999 pts H<sub>2</sub>O at 1°  
and 574 p s at 100° (Carnelley, Che-  
Soc (2) 11 323)

**Thallous pyrovanadate, Tl<sub>4</sub>V<sub>2</sub>O<sub>7</sub>**

Sol in 4996 pts H<sub>2</sub>O at 14°, and 3840 p  
H<sub>2</sub>O at 100° (Carnelley)

**Thallous vanadate, Tl<sub>12</sub>V<sub>8</sub>O<sub>28</sub>**

Sol in 3406 pts H<sub>2</sub>O at 14°, and 533 p  
at 100° (Carnelley)  
Tl<sub>12</sub>V<sub>10</sub>O<sub>31</sub> Sol in 9372 pts H<sub>2</sub>O at 1  
and 3366 pts at 100° (Carnelley)  
Tl<sub>12</sub>V<sub>14</sub>O<sub>41</sub> Ppt (Carnelley)

**Thorium vanadate, Th<sub>3</sub>O<sub>12</sub>(VO)<sub>4</sub>, 16V<sub>2</sub>O<sub>5</sub>  
24H<sub>2</sub>O (?)**

Sol in H<sub>2</sub>O (Cleve)  
ThO<sub>2</sub>, V<sub>2</sub>O<sub>5</sub>+6H<sub>2</sub>O Sol in acids (Volo  
Z anorg 1894 6 167)

**Uranyl vanadate, 2UO<sub>3</sub>, V<sub>2</sub>O<sub>5</sub>, (UO<sub>2</sub>)<sub>2</sub>V<sub>2</sub>O<sub>7</sub>**  
Insol in H<sub>2</sub>O (Carnot, C R 104 185)

**Vanadium vanadate, 2VO<sub>2</sub>, V<sub>2</sub>O<sub>5</sub>=V<sub>4</sub>O<sub>9</sub>**

Insol in H<sub>2</sub>O Sol in dil H<sub>2</sub>SO<sub>4</sub> or HN  
+Aq R n n l l cr )  
Slowly sol in HNO<sub>3</sub>+Aq Slow  
sol in NH<sub>4</sub>OH+Aq Reasily sol in HCl+  
(Ditte, C R 101 1487)  
+2½H<sub>2</sub>O (Brierley)  
2VO<sub>2</sub>, 2V<sub>2</sub>O<sub>5</sub>+8H<sub>2</sub>O Insol in H  
(Brierley, Chem Soc 49 31)

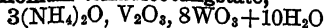
**Ytterbium vanadate, 3Yb<sub>2</sub>O<sub>3</sub>, 5V<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O**  
Yb<sub>2</sub>O<sub>3</sub>, 15V<sub>2</sub>O<sub>5</sub> Ppt (Cleve, Z anorg  
1902, 32 150)

**Yttrium vanadate**

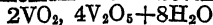
Precipitate (Berzelius)

**Vanadate, Zn(VO<sub>3</sub>)<sub>2</sub>+2H<sub>2</sub>O**Sol in H<sub>2</sub>O (Ditte, C R 104 1705)**Vanadate, Zn<sub>2</sub>V<sub>2</sub>O<sub>7</sub>**Appreciably sol in H<sub>2</sub>O (Ditte, C R 6. 1048)**Pervanadic acid**

See Pervanadic acid

**Vanadicotungstic acid****Ammonium vanadicotungstate,**Very sol in H<sub>2</sub>O

Insol in organic solvents (E F Smith, Am Chem Soc 1903, 25 1227)

**Vanadicoxovanadic acid****Ammonium vanadicoxovanadate, (NH<sub>4</sub>)<sub>2</sub>O,**Sl sol in cold and warm H<sub>2</sub>O (Gibbs, Am Ch J 7 209)(NH<sub>4</sub>)<sub>2</sub>O, 2V<sub>2</sub>O<sub>4</sub>, 2V<sub>2</sub>O<sub>5</sub>+14H<sub>2</sub>O Sol in H<sub>2</sub>O (Brierley, Chem Soc 49 30)3(NH<sub>4</sub>)<sub>2</sub>O, 2V<sub>2</sub>O<sub>4</sub>, 4V<sub>2</sub>O<sub>5</sub>+6H<sub>2</sub>O Insol in H<sub>2</sub>O (Brierley)**Potassium —, 2K<sub>2</sub>O, 2V<sub>2</sub>O<sub>4</sub>, V<sub>2</sub>O<sub>5</sub>+6H<sub>2</sub>O**Sol in hot H<sub>2</sub>O (Brierley, Chem Soc 59 30)5K<sub>2</sub>O, 2V<sub>2</sub>O<sub>4</sub>, 4V<sub>2</sub>O<sub>5</sub>+H<sub>2</sub>O Insol in H<sub>2</sub>O (Brierley)K<sub>2</sub>O, V<sub>2</sub>O<sub>4</sub>, 8V<sub>2</sub>O<sub>5</sub> Insol in H<sub>2</sub>OSol in conc H<sub>2</sub>SO<sub>4</sub> (Prandtl, B 1905, 18 660)**Sodium —, 2Na<sub>2</sub>O, 2V<sub>2</sub>O<sub>4</sub>, V<sub>2</sub>O<sub>5</sub>+13H<sub>2</sub>O**Easily sol in H<sub>2</sub>O Insol in conc solutions of salts, especially acetate (Brierley, Chem Soc 49 30)2Na<sub>2</sub>O, V<sub>2</sub>O<sub>4</sub>, 5V<sub>2</sub>O<sub>5</sub> Insol in H<sub>2</sub>O Sol in conc H<sub>2</sub>SO<sub>4</sub> Not attacked by boiling with conc HNO<sub>3</sub> Slowly attacked by hot dil NH<sub>4</sub>OH+Aq (Prandtl, B 1905, 38 359)**Vanadioarsenic acid**

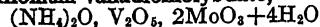
See Arsenovanadic acid

**Vanadioiodic acid**

See Iodovanadic acid.

**Vanadiomolybdic acid, 8MoO<sub>3</sub>, V<sub>2</sub>O<sub>5</sub>+5H<sub>2</sub>O**Very sl sol, in H<sub>2</sub>O, and sl sol in boiling HNO<sub>3</sub>+Aq (Ditte, C R 102 757)

Could not be obtained (Friedheim, B 24 1173)

**Ammonium vanadiomolybdate,**Nearly insol in H<sub>2</sub>O (Friedheim and Castendyck, B 1900, 33 1615)(NH<sub>4</sub>)<sub>2</sub>O, 2V<sub>2</sub>O<sub>5</sub>, 2MoO<sub>3</sub>+8H<sub>2</sub>O Nearly insol in H<sub>2</sub>O (Friedheim and Castendyck)2(NH<sub>4</sub>)<sub>2</sub>O, V<sub>2</sub>O<sub>5</sub>, 3MoO<sub>3</sub>+6H<sub>2</sub>O (Euler-Chelpin, Dissert, 1895)(NH<sub>4</sub>)<sub>2</sub>O, V<sub>2</sub>O<sub>5</sub>, 3MoO<sub>3</sub>+17H<sub>2</sub>O (Euler-Chelpin)2(NH<sub>4</sub>)<sub>2</sub>O, V<sub>2</sub>O<sub>5</sub>, 4MoO<sub>3</sub>+7H<sub>2</sub>O and +8H<sub>2</sub>O (Euler-Chelpin)3(NH<sub>4</sub>)<sub>2</sub>O, 2V<sub>2</sub>O<sub>5</sub>, 4MoO<sub>3</sub>+7H<sub>2</sub>O (Milch, Dissert Berlin, 1887)+9H<sub>2</sub>O Sol in H<sub>2</sub>O (Ditte, C R 102 1019)+11H<sub>2</sub>O Easily sol in H<sub>2</sub>O Correct composition of above compounds is = (NH<sub>4</sub>)<sub>2</sub>O, 2V<sub>2</sub>O<sub>5</sub>+2[(NH<sub>4</sub>)<sub>2</sub>O, 2MoO<sub>3</sub>]+11H<sub>2</sub>O (Friedheim, B 24 1173)Moderately sol in H<sub>2</sub>O and can be recryst therefrom (Euler-Chelpin, Dissert, 1895)2(NH<sub>4</sub>)<sub>2</sub>O, 3V<sub>2</sub>O<sub>5</sub>, 4MoO<sub>3</sub>+11H<sub>2</sub>O Nearly insol in H<sub>2</sub>O (Friedheim and Castendyck, B 1900, 33 1615)2(NH<sub>4</sub>)<sub>2</sub>O, 2V<sub>2</sub>O<sub>5</sub>, 5MoO<sub>3</sub> Nearly insol in cold H<sub>2</sub>O (Euler-Chelpin, Dissert 1895)+8H<sub>2</sub>O Nearly insol in H<sub>2</sub>O (Friedheim and Castendyck, B 1900, 33 1615)3(NH<sub>4</sub>)<sub>2</sub>O, 2V<sub>2</sub>O<sub>5</sub>, 5MoO<sub>3</sub>+8½H<sub>2</sub>O Very easily sol in H<sub>2</sub>O (Liebert, Dissert 1891)4(NH<sub>4</sub>)<sub>2</sub>O, 12V<sub>2</sub>O<sub>5</sub>, 5MoO<sub>3</sub>+24H<sub>2</sub>O Practically insol in H<sub>2</sub>O (Friedheim and Castendyck, B 1900, 33 1615)2(NH<sub>4</sub>)<sub>2</sub>O, V<sub>2</sub>O<sub>5</sub>, 6MoO<sub>3</sub>+5H<sub>2</sub>O Sol in a large amount of H<sub>2</sub>O (Gibbs, Am Ch J 5 361)+6H<sub>2</sub>O Rather sl sol in H<sub>2</sub>O

Easily sol in acids (Liebert, Dissert, 1891)

Composition is double the above formula, or—

4(NH<sub>4</sub>)<sub>2</sub>O, 2V<sub>2</sub>O<sub>5</sub>, 12MoO<sub>3</sub>+12H<sub>2</sub>O Rather difficultly sol in H<sub>2</sub>O Composition is (NH<sub>4</sub>)<sub>2</sub>O, 2V<sub>2</sub>O<sub>5</sub>+3[(NH<sub>4</sub>)<sub>2</sub>O, 4MoO<sub>3</sub>] (Friedheim)3(NH<sub>4</sub>)<sub>2</sub>O, V<sub>2</sub>O<sub>5</sub>, 6MoO<sub>3</sub>+7H<sub>2</sub>O (Isenburg, Dissert, 1901)5(NH<sub>4</sub>)<sub>2</sub>O, 4V<sub>2</sub>O<sub>5</sub>, 6MoO<sub>3</sub>+12H<sub>2</sub>O and +14H<sub>2</sub>O (Euler-Chelpin, Dissert, 1895)5(NH<sub>4</sub>)<sub>2</sub>O, 3V<sub>2</sub>O<sub>5</sub>, 7MoO<sub>3</sub>+13H<sub>2</sub>O and +16H<sub>2</sub>O Sol in H<sub>2</sub>O and can be recryst therefrom (Toggenburg, Dissert, 1902)5(NH<sub>4</sub>)<sub>2</sub>O, 3V<sub>2</sub>O<sub>5</sub>, 8MoO<sub>3</sub>+14H<sub>2</sub>O (Stamm, Dissert, 1905)5(NH<sub>4</sub>)<sub>2</sub>O, 2V<sub>2</sub>O<sub>5</sub>, 12MoO<sub>3</sub>+10H<sub>2</sub>O Quite easily sol in H<sub>2</sub>O Composition is (NH<sub>4</sub>)<sub>2</sub>O, 2V<sub>2</sub>O<sub>5</sub>+4[(NH<sub>4</sub>)<sub>2</sub>O, 3MoO<sub>3</sub>]+10H<sub>2</sub>O6(NH<sub>4</sub>)<sub>2</sub>O, 3V<sub>2</sub>O<sub>5</sub>, 12MoO<sub>3</sub>+21H<sub>2</sub>O Sol in H<sub>2</sub>O Composition is (NH<sub>4</sub>)<sub>2</sub>O, 3V<sub>2</sub>O<sub>5</sub>+5(NH<sub>4</sub>)<sub>2</sub>O, 12MoO<sub>3</sub> (F)8(NH<sub>4</sub>)<sub>2</sub>O, 4V<sub>2</sub>O<sub>5</sub>, 18MoO<sub>3</sub>+21H<sub>2</sub>O Sol in H<sub>2</sub>O (Isenburg, Dissert, 1901)8(NH<sub>4</sub>)<sub>2</sub>O, V<sub>2</sub>O<sub>5</sub>, 18MoO<sub>3</sub>+15H<sub>2</sub>O Decomp by hot H<sub>2</sub>O (Gibbs) Could not be obtained (Friedheim)10(NH<sub>4</sub>)<sub>2</sub>O, 3V<sub>2</sub>O<sub>5</sub>, 24MoO<sub>3</sub>+10H<sub>2</sub>O Sol in H<sub>2</sub>O (Milch) Could not be obtained (Friedheim)

**Ammonium barium vanadiomolybdate,**  
 $5(\text{NH}_4)_2\text{O}, 15\text{BaO}, 6\text{V}_2\text{O}_5, 36\text{MoO}_3$ 

(Milch)

 $(\text{NH}_4)_2\text{O}, \text{BaO}, \text{V}_2\text{O}_5, \text{MoO}_3 + 6\text{H}_2\text{O}$ 

(Euler-Chelpin, Dissert, 1895)

 $3(\text{NH}_4)_2\text{O}, \text{BaO}, 3\text{V}_2\text{O}_5, 5\text{MoO}_3 + 9\text{H}_2\text{O}$ Sl sol in cold and hot  $\text{H}_2\text{O}$  (Euler-Chelpin)**Ammonium potassium —,  $(\text{NH}_4)_2\text{O}, 3\text{K}_2\text{O}, 2\text{V}_2\text{O}_5, 4\text{MoO}_3 + 5\text{H}_2\text{O}$** Decomp by  $\text{H}_2\text{O}$  (Euler-Chelpin.) $(\text{NH}_4)_2\text{O}, 3\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 5\text{MoO}_3 + 9\text{H}_2\text{O}$   
(Euler-Chelpin) $\frac{1}{2}(\text{NH}_4)_2\text{O}, 3\frac{1}{2}\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 5\text{MoO}_3 + 16\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Jacoby, Dissert 1900)**Ammonium sodium —,  $(\text{NH}_4)_2\text{O}, \text{Na}_2\text{O}, 2\text{V}_2\text{O}_5, 6\text{MoO}_3 + 12\text{H}_2\text{O}$** 

(Euler-Chelpin, Dissert, 1895)

**Barium —,  $\text{BaO}, \text{V}_2\text{O}_5, \text{MoO}_3 + 7\text{H}_2\text{O}$** 

(Euler-Chelpin)

**Barium —,  $3\text{BaO}, 2\text{V}_2\text{O}_5, 6\text{MoO}_3$** 

(Milch)

 $+ 8\text{H}_2\text{O}$  (Euler-Chelpin) $5\text{BaO}, 4\text{V}_2\text{O}_5, 6\text{MoO}_3 + 28\text{H}_2\text{O}$  Sol in hot  $\text{H}_2\text{O}$  (Euler-Chelpin) $3\text{BaO}, \text{V}_2\text{O}_5, 8\text{MoO}_3 + 2\text{BaO}, \text{H}_2\text{O}, \text{V}_2\text{O}_5, 8\text{MoO}_3 + 28\text{H}_2\text{O}$  Sol in hot  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 5 361) $7\text{BaO}, 3\text{V}_2\text{O}_5, 18\text{MoO}_3 + 16\text{H}_2\text{O} = \text{BaO}, 3\text{V}_2\text{O}_5 + 6(\text{BaO}, 3\text{MoO}_3) + 16\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  $+ 36\text{H}_2\text{O}$  and  $+ 48\text{H}_2\text{O}$  (Liebert, Dissert 1891)**Potassium —,  $\text{K}_2\text{O}, \text{V}_2\text{O}_5, 3\text{MoO}_3 + 15\text{H}_2\text{O}$** Nearly insol in cold  $\text{H}_2\text{O}$  (Euler-Chelpin, Dissert, 1895) $3\text{K}_2\text{O}, 2\text{V}_2\text{O}_5, 4\text{MoO}_3 + 8\text{H}_2\text{O} = \text{K}_2\text{O}, 2\text{V}_2\text{O}_5 + 2(\text{K}_2\text{O}, 2\text{MoO}_3) + 8\text{H}_2\text{O}$ Very sol in  $\text{H}_2\text{O}$  (Friedheim) $+ 7\text{H}_2\text{O}$  Easily sol in cold  $\text{H}_2\text{O}$  (Euler-Chelpin) $+ 9\text{H}_2\text{O}$  Easily sol in cold  $\text{H}_2\text{O}$  (Euler-Chelpin) $2\text{K}_2\text{O}, 2\text{V}_2\text{O}_5, 5\text{MoO}_3 + 10\text{H}_2\text{O}$  Nearly insol in cold, very sl sol in hot  $\text{H}_2\text{O}$  (Euler-Chelpin) $3\text{K}_2\text{O}, \text{V}_2\text{O}_5, 6\text{MoO}_3 + 5\text{H}_2\text{O}$  (Euler-Chelpin) $2\text{K}_2\text{O}, \text{V}_2\text{O}_5, 6\text{MoO}_3 + 6\text{H}_2\text{O}$  Very sl sol in cold easily sol in hot  $\text{H}_2\text{O}$  (Liebert) $4\text{K}_2\text{O}, 2\text{V}_2\text{O}_5, 12\text{MoO}_3 + 12\text{H}_2\text{O} = \text{K}_2\text{O}, 2\text{V}_2\text{O}_5 + 3(\text{K}_2\text{O}, 4\text{MoO}_3) + 12\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$  (Friedheim) $5\text{K}_2\text{O}, 2\text{V}_2\text{O}_5, 12\text{MoO}_3 + 12\text{H}_2\text{O} = \text{K}_2\text{O}, 2\text{V}_2\text{O}_5 + 4(\text{K}_2\text{O}, 3\text{MoO}_3) + 12\text{H}_2\text{O}$  Rather sl sol in  $\text{H}_2\text{O}$  (Friedheim)Sl sol in cold easily sol in hot  $\text{H}_2\text{O}$  (Liebert, Dissert 1891.) $3\text{K}_2\text{O}, \text{V}_2\text{O}_5, 12\text{MoO}_3 + 15\text{H}_2\text{O}$  (Liebert)**Potassium sodium vanadiomolybdate,  $\text{K}_2\text{O}, 4\text{Na}_2\text{O}, 2\text{V}_2\text{O}_5, 12\text{MoO}_3 + 18\text{H}_2\text{O}$** 

(Euler-Chelpin Dissert 1895)

**Sodium —,  $2\text{Na}_2\text{O}, \text{V}_2\text{O}_5, 6\text{MoO}_3 + 16\text{H}_2\text{O}$** 

(Euler-Chelpin, Dissert, 1895)

**Vanadiophosphoric acid**

See Phosphovanadic acid

**Vanadioselenious acid,  $3\text{V}_2\text{O}_5, 4\text{SeO}_2 + 4\text{H}_2\text{O}$**  $+ 6\text{H}_2\text{O}$  Difficultly sol in  $\text{H}_2\text{O}$  Can be cryst from  $\text{H}_2\text{O}$  $+ 10\text{H}_2\text{O}$  Difficultly sol in  $\text{H}_2\text{O}$  Can be cryst from  $\text{H}_2\text{O}$  (Prandtl, B 1905, 38 1307)**Ammonium vanadioselenite,** $4(\text{NH}_4)_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 13\text{H}_2\text{O}$ Sl sol in  $\text{H}_2\text{O}$  Decomp by boiling  $\text{H}_2\text{O}$  $3(\text{NH}_4)_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{SeO}_2 + 2\text{H}_2\text{O}$  Ppt (Prandtl, B 1905, 38 1309) $(\text{NH}_4)_2\text{H}_2\text{V}_2\text{O}_{17}, 12\text{SeO}_2 + 2\text{H}_2\text{O}$  Ppt  $+ 4\text{H}_2\text{O}$  Ppt (Prandtl, Z anorg 1911, 73 231)**Ammonium silver —,  $2\frac{2}{3}(\text{NH}_4)_2\text{O}, 1\frac{1}{3}\text{Ag}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 12\text{H}_2\text{O}, + 16\text{H}_2\text{O}$  and  $+ 22\text{H}_2\text{O}$** 

(Prandtl, Z anorg 1907, 53 402)

**Lithium —,  $4\text{Li}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 30\text{H}_2\text{O}$** Very sol in  $\text{H}_2\text{O}$  (Prandtl)**Potassium —,  $4\text{K}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 13\text{H}_2\text{O}$**  $3\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{SeO}_2$  (Prandtl, B, 1905 38 1309)**Sodium —,  $4\text{Na}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 20\text{H}_2\text{O}$** Verv sol in  $\text{H}_2\text{O}$  (Prandtl Z anorg 1907, 53 403)**Vanadiosulphuric acid,  $\text{V}_2\text{O}_5, 3\text{SO}_3 + 3\text{H}_2\text{O}$** Deliquescent Sol in  $\text{H}_2\text{O}$  but is decomp by boiling (Ditté C P 102 757)

See Sulphate, vanadium

**Vanadiosulphurous acid****Ammonium vanadiosulphite,** $3(\text{V}_2\text{O}_4\text{SO}_3), (\text{NH}_4)_2\text{O}, \text{SO}_2 + 4\text{H}_2\text{O}$ 

(Grun, C R 1907 144 1185)

**Cæsium —,  $(\text{V}_2\text{O}_4\text{SO}_2), 3(\text{Cs}_2\text{O}, \text{SO}_2) + 8\text{H}_2\text{O}$** 

(Grun)

**Lithium —,  $(\text{V}_2\text{O}_4\text{SO}_2), 5(\text{Li}_2\text{O}, \text{SO}_2) + 8\text{H}_2\text{O}$** 

(Grun)

di 5

**Potassium vanadiousulphite**,  $3\text{SO}_2, (\text{V}_2\text{O}_4), \text{SO}_2, (\text{K}_2\text{O}) + 5\text{H}_2\text{O}$   
(Gain)

**Rubidium** —,  $(\text{V}_2\text{O}_4, \text{SO}_2), 2(\text{Rb}_2\text{O}, \text{SO}_2) + 2\text{H}_2\text{O}$   
(Gain)

**Sodium** —,  $5(\text{V}_2\text{O}_4, \text{SO}_2), (\text{Na}_2\text{O}, \text{SO}_2) + 2\text{H}_2\text{O}$   
(Gain)

**Thallium** —,  $3(\text{V}_2\text{O}_4, \text{SO}_2), (\text{Tl}_2\text{O}, \text{SO}_2) + 8\text{H}_2\text{O}$   
(Gain)

**Vanadiotungstic acid**,  $6\text{H}_2\text{O}, \text{V}_2\text{O}_5, 10\text{WO}_3 + 16\text{H}_2\text{O}$

Very sl sol in cold, more easily in hot  $\text{H}_2\text{O}$  (Gibbs, Am Ch J 5 361)

$6\text{H}_2\text{O}, \text{V}_2\text{O}_5, 16\text{WO}_3 + 30\text{H}_2\text{O}$  Readily sol in  $\text{H}_2\text{O}$  (Gibbs)

$17\text{H}_2\text{O}, 4\text{V}_2\text{O}_5, 16\text{WO}_3 + 24\text{H}_2\text{O}$  Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  (Rosenheim, A 251 228)

**Aluminum sodium vanadiotungstate**,  $7\text{Al}_2\text{O}_3, 27\text{Na}_2\text{O}, 36\text{V}_2\text{O}_5, 144\text{WO}_3 + 504\text{H}_2\text{O} = 3(\text{Al}_2\text{O}_3, 9\text{Na}_2\text{O}, 48\text{WO}_3), 4(\text{Al}_2\text{O}_3, 9\text{V}_2\text{O}_5) + 504\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Rothenbach, B 23 3055)

**Ammonium** —,  $(\text{NH}_4)_2\text{O}, 3\text{V}_2\text{O}_5, \text{WO}_3 + 6\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Rammelsberg, B 1 158)

$2(\text{NH}_4)_2\text{O}, \text{V}_2\text{O}_5, 4\text{WO}_3 + 4\text{H}_2\text{O}$  (Friedheim and Lowy, Z anorg 1984, 6 24)

$4(\text{NH}_4)_2\text{O}, 2\text{H}_2\text{O}, \text{V}_2\text{O}_5, 5\text{WO}_3 + 11\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Gibbs Am Ch J 5 361)

$2(\text{NH}_4)_2\text{O}, \text{V}_2\text{O}_5, 5\text{WO}_3 + 10\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Ditté, C R 102 1019)

$31(\text{NH}_4)_2\text{O}, 14\text{V}_2\text{O}_5, 60\text{WO}_3 + 58\text{H}_2\text{O} = 5[5(\text{NH}_4)_2\text{O}, 12\text{WO}_3], 2[3(\text{NH}_4)_2\text{O}, 7\text{V}_2\text{O}_5]$  Sol in  $\text{H}_2\text{O}$  (Rothenbach, B 23 3051)

$7(\text{NH}_4)_2\text{O}, 4\text{V}_2\text{O}_5, 14\text{WO}_3 + 16\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Rosenheim A 251 197)

$8(\text{NH}_4)_2\text{O}, 4\text{V}_2\text{O}_5, 16\text{WO}_3, 9\text{H}_2\text{O} + 4\text{H}_2\text{O}$  Efflorescent Very sol in  $\text{H}_2\text{O}$  (Rosenheim, A 251 216)

**Barium** —,  $19\text{BaO}, 10\text{V}_2\text{O}_5, 36\text{WO}_3 + 94\text{H}_2\text{O} = 3(5\text{BaO}, 12\text{WO}_3), 2(2\text{BaO}, 5\text{V}_2\text{O}_5) + 94\text{H}_2\text{O}$

Sl sol in  $\text{H}_2\text{O}$  (Rothenbach, B 23 3052)

$8\text{BaO}, 4\text{V}_2\text{O}_5, 16\text{WO}_3, 9\text{H}_2\text{O} + 44\text{H}_2\text{O}$  Efflorescent Not very sol in  $\text{H}_2\text{O}$  (Rosenheim, A 251 218)

$3\text{BaO}, 12\text{WO}_3, 3\text{V}_2\text{O}_5 + 20\text{H}_2\text{O}$

Not easily sol in  $\text{H}_2\text{O}$  (Friedheim and Lowy, Z anorg 1894, 6 18)

$4\text{BaO}, 4\text{V}_2\text{O}_5, 12\text{WO}_3 + 44\text{H}_2\text{O}$  Less sol.

than preceding salt Decomp by boiling or by mineral acids (Rosenheim)

Composition is  $4\text{BaO}, 12\text{WO}_3, 3\text{V}_2\text{O}_5 + 30\text{H}_2\text{O}$  (Friedheim)

**Calcium vanadiotungstate**,  $2\text{CaO}, \text{V}_2\text{O}_5, 2\text{WO}_3 + 12\text{H}_2\text{O}$

(Friedheim and Löwy, Z anorg 1894, 6 20)

**Magnesium sodium** —,  $\text{MgO}, 6\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 12\text{WO}_3 + 42\text{H}_2\text{O} = 5\text{Na}_2\text{O}, 12\text{WO}_3 + \text{MgO}, \text{Na}_2\text{O}, 3\text{V}_2\text{O}_5 + 42\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Rothenbach, B 23 3054)

**Potassium** —,  $4\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 12\text{WO}_3 + 30\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$

Composition is potassium *metatungstate* vanadate,  $3(\text{K}_2\text{O}, 4\text{WO}_3) + \text{K}_2\text{O}, 3\text{V}_2\text{O}_5 + 30\text{H}_2\text{O}$  (Friedheim, B 23 1515)

$8\text{K}_2\text{O}, 4\text{V}_2\text{O}_5, 16\text{WO}_3, 9\text{H}_2\text{O} + 24\text{H}_2\text{O}$  Very efflorescent Easily sol in  $\text{H}_2\text{O}$ , (Rosenheim, A 251 214)

Formula is  $6\text{K}_2\text{O}, 12\text{WO}_3, 3\text{V}_2\text{O}_5 + 24\text{H}_2\text{O}$ , which is a double salt,  $5\text{K}_2\text{O}, 12\text{WO}_3 + \text{K}_2\text{O}, 3\text{V}_2\text{O}_5$  (Friedheim, B 23 1505)

**Potassium sodium** —,  $(5\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 22\text{H}_2\text{O}), 4(5\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 22\text{H}_2\text{O})$  or  $\text{Na}_2\text{O}, 4\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 22\text{H}_2\text{O}$

(Friedheim and Lowy, Z anorg 1894, 6 22)

$4(5\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 24\text{H}_2\text{O}), 3(5\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 24\text{H}_2\text{O})$  (Friedheim and Lowy)

$5(5\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 24\text{H}_2\text{O}), 5\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 24\text{H}_2\text{O}$  (Friedheim and Lowy)

**Silver** —,  $8\text{Ag}_2\text{O}, 4\text{V}_2\text{O}_5, 16\text{WO}_3, 9\text{H}_2\text{O}$

Somewhat sol in cold  $\text{H}_2\text{O}$ , more easily upon addition of little  $\text{HNO}_3$  Decomp by warm  $\text{H}_2\text{O}$  (Rosenheim, A 251 224)

$3\text{Ag}_2\text{O}, 2\text{V}_2\text{O}_5, 6\text{WO}_3 + 3\text{H}_2\text{O}$  Nearly insol in cold  $\text{H}_2\text{O}$  Decomp by addition of  $\text{HNO}_3$  or upon warming (Rosenheim)

**Sodium** —,  $5\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 36\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$

Composition is  $3(\text{Na}_2\text{O}, 2\text{WO}_3) + 2(\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5) + 36\text{H}_2\text{O}$  (Friedheim, B 23 1527)

$+ 38\text{H}_2\text{O}$  Sol in 125 pts  $\text{H}_2\text{O}$  at  $13.8^\circ$  (Friedheim and Lowy)

$2\text{Na}_2\text{O}, 2\text{V}_2\text{O}_5, 3\text{WO}_3 + 20\text{H}_2\text{O}$  Very sol in  $\text{H}_2\text{O}$

Composition is  $\text{Na}_2\text{O}, 3\text{WO}_3 + \text{Na}_2\text{O}, 2\text{V}_2\text{O}_5 + 20\text{H}_2\text{O}$ , double salt of sodium *tritungstate* and *divanadate* (Friedheim, B 23 1523)

$4\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 12\text{WO}_3 + 38\text{H}_2\text{O} = 3(\text{Na}_2\text{O}, 4\text{WO}_3) + \text{Na}_2\text{O}, 3\text{V}_2\text{O}_5 + 38\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Rothenbach, B 23 3050)

$3\text{Na}_2\text{O}, 4\text{V}_2\text{O}_5, 16\text{WO}_3, 9\text{H}_2\text{O} + 48\text{H}_2\text{O}$

Efflorescent Easily sol in  $H_2O$  (Rosenheim, A 251 210)

Formula is  $6Na_2O, 12WO_3, 3V_2O_5 + 42H_2O$ , and is a double salt of sodium *paratungstate*,  $5Na_2O, 12WO_3$ , and sodium *trivanadate*,  $Na_2O, 3V_2O_5$  (Friedheim, B 23 1505)

$7Na_2O, V_2O_5, 12WO_3 + 29H_2O$  Easily sol in  $H_2O$  (Friedheim and Lowy, Z anorg 1894, 6 15)

$8Na_2O, V_2O_5, 14WO_3 + 60H_2O$  and  $+66H_2O$  (Friedheim and Lowy)

**Strontium vanadotungstate**,  $19SrO, 36WO_3, 10V_2O_5 + 122H_2O = 3(5SrO, 12WO_3, 2(2SrO, 5V_2O_5) + 122H_2O$

Sol in  $H_2O$  (Rothenbach, B 23 3053)

### Vanadious acid

See Hypovanadic acid

### Vanadovanadicomolybdic acid

**Ammonium vanadovanadicomolybdate**,  $11(NH_4)_2O, 4V_2O_5, VO_3, 28MoO_3 + 48H_2O$

Sl sol in cold, sol in hot  $H_2O$  without decomp (Gibbs, Am Ch J 5 391)

**Barium —**,  $14BaO, 2V_2O_5, 3VO_2, 30MoO_3 + 48H_2O$

Very sl sol in cold, decomp (Gibbs)

### Vanadovanadicotungstic acid

**Ammonium vanadovanadicotungstate**,  $6(NH_4)_2O, 2V_2O_5, 3VO_2, 12WO_3 + 12H_2O$

Sol in  $H_2O$  (Gibbs, Am Ch J 5 391)

**Silver —**,  $6Ag_2O, 2V_2O_5, 3VO_2, 12WO_3 + 8H_2O$

Precipitate Very sl sol in cold, sol in much warm  $H_2O$  (Gibbs)

**Sodium —**,  $6Na_2O, 2V_2O_5, 3VO_2, 12WO_3$  Very sol in  $H_2O$  (Gibbs)

### Vanadium, V

Insol in  $H_2O$ , HCl, dil  $H_2SO_4 + Aq$ , and cold conc  $H_2SO_4$  Sol in hot conc  $H_2SO_4$  Slowly sol in HF + Aq Easily sol in dil or conc  $HNO_3 + Aq$  Not attacked by hot or cold NaOH or KOH + Aq (Roscoe, A suppl 7 85)

Does not alter in the air, not acted upon by HCl and very slowly by  $H_2SO_4$  (Moissan, C R 1896, 122 1299)

### Vanadium boride, VB

Sol in HF and  $HNO_3$  Decomp by fused alkalis (Wedekind, B 1913, 46 1203)

### Vanadium tribromide, VBr<sub>3</sub>

Very deliquescent, quickly decomposes (Roscoe, A suppl 8 99)

$+6H_2O$  Sol in  $H_2O$  with decomp (Locke and Edwards, Am Ch J 1898, 20 600)

Sol in  $H_2O$ , alcohol and ether Insol in HBr (Piccini Z anorg 1899, 19 398)

### Vanadium carbide, VC

Insol in HCl and  $H_2SO_4$

Sol in  $HNO_3$  in the cold, and in fused  $KNO_3$  and  $KClO_3$  (Moissan, C R 1896, 122 1300)

### Vanadium dichloride, VCl<sub>2</sub>

Very deliquescent Sol in  $H_2O$ , alcohol, and ether (Roscoe, A suppl 7 79)

### Vanadium trichloride, VCl<sub>3</sub>

Deliquescent Sol in  $H_2O$ , absolute alcohol, and ether

$+6H_2O$  Sol in  $H_2O$ , sl sol in conc HCl + Aq

Sol in alcohol and ether (Piccini, Z anorg 1899, 19 395)

### Vanadium tetrachloride, VCl<sub>4</sub>

Sol with decomp in  $H_2O$ , alcohol, and ether (Roscoe)

Sol in  $H_2O$  with decomp

Sol in fuming HCl with decomp

Sol in anhydrous  $CHCl_3$  or glacial acetic acid apparently without chemical change (Koppel, Z anorg 1905, 45 346)

### Vanadium difluoride, VF<sub>2</sub>

Sol in HF with evolution of  $H_2$  and formation of  $VF_3$  (Manchot, A 1907, 357 135)

### Vanadium trifluoride, VF<sub>3</sub>

Nearly insol in  $H_2O$  and organic solvents (Ruff, B 1911, 44 2544)

$+3H_2O$  Efflorescent Easily sol in cold, extremely sol in hot  $H_2O$  with decomp

Can be recryst from HF + Aq Insol in strong alcohol (Petersen, J pr (2) 40 48)

### Vanadium tetrafluoride, VF<sub>4</sub>

Very hygroscopic

Easily sol in  $H_2O$

Difficultly sol in  $SO_2Cl_2$  and  $SiCl_4$

Sol in  $POCl_3$  with evolution of gas

Sol in acetone and acetic acid

Difficultly sol in alcohol and  $CHCl_3$  (Ruff, B 1911, 44 2545)

### Vanadium pentafluoride, VF<sub>5</sub>

Easily sol in  $H_2O$

Easily sol in alcohol,  $CHCl_3$ , acetone, and ligroin Insol in  $CS_2$  Decomp toluene and ether (Ruff, B 1911, 44 2549)

### Vanadium trifluoride with MF

See Fluovanadate, M

**Vanadium hydride,**

Stable Does not react with boiling  $\text{H}_2\text{O}$   
 Not attacked by boiling  $\text{HCl}$ , but oxidized  
 by hot  $\text{H}_2\text{SO}_4$   
 Sol in boiling  $\text{HNO}_3$  (Muthmann, A  
 1907, 355 86)

**Vanadium dihydroxide,  $\text{VO}, x\text{H}_2\text{O}$** 

Insol in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$   
 $\text{V}(\text{OH})_2$  Sol in  $\text{HCl}$  (Locke and Ed-  
 wards, Am Ch J 1898, 20 598)

**Vanadium trihydroxide,  $\text{V}_2\text{O}_3, x\text{H}_2\text{O}$** 

Easily sol in all acids (Petersen, J pr  
 (2) 40 49)

**Vanadium tetrahydroxide (Hypovanadic hy-  
 droxide),  $\text{V}_2\text{O}_5(\text{OH})_4 + 5\text{H}_2\text{O}$** 

Easily sol in acids or alkalis (Crow,  
 Chem Soc 30 453)

**Vanadium trioxide,  $\text{VI}_3 + 6\text{H}_2\text{O}$** 

Very hygroscopic, sol in  $\text{H}_2\text{O}$  Only sl  
 sol in cold conc  $\text{HI} + \text{Aq}$   
 Sol in alcohol (Piccini, Z anorg 1899,  
 19 399)

**Vanadium nitride,  $\text{V}_2\text{N}$** 

Insol in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , and  $\text{KOH} + \text{Aq}$  Sol  
 in  $\text{HNO}_3 + \text{H}_2\text{SO}_4$   
 Decomp by fusing with  $\text{KOH}$  (Muth-  
 mann, A 1907, 355 93)  
 Insol in liquid  $\text{NH}_3$  (Gore, Am Ch J  
 1898, 20 830)  
 $\text{VN}$  (Roscoe, A suppl 6 114)  
 $\text{VN}_2$  Not attacked by cold  $\text{HNO}_3 + \text{Aq}$   
 (Uhrlaub, Pogg 103 134)

**Vanadium dioxide,  $\text{VO}$** 

Insol in  $\text{H}_2\text{O}$ , easily sol in dil acids  
 (Roscoe, A suppl 6 95)

**Vanadium trioxide,  $\text{V}_2\text{O}_3$** 

Oxidized in  $\text{H}_2\text{O}$  in contact with air and  
 then dissolves Insol in acids, except  $\text{HNO}_3$ ,  
 and in alkalis +  $\text{Aq}$  (Roscoe, A suppl 6  
 99)  
 Easily sol in  $\text{HF}$  (Petersen, J pr (2) 40  
 48)

**Vanadium tetroxide,  $\text{VO}_2$** 

Sol in acids and alkalis +  $\text{Aq}$

**Vanadium pentoxide,  $\text{V}_2\text{O}_5$** 

Sol in about 1000 pts  $\text{H}_2\text{O}$  (Berzelius)  
 Sol in acids, alkali hydrates, and carbon-  
 ates +  $\text{Aq}$  Insol in absolute, very sl sol  
 in dil alcohol  
 Insol in glacial  $\text{HC}_2\text{H}_3\text{O}_2$   
 Sol in conc  $\text{KF} + \text{Aq}$  (Ditte, C R 105  
 1067)  
 Sol in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  and alkali oxalates +  
 $\text{Aq}$  (Halberstadt, Z anal 22 1)  
 Three modifications—(a) Forms hydrates

with 2, and  $5\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  1 l of sat  
 solution contains 8 g  $\text{V}_2\text{O}_5$

( $\beta$ )  $\text{V}_2\text{O}_5, 2\text{H}_2\text{O}$  Very sl sol in  $\text{H}_2\text{O}$  1 l  
 of sat solution contains 0.5 g  $\text{V}_2\text{O}_5$   
 ( $\gamma$ )  $\text{V}_2\text{O}_5, 5\text{H}_2\text{O}$  Less sol in  $\text{H}_2\text{O}$  than  
 $\beta$  1 l  $\text{H}_2\text{O}$  contains 0.05 g  $\text{V}_2\text{O}_5$  when sat-  
 urated (Ditte, C R 101 698)  
 See Vanadic acid.

**Vanadium oxide,  $\text{V}_2\text{O}_5 = 2\text{VO}_2, \text{V}_2\text{O}_5$** 

See Vanadate, vanadium  
 $\text{V}_2\text{O}_5, \text{V}_2\text{O}_5 + \frac{1}{3}\text{H}_2\text{O}$  (Brierley, Chem  
 Soc 49 30)  
 See also Vanadovanadic acid  
 $\text{V}_2\text{O}_5, 2\text{V}_2\text{O}_5 + 8\text{H}_2\text{O}$   
 See Vanadate, vanadium

**Vanadium pentoxide with MF**

See Fluoxyvanadate, M

**Vanadium oxy compounds**

See Vanadyl compounds

**Vanadium silicide,  $\text{V}_2\text{Si}$** 

Insol in  $\text{H}_2\text{O}$   
 Not attacked by  $\text{HCl}$ ,  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$   
 Readily attacked by  $\text{HF}$   
 Not attacked by  $\text{KOH} + \text{Aq}$ ,  $\text{NaOH} + \text{Aq}$   
 or  $\text{NH}_4\text{OH}$  Decomp by fused  $\text{KOH}$   
 Insol in alcohol, ether and benzene  
 (Moissan, C R 1902 135 496)  
 $\text{VS}_2$  Sol in  $\text{HF}$ , insol in acids and al-  
 kalies  
 Decomp by fused  $\text{KOH}$  (Moissan, C R  
 1902, 135 78)

**Vanadium disulphide,  $\text{V}_2\text{S}_2$** 

Insol in boiling dil or conc  $\text{HCl}$ , dil  
 $\text{H}_2\text{SO}_4 + \text{Aq}$ , or cold conc  $\text{H}_2\text{SO}_4$  Easily  
 sol in hot dil or conc  $\text{HNO}_3 + \text{Aq}$ , or in  
 boiling conc  $\text{H}_2\text{SO}_4$  Insol in alkalis +  $\text{Aq}$   
 Sl sol in  $\text{KSH} + \text{Aq}$ , sol in  $\text{NH}_4\text{SH} + \text{Aq}$   
 (Kay, Chem Soc 37 728)

**Vanadium trisulphide,  $\text{V}_2\text{S}_3$** 

Insol in cold  $\text{HCl}$  or dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  Very  
 sl sol in hot  $\text{HCl}$  or dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  More  
 sol in  $\text{HNO}_3 + \text{Aq}$  or conc  $\text{H}_2\text{SO}_4$  Sl sol  
 in  $\text{NaOH}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  Easily sol in  
 $(\text{NH}_4)_2\text{S}$  or  $\text{NH}_4\text{SH} + \text{Aq}$ , also in  $\text{K}_2\text{S} + \text{Aq}$   
 (Kay, Chem Soc 37 728)

**Vanadium pentasulphide,  $\text{V}_2\text{S}_5$** 

Sl attacked by hot conc  $\text{HCl}$  or hot dil  
 $\text{H}_2\text{SO}_4 + \text{Aq}$ , sol in hot conc  $\text{H}_2\text{SO}_4$  Sol in  
 hot dil  $\text{HNO}_3 + \text{Aq}$  Sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$ ,  
 but easily dissolved by  $\text{NaOH} + \text{Aq}$  Sl sol  
 in  $\text{Na}_2\text{S} + \text{Aq}$  Sol in  $\text{NH}_4\text{SH} + \text{Aq}$  (Kay)

**Vanadium sulphochloride sulphur chloride,  
 $4\text{VSCl}_3, \text{S}_2\text{Cl}_2$** 

Decomp in the air (Koppel, Z anorg  
 1905, 45 357)



**Vanadous acid****Ammonium vanadite, basic,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{V}_2\text{O}_4$** 

Sl sol in cold, easily in hot  $\text{H}_2\text{O}$  (Ditte, C R 102 1310)

**Ammonium vanadite,  $(\text{NH}_4)_2\text{V}_2\text{O}_5 + 3\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$  (Crow, Chem Soc 30 460)  
 $+x\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$   
 Insol in alcohol, ether and ammonia  
 (Koppel, Z anorg 1903, 36 297)  
 $+3\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Mawrow, Z anorg 1907, 55 150)

**Barium vanadite,  $\text{BaV}_2\text{O}_5 + 4\text{H}_2\text{O}$** 

Ppt (Koppell, Z anorg 1903, 36 300)  
 $+5\text{H}_2\text{O}$  Precipitate Easily sol in  $\text{HNO}_3$ ,  
 or  $\text{HCl} + \text{Aq}$  (Crow, Chem Soc 30 460)

**Lead vanadite,  $\text{PbV}_2\text{O}_5$** 

Ppt (Crow)

**Potassium vanadate,  $\text{K}_2\text{V}_2\text{O}_5 + 4\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$   
 Insol in alcohol, ether and ammonia  
 (Koppel, Z anorg 1903, 36 300)  
 $+7\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  Insol in  
 cold, sol in hot  $\text{KOH} + \text{Aq}$  Insol in alcohol  
 (Crow)  
 Ditte, C R 102 1310

**Sodium vanadate,  $\text{Na}_2\text{V}_2\text{O}_5 + 4\text{H}_2\text{O}$** 

Sol in  $\text{H}_2\text{O}$   
 Insol in alcohol, ether and ammonia  
 (Koppel, Z anorg 1903, 36 299)  
 $+7\text{H}_2\text{O}$  Easily sol in  $\text{H}_2\text{O}$  (Crow, Chem Soc 30 459)

**Vanadosotungstic acid****Ammonium vanadosotungstate,  $5(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $14\text{WO}_3 + 13\text{H}_2\text{O}$** 

Vcry sol in  $\text{H}_2\text{O}$  (E F Smith, J Am Chem Soc 1903, 25 1228)

**Vanadous acid**

See Hypovanadic acid

**Vanadovanadic acid**

See Vanadicovanadic acid

**Vanadyl bromide,  $\text{VOBr}_2$** 

Very sl sol in  $\text{H}_2\text{O}$ , acetic anhydride, ethyl acetate, and acetone  
 Insol in alcohol, ether, acetic acid,  $\text{CHCl}_3$ , toluene and  $\text{CCl}_4$  (Ruff, B 1911, 44 2537)

**Vanadyl dibromide,  $\text{VOBr}_2$** 

Very deliquescent, and sol in  $\text{H}_2\text{O}$  (Roscoe)

**Vanadyl tribromide,  $\text{VOBr}_3$** 

Very deliquescent, and quickly decomposes in moist air Sol in  $\text{H}_2\text{O}$  (Roscoe)

**Vanadyl bromide,  $\text{V}_2\text{O}_5\text{Br}_2$ ,  $2\text{HBr} + 7\text{H}_2\text{O}$** 

Very deliquescent (Ditte, C R 102 1310)

**Vanadyl semichloride,  $\text{V}_2\text{O}_5\text{Cl}$** 

Insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HNO}_3 + \text{Aq}$  (Roscoe, A suppl 6 114)

**Vanadyl monochloride,  $\text{VOCl}$** 

Insol in  $\text{H}_2\text{O}$  Easily sol in  $\text{HNO}_3 + \text{Aq}$  (Roscoe)

**Vanadyl dichloride,  $\text{VOCl}_2$** 

Deliquescent Slowly decomp by  $\text{H}_2\text{O}$   
 Easily sol in  $\text{HNO}_3 + \text{Aq}$  (Roscoe)

**Vanadyl trichloride,  $\text{VOCl}_3$** 

Deliquescent Sol in  $\text{H}_2\text{O}$  and alcohol with decomp (Bedson, A 180 235)  
 Sol in ether with combination

**Divanadyl chloride,  $\text{V}_2\text{O}_5\text{Cl}_2 + 5\text{H}_2\text{O}$** 

Deliquescent, and sol in  $\text{H}_2\text{O}$ , fuming  $\text{HCl}$ , or alcohol (Crow, Chem Soc 30 457)

**Vanadyl chloride,  $\text{V}_2\text{O}_5\text{Cl}_2 + 4\text{H}_2\text{O}$** 

Very deliquescent (Ditte, C R 102 1310)

**Vanadyl platinum chloride**

See Chloroplatinate, vanadyl

**Vanadyl trichloride ammonia,  $\text{VOCl}_3, x\text{NH}_3$** 

Decomp by  $\text{H}_2\text{O}$  (Roscoe)

**Vanadyl difluoride,  $\text{VOF}_2$** 

Insol in  $\text{H}_2\text{O}$  Insol in alcohol, ether,  $\text{CHCl}_3$  Sl sol in acetone (Ruff, B 1911, 44 2546)

**Vanadyl trifluoride,  $\text{VOF}_3$** 

Very hygroscopic Easily sol in  $\text{H}_2\text{O}$   
 Sol in  $\text{POCl}_3$  with evolution of gas Difficultly sol in  $\text{PCl}_3$  and  $\text{AsCl}_3$  Sol in hot  $\text{CHCl}_3$  and acetic anhydride (Ruff, B 1911, 44 2547)

**Vanadyl fluoride *wh h* MF**

See Fluoxyvanadate, and Fluoxhypovanadate, M

**Vanadyl iodide,  $\text{V}_2\text{O}_5\text{I}_2, 3\text{HI} + 10\text{H}_2\text{O}$** 

Very deliquescent and sol in  $\text{H}_2\text{O}$  (Ditte, C R 102 1310)  
 $\text{V}_2\text{O}_5\text{I}_2, 2\text{HI} + 8\text{H}_2\text{O}$  As above

**Vanadyl sulphide,  $\text{VOS}$  (?)**

(a) Insol in  $\text{H}_2\text{O}$ , alkalis, alkali sulphides +  $\text{Aq}$  Sol in acids, except nitric acid and aqua regia (Berzelius)

(b) Sol in alkalis, alkali carbonates, and sulphides + Aq Insol in acids (Berzelius)

### Water, H<sub>2</sub>O

Water is the most universal solvent. It absorbs all gases, usually with an increase of volume, seldom, as in the case of NH<sub>3</sub>, with a diminution of volume. It dissolves almost all solids in greater or less quantity, and mixes with or dissolves considerable amounts of many liquids.

Miscible with alcohol Sol in 36 pts ether  
Sol in 30-33 vols ethyl acetate (Becker)  
Sol in 5 vols iodhydric  
Sl sol in most of the fatty oils

### Solubility in organic solvents at t°

Solvent	t°	G H <sub>2</sub> O in 100 g of the solution
Benzene	+3	0.030
	23	0.060
	40	0.114
	55	0.184
	66	0.255
	77	0.337
Petroleum bpt 190-250° at atmos pressure	-2	0.0012
	+18	0.005
	23	0.007
	30	0.008
	36	0.012
	53	0.026
	59	0.031
	61	0.035
	66	0.043
	79	0.063
	85	0.075
	94	0.097
Paraffin oil bpt 200-300° at 10 mm pressur	+16	0.003
	50	0.013
	65	0.022
	73	0.030
	77	0.035
	94	0.055

(Groschuff, Z Elektrochem, 1911, 17 350)

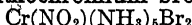
### White precipitate, fusible

See Mercuriammonium chloride

### White precipitate, infusible

See Mercuric chloramide

### Xanthochromium bromide,

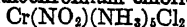


Sol in H<sub>2</sub>O. Resembles the chloride (Christensen, J pr (2) 24 74)

### Carbonate, Cr(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>CO<sub>3</sub>

Easily sol in H<sub>2</sub>O (Christensen)

### Xanthochromium chloride,



More sol in H<sub>2</sub>O than the roseo, but less than the purpureo salt

Solution decomp by light or boiling. Decomp by dil acids. Sol in NaOH + Aq and in NH<sub>4</sub>OH + Aq (sp gr 0.91). Insol in alcohol (Christensen, J pr (2) 24 74)

### Chloroplatinate, Cr(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>PtCl<sub>6</sub>

Insol in pure H<sub>2</sub>O, but sol when warmed with H<sub>2</sub>O containing HCl, with formation of a new double salt (Christensen)

### Mercuric chloride, Cr(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>Cl<sub>2</sub>, 2HgCl<sub>2</sub>

Precipitate. Decomp by long contact with H<sub>2</sub>O (Christensen)

### Chromate, Cr(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>CrO<sub>4</sub>

Difficultly sol in H<sub>2</sub>O (Christensen)

### Dichromate, Cr(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>Cr<sub>2</sub>O<sub>7</sub>

Difficultly sol in H<sub>2</sub>O (Christensen)

### Dithionate, Cr(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>S<sub>2</sub>O<sub>8</sub>

Insol in cold H<sub>2</sub>O (Christensen)

### Hydroxide, Cr(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>(OH)<sub>2</sub>

Known only in solution (Christensen)

### Iodide, Cr(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>I<sub>2</sub>

Quite difficultly sol in H<sub>2</sub>O (Christensen)

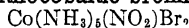
### Nitrate, Cr(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>(NO<sub>3</sub>)<sub>2</sub>

Sol in about 150 pts H<sub>2</sub>O (Christensen)

### Sulphate, Cr(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>SO<sub>4</sub> + H<sub>2</sub>O

Sol in H<sub>2</sub>O and (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> + Aq (Christensen)

### Xanthocobaltic bromide,



Easily sol in cold H<sub>2</sub>O (Werner and Miolati, Gazz ch it 23, 2 140)

### Bromonitrate, Co(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>(NO<sub>3</sub>)Br

Sl sol in cold, more easily in hot H<sub>2</sub>O (Gibbs)

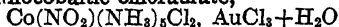
### Chloride, Co(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>Cl<sub>2</sub>

Sl sol in cold H<sub>2</sub>O, and decomp by boiling therewith. Insol in HCl + Aq and alkali chlorides + Aq. Easily decomp by boiling with acids, even dilute (Gibbs and Genth)

Sol in 50 pts cold H<sub>2</sub>O (Jorgensen Z anorg 5 172)

### Mercuric chloride, Co(NO<sub>2</sub>)(NH<sub>3</sub>)<sub>5</sub>Cl<sub>2</sub>, 2HgCl<sub>2</sub> + H<sub>2</sub>O

Insol in cold, sl sol in hot H<sub>2</sub>O without decomp. More sol in acidified H<sub>2</sub>O (Gibbs and Genth)

**Xanthocobaltic chloraurate,**

Can be easily crystallised out of hot  $\text{H}_2\text{O}$   
(Gibbs and Genth, Sill Am J (2) **24** 90)

— **chloronitrate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_5(\text{NO}_3)\text{Cl}$   
Sl sol in cold, more easily in hot  $\text{H}_2\text{O}$

— **chloronitrate gold chloride**,  
 $\text{Co}(\text{NO}_2)(\text{NH}_3)_5(\text{NO}_3)\text{Cl}, \text{AuCl}_3$

— **chloronitrate platonic chloride**,  
 $2\text{Co}(\text{NO}_2)(\text{NH}_3)_5(\text{NO}_3)\text{Cl}, \text{PtCl}_4$

— **chloroplatinate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_5\text{Cl}_2$ ,  
 $\text{PtCl}_4 + \text{H}_2\text{O}$

Scarcely sol in hot or cold  $\text{H}_2\text{O}$  Can be  
recryst from dil  $\text{HNO}_3 + \text{Aq}$  Sol in hot dil  
 $\text{HCl} + \text{Aq}$  (Gibbs and Genth, Sill Am J (2)  
**24** 91)

— **chromate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_5\text{CrO}_4 + \text{H}_2\text{O}$   
Very sl sol in cold, and but slightly sol in  
hot  $\text{H}_2\text{O}$  (Gibbs)

— **dichromate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_5\text{Cr}_2\text{O}_7$   
Easily sol in hot  $\text{H}_2\text{O}$

— **ferrocyanide**,  $[\text{Co}(\text{NO}_2)(\text{NH}_3)_5]_2\text{Fe}(\text{CN})_6$   
 $\perp 7\text{H}_2\text{O}$   
insol in cold, decomp by warm  
 $+ 6\text{H}_2\text{O}$  (Braun, A **132** 47)

— **iodide**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_5\text{I}_2$   
Sol in  $\text{H}_2\text{O}$  (Gibbs)

— **iodosulphate**,  
 $[\text{Co}(\text{NO}_2)(\text{NH}_3)_5]_2(\text{SO}_4)_2\text{I}_2$   
Sol in  $\text{H}_2\text{O}$

— **periodosulphate**,  
 $[\text{Co}(\text{NO}_2)(\text{NH}_3)_5]_2(\text{SO}_4)_2\text{I}_4$   
Easily decomp by hot  $\text{H}_2\text{O}$

— **nitrate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_5(\text{NO}_3)_2$   
Sl sol in cold, moderately sol in hot  $\text{H}_2\text{O}$   
Decomp by boiling Much less sol than  
 $\text{NH}_4\text{Cl}$  or  $(\text{NH}_4)_2\text{SO}_4$  in cold  $\text{H}_2\text{O}$  Insol in  
 $\text{HNO}_3$  (Gibbs and Genth)

— **nitrite**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_5(\text{NO}_2)_2 + 2\text{H}_2\text{O}$   
Sol in  $\text{H}_2\text{O}$  (Gibbs)

— **cobaltic nitrite**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_5(\text{NO}_2)_2$   
 $+ 2\text{H}_2\text{O}$   
Sl sol in  $\text{H}_2\text{O}$  (Gibbs, Proc Am Acad  
**11** 8)  
Is nitratopurplecobaltic cobaltic nitrite,

$[(\text{NO}_2)\text{Co}(\text{NH}_3)_5]_3[\text{Co}(\text{NO}_2)_6]_2 + 2\text{H}_2\text{O}$  (Jor-  
gensen, Z anorg **5** 175)  
 $[\text{Co}(\text{NO}_2)(\text{NH}_3)_5]_3[\text{Co}(\text{NO}_2)_6]_2$  Not so  
difficultly sol as the luteo salt (Jorgensen)

**Xanthocobaltic tetramine cobaltic nitrite**,  
 $\text{Co}_2(\text{NO}_2)_2(\text{NH}_3)_{10}[\text{Co}_2(\text{NH}_3)_4(\text{NO}_2)_6]_2$

Can be recryst from hot  $\text{H}_2\text{O}$  (Gibbs,  
Proc Am Acad **11** 8)

$= (\text{NO}_2)\text{Co}(\text{NH}_3)_5[(\text{NO}_2)_2(\text{NH}_3)_2\text{Co}(\text{NO}_2)_2]_2$   
Xanthocobaltic diamine cobaltic nitrite  
Very sl sol in cold  $\text{H}_2\text{O}$  (Jorgensen, Z  
anorg **5** 180)

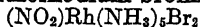
— **oxalate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_5\text{C}_2\text{O}_4$

Nearly insol in cold, sl sol in hot  $\text{H}_2\text{O}$

— **sulphate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_5\text{SO}_4$

Moderately sol in hot, much less in cold  
 $\text{H}_2\text{O}$  Sol without decomp in  $\text{H}_2\text{SO}_4 + \text{Aq}$   
(Gibbs and Genth)

Sol in 25 pts hot  $\text{H}_2\text{O}$  acidified with  
 $\text{HCl} \cdot \text{H}_2\text{O}_2$  (Jorgensen, Z anorg **5** 172)  
 $4\text{Co}(\text{NO}_2)(\text{NH}_3)_5\text{SO}_4, 3\text{H}_2\text{SO}_4$  Decomp  
by  $\text{H}_2\text{O}$ , not by absolute alcohol (Jorgensen)

**Xanthorhodrum bromide,**

Moderately sol in  $\text{H}_2\text{O}$  (Jorgensen, J  
pr (2) **34** 394)

— **chloride**,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_5\text{Cl}_2$

Much more sol in  $\text{H}_2\text{O}$  than the nitrate

— **chloroplatinate**,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_5\text{PtCl}_6$   
Ppt Extremely sl sol in cold  $\text{H}_2\text{O}$

— **dithionate**,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_5\text{S}_2\text{O}_6 + \text{H}_2\text{O}$   
Nearly insol in  $\text{H}_2\text{O}$

— **fluosilicate**,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_5\text{SiF}_6$   
Ppt

— **hydroxide**,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_5(\text{OH})_2$

— **nitrate**,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_5(\text{NO}_3)_2$

Moderately sol in cold, easily in hot  $\text{H}_2\text{O}$   
Insol in alcohol Less sol in conc  $\text{NH}_4\text{OH} +$   
 $\text{Aq}$  than in  $\text{H}_2\text{O}$   
Insol in dil  $\text{HNO}_3 + \text{Aq}$ , sol in  $\text{HNO}_3 + \text{Aq}$   
of 1 4 sp gr

— **oxalate**,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_5\text{C}_2\text{O}_4$

Nearly insol in cold  $\text{H}_2\text{O}$  Very sl sol in  
warm  $\text{H}_2\text{O}$  Easily sol in dil  $\text{HCl} \cdot \text{H}_2\text{O}_2 + \text{Aq}$

— **sulphate**,  $(\text{NO}_2)\text{Rh}(\text{NH}_3)_5\text{SO}_4$

Slowly sol in cold, quite easily in hot  $\text{H}_2\text{O}$   
 $4(\text{NO}_2)\text{Rh}(\text{NH}_3)_5\text{SO}_4, 3\text{H}_2\text{SO}_4$  Sl sol in  
cold, easily in hot  $\text{H}_2\text{O}$  Can be recrystal-  
lized from dil  $\text{H}_2\text{SO}_4 + \text{Aq}$

**Xenon, Xe**Absorption by H<sub>2</sub>O at t°

t°	Absorption coefficient
0	0 2189
10	0 1500
20	0 1109
30	0 0900
40	0 0812
50	0 0878

(Antropoff, Roy Soc Proc 1910, **83** A, 480)**Ytterbium, Yb****Ytterbium bromide, YbBr<sub>3</sub>+8H<sub>2</sub>O**Very sol in H<sub>2</sub>O Hydrosopic (Cleve, Z anorg 1902, **32** 135)**Ytterbium chloride, YbCl<sub>3</sub>+6H<sub>2</sub>O**Very sol in H<sub>2</sub>O (Cleve, Z anorg 1902, **32** 134)Mpt 150-155° Anhydrous salt is sol in H<sub>2</sub>O and in alcohol (Matignon, A ch 1906, (8) **8** 442)**Ytterbium oxide, Yb<sub>2</sub>O<sub>3</sub>**

Slowly attacked by cold or warm acids, but easily sol at 100°

**Ytterbium oxychloride, YbOCl**Ppt (Cleve, Z anorg 1902, **32** 135)**Yttrium, Y**Decomposes H<sub>2</sub>O (Cleve, Bull Soc (2) **21** 344) Decomp H<sub>2</sub>O slightly at ord temp, more rapidly by boiling Easily sol in dil acids, even acetic acid Slightly acted upon by conc H<sub>2</sub>SO<sub>4</sub> Decomposes hot KOH+Aq and cold NH<sub>4</sub>Cl+Aq Not attacked by NH<sub>4</sub>OH+Aq (Popp, A **131** 179)

Popp's yttrium contained erbium

**Yttrium bromide, YBr<sub>3</sub>**Sol in H<sub>2</sub>O with evolution of heat (Duboin, C R **107** 243)+9H<sub>2</sub>O Deliquescent Easily sol in H<sub>2</sub>O and alcohol Insol in ether (Cleve)**Yttrium carbide, YC<sub>2</sub>**Decomp by H<sub>2</sub>O and by dil acids, very slowly attacked by conc acids (Moissan, C R 1896, **122** 575)Decomp by H<sub>2</sub>O and dil acids (Pettersson, B 1895, **28** 2421)**Yttrium chloride, YCl<sub>3</sub>**Anhydrous Sol in H<sub>2</sub>O with evolution of heat (Cleve)+6H<sub>2</sub>O Deliquescent Very sol in H<sub>2</sub>O Sl sol in alcohol Insol in ether (Cleve)

Mpt 156-160°, sol in alcohol

60.1 grams anhydrous salt are sol in 100 grams of abs alcohol at 15°  
6.5 grams are sol in 100 grams pyridine (Matignon, A ch 1906, (8) **8** 437)**Yttrium fluoride, YF<sub>3</sub>+½H<sub>2</sub>O**

Nearly insol in dil acids (Cleve)

**Yttrium hydroxide, Y<sub>2</sub>O<sub>3</sub>, 6H<sub>2</sub>O or Y<sub>2</sub>O<sub>3</sub>H<sub>6</sub>+3H<sub>2</sub>O**Insol in H<sub>2</sub>OInsol in KOH or NaOH+Aq Easily sol in acids Sol in alkali carbonates+Aq When freshly pptd, easily sol in NH<sub>4</sub>Cl+Aq**Yttrium iodide, YI<sub>3</sub>**Very deliquescent Easily sol in H<sub>2</sub>O and alcohol

Sl sol in ether (Cleve)

**Yttrium oxide, Y<sub>2</sub>O<sub>3</sub>**Insol in H<sub>2</sub>O Sl sol in cold HCl, HNO<sub>3</sub>, or dil H<sub>2</sub>SO<sub>4</sub>+Aq, but gradually completely sol on warming Insol in NH<sub>4</sub>OH and sl sol in KOH+Aq Sol in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq Somewhat sol in K<sub>2</sub>CO<sub>3</sub>+Aq**Yttrium peroxide, Y<sub>4</sub>O<sub>7</sub>**(Cleve, Bull Soc (2) **43** 53)**Yttrium oxychloride, Y<sub>2</sub>O<sub>2</sub>Cl<sub>2</sub>**Insol in H<sub>2</sub>O (Popp)**Yttrium sulphide, Y<sub>2</sub>S<sub>3</sub>**Not prepared in pure state Impure is insol in H<sub>2</sub>O, and partially decomp thereby Easily sol in acids with decomp (Popp)**Zinc, Zn**Not attacked by pure cold H<sub>2</sub>O Slowly oxidised by boiling H<sub>2</sub>O Pure H<sub>2</sub>O free from O dissolved nothing from 2500 sq mm Zn Presence of air containing CO<sub>2</sub> caused a solution of 3.5 mg Zn, which maximum was reached in 2 days Air without CO<sub>2</sub> also caused a slight action (Snyders, B **11** 936)100 ccm distilled H<sub>2</sub>O dissolved 14 mg Zn from 11.8 sq cm in one week, during which air free from CO<sub>2</sub> was passed through the liquid and 19 mg when air containing CO<sub>2</sub> was used (Wagner, Dingl **221** 260)Filtered rain water was found to contain 20 mg Zn per l (Burg, Isis, **1873** 119)Very pure H<sub>2</sub>O, when conducted through a great length of galvanized iron pipe, contained 1.7 pts Zn to 100,000 pts H<sub>2</sub>O (Davies, J Soc Chem Ind 1899, **18** 102)Action of H<sub>2</sub>O on Zn in galvanized pipes is caused by electrolysis (Smetham, C N 1879, **39** 236)All kinds of H<sub>2</sub>O attack Zn, rain water the leastIn distilled H<sub>2</sub>O exposed to air Zn is abun-

dantly coated with  $\text{ZnCO}_3 \cdot 2\text{ZnO} \cdot 3\text{H}_2\text{O}$ . By allowing 32 g Zn to stand in 270 cc distilled  $\text{H}_2\text{O}$  in a flask loosely stoppered with filter paper, 1.2 pts Zn to 100,000 pts  $\text{H}_2\text{O}$  was found in solution in 1-2 days (Smith, J Soc Chem Ind 1904, **23** 475)

Sol in all acids. Very slowly sol in dil  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$  in glass vessels if Zn is pure. According to Jacquelin, 24 hours were necessary to dissolve 6 g pure zinc. When fused at the lowest possible temperature, it is much more slowly sol than when heated to a red heat. In both cases it is much more rapidly dissolved if cooled quickly (Bolley, A **95** 294, Rammelsberg)

Dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  dissolves given % zinc in the same length of time (B=according to Bolley, R=according to Rammelsberg)

	Slowly cooled		Rapidly cooled	
	B	R	B	R
Cast at the melting point	42.5	74.1	13.0	0.9
Cast at a red heat	100.0	69.4	85.5	9.5

50 cc  $\text{H}_2\text{SO}_4 + \text{Aq}$  dissolved in 2 hours the following amts from 1 sq cm Zn at t°

t°	Strength of acid	Grms dissolved
20	$\text{H}_2\text{SO}_4$	0.000
130	"	0.075
150	"	0.232
20	$\text{H}_2\text{SO}_4 + \text{H}_2\text{O}$	0.002
130	"	0.142
150	"	0.345
20	$\text{H}_2\text{SO}_4 + 2\text{H}_2\text{O}$	0.002
130	"	4.916
150	"	5.450
20	$\text{H}_2\text{SO}_4 + 3\text{H}_2\text{O}$	0.005
130	"	3.080
20	$\text{H}_2\text{SO}_4 + 4\text{H}_2\text{O}$	0.049
130	"	0.456
20	$\text{H}_2\text{SO}_4 + 5\text{H}_2\text{O}$	0.027
130	"	0.337
20	$\text{H}_2\text{SO}_4 + 6\text{H}_2\text{O}$	0.018
100	"	3.16

(Calvert and Johnson, Chem Soc **19** 437)

C P zinc is more quickly sol in dil acids in vacuo than under normal pressure, the ratio being about 1.65. The rate of solubility increases slowly with rise of temp from 0° to 98°, when it amounts to about 4 times that at 0°, but from 98°-100° the increase is thirteenfold. Thus, as an average of 6 experiments, dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (1.20) dissolves in 30 minutes 2.1 mg Zn at 0°, 4.9 mg at 20°, 7.4 mg at 60°, 9.3 mg at 98°, but 122.1 mg at 100°. If, however, the acid was prevented from boiling by increasing the pressure, the sudden increase between 98° and 100° does not take place.

The rate of solubility in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$  (1.20) is also increased 175 times by the addition of  $\text{CrO}_3$  and 306 times by the addition of  $\text{H}_2\text{O}_2$ . The above phenomena are explained by assuming the formation of a condensed hydrogen atmosphere around the metal, which prevents the further action of the acid (Weeren, B **24** 1785)

Not attacked by  $\text{HNO}_3 + \text{Aq}$  of 1.512 to 1.419 sp gr at a temp of -18° or less, but violently attacked if temp is raised.  $\text{HNO}_3 + \text{Aq}$  of 1.419-1.401 sp gr does not attack Zn at temp of a freezing mixture, but violently at 0°. More dil  $\text{HNO}_3 + \text{Aq}$  attacks Zn even at -20° (Millon, A ch (3) 6.99)

Sol in  $\text{H}_2\text{CO}_3 + \text{Aq}$  (Berzelius)

Solubility of Zn in acids is very much affected by the presence of small quantities of various metallic salts. Small amts of  $\text{PtCl}_4 + \text{Aq}$  accelerated the action of  $\text{H}_2\text{SO}_4 + \text{Aq}$  149 times, and  $\text{As}_2\text{O}_3$  123 times.  $\text{HgCl}_2$  has a strong retarding action owing to pptn of Hg on the Zn.

The rate of solution of Zn in acids and the effect of changes in concentration and temperature and of the presence of inorganic salts and organic substances on this rate has been studied. 26 Tables are given (Ericson-Aurén, Z anorg 1901, **27** 209-253)

Speed of solution in  $\text{H}_2\text{SO}_4$  and in  $\text{HCl}$  (Centnerszwer, Z phys Ch 1914, **87** 692)

Various saline solutions have a strong solvent power in presence of  $\text{PtCl}_4$ , i.e.  $\text{KCl}$ ,  $\text{NaCl}$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{MgSO}_4 + \text{Aq}$ .  $\text{PtCl}_4$  also causes Zn to decompose distilled  $\text{H}_2\text{O}$ .  $\text{CuSO}_4$  has a similar but less energetic effect.

In all the above cases the disengagement of hydrogen is slower in the dark than in the light (Millon, C R **21** 37)

According to Barreswill (C R **21** 292) the above reactions are all caused by galvanic action due to pptd metal, and a piece of Pt in contact with the Zn causes the same action as the  $\text{PtCl}_4$  in solution.

Easily sol in alkalis + Aq, even  $\text{NH}_4\text{OH} + \text{Aq}$ , especially when the Zn is in contact with Fe. Sol in  $\text{NaCl} + \text{Aq}$  with pptn of  $\text{ZnO}$  (Sierich, J B **1867** 257)

Sol in sat alkali and alkali earth chlorides + Aq (Post, **1872**)

Sol in  $\text{NH}_4$  salts + Aq (Iorin, J B **1865** 124)

Sol in sat  $\text{Na}_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{MgSO}_4$ ,  $\text{NaNO}_3$ ,  $\text{KNO}_3$ ,  $\text{Ba(NO}_3)_2$ ,  $\text{CaCl}_2$ ,  $\text{MgCl}_2$  and  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . Chlorides and sulphates (especially  $\text{Na}_2\text{SO}_4$  and  $\text{MgCl}_2$ ) have strongest action,  $\text{MgSO}_4$  and nitrates the least. The action is greatly increased by heat (Snyders, B **11** 936)

Sol in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol in neutral  $\text{FeCl}_2 + \text{Aq}$  with pptn of Fe, especially easily at 100° (Capitaine, C R **9** 737)

Sol in  $\text{NiSO}_4 + \text{Aq}$  with pptn of  $\text{NiO}$  (Iupputi)

Sol in conc hot  $\text{ZnCl}_2 + \text{Aq}$ , but Zn oxy-

chloride is pptd on diluting (Ordway, Am J Sci (2) **23** 222)  
Sol in  $\text{GISO}_4 + \text{Aq}$  (Debray) —

Solubility of Zn in dilute solutions of salts  
100 ccm of solutions of the given salts were allowed to act one week on 11.8 sq cm Zn while a current of air with or without  $\text{CO}_2$  was passed through the solution

Salt	G salt in 100 ccm solution	Mg Zn dissolved without $\text{CO}_2$	Mg Zn dissolved with $\text{CO}_2$
NaCl } or KCl }	0 5	7	38
$\text{NH}_4\text{Cl}$	1 0	51	36
$\text{MgCl}_2$	0 83	18	54
$\text{K}_2\text{SO}_4$	1 0	30	53
$\text{KNO}_3$	1 0	9	37
$\text{Na}_2\text{CO}_3$	1 0	13	
NaOH	0 923	60	
$\text{CaO}_2\text{H}_2$	Sat	3	

(Wagner, Dingl **221** 260)

Action of dil salt solutions (1%) on Zn The following amts of Zn in mg were dissolved from 2500 sq mm Zn in 14 days by 400 ccm 1% solution of the given salts

Salt	Mg Zn	Salt	Mg Zn
NaCl	11 2	$\text{NaNO}_3$	6
KCl	14 8	$\text{Ba}(\text{NO}_3)_2$	8
$\text{CaCl}_2$	15 2	$\text{NH}_4\text{Cl}$	24 0
$\text{MgCl}_2$	17 2	$(\text{NH}_4)_2\text{SO}_4$	31 6
$\text{BaCl}_2$	13 2	$\text{NH}_4\text{NO}_3$	26 0
$\text{K}_2\text{SO}_4$	12 0	$\text{NaHCO}_3$	0
$\text{MgSO}_4$	8 8	$\text{K}_2\text{CO}_3$	0
$\text{KNO}_3$	6 8	$\text{N}_2\text{CO}_3$	0

Sl attacked by  $\text{H}_2\text{O}$  at  $80^\circ$  by hot conc  $\text{NH}_4\text{OH}$ , attacked by  $\text{H}_3\text{PO}_4$  or  $\text{NaCl} + \text{Aq}$ , very sl attacked by  $\text{NaNO}_3 + \text{Aq}$  or  $\text{KNO}_3 + \text{Aq}$  at  $100^\circ$  (Smith J Soc Chem Ind 1904, **23** 476)

$\frac{1}{2}$  ccm oleic acid dissolves 0.0240 g Zn in 6 days (Gates, J phys Chem 1911, **15** 143)

Attacked by conc sugar + Aq at  $115^\circ$  (Klein and Berg, C R **102** 1170)

### Zinc amide, $\text{Zn}(\text{NH}_2)_2$

Decomp by  $\text{H}_2\text{O}$  and alcohol Insol in ether (Frankland, Phil Mag (4) **15** 149)

### Zinc antimonide, $\text{ZnSb}$

Does not decomp boiling  $\text{H}_2\text{O}$  except slightly Not attacked by dil mineral acids, but decomp by conc  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  (Cooke, Proc Am Acad **5** 348)

$\text{Zn}_3\text{Sb}_2$  Decomp  $\text{H}_2\text{O}$  rapidly at  $100^\circ$

Violently decomp by dil  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , also by  $\text{HNO}_3 + \text{Aq}$  Completely sol in  $\text{HCl} + \text{Aq}$  mixed with a little  $\text{HNO}_3$  (Cooke)

### Zinc azomide, basic, $\text{Zn}(\text{OH})\text{N}_3$

Very sl sol in  $\text{H}_2\text{O}$  Decomp by hot  $\text{H}_2\text{O}$  (Curtius, J pr 1898, (2) **58** 293)

### Zinc azomide ammonia, $\text{ZnN}_3 \cdot 2\text{NH}_3$

Insol in  $\text{H}_2\text{O}$ , but gradually decomp thereby (Dennis, J Am Chem Soc 1907 **29** 20)

### Zinc bromide, $\text{ZnBr}_2$

Very deliquescent, and sol in  $\text{H}_2\text{O}$

Sat  $\text{ZnBr}_2 + \text{Aq}$  contains at

$-20^\circ$   $+4^\circ$   $22^\circ$   $97^\circ$   
66 3 68 8 77 5 83 6%  $\text{ZnBr}_2$ ,

$107^\circ$   $170^\circ$   $210^\circ$   $375^\circ$  (mpt)  
83 8 85 0 89 3 100%  $\text{ZnBr}_2$

(Étard, A ch 1894, (7) **2** 541)

Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at

$35^\circ$   $40^\circ$   $60^\circ$   $80^\circ$   $100^\circ$   
85 45 85 53 86 08 86 57 87 05 g  $\text{ZnBr}_2$

(Dietz, Z anorg 1899, **20** 250)

See also below under hydrated salts

Sp gr of  $\text{ZnBr}_2 + \text{Aq}$  at  $19.5^\circ$  containing

18 3 31 7 43 2 %  $\text{ZnBr}_2$ ,  
1 1849 1 3519 1 5276

52 6 59 1 68 %  $\text{ZnBr}_2$   
1 7082 1 8525 2 1027

(Kremers, Pogg **108** 117)

Sp gr of  $\text{ZnBr}_2 + \text{Aq}$  at  $19.5^\circ$

% $\text{ZnBr}_2$	Sp gr	% $\text{ZnBr}_2$	Sp gr	% $\text{ZnBr}_2$	Sp gr
5	1 045	25	1 265	45	1 560
10	1 093	30	1 330	50	1 650
15	1 196	35	1 400	55	1 755
20	1 204	40	1 475	60	1 875

(Kremers, calculated by Gerlach, Z anal **8** 285)

Sol in conc  $\text{HCl}$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , also in  $\text{NH}_4\text{OH} + \text{Aq}$

Sol in  $\text{AlBr}_3$  (Isbekow, Z anorg 1913 **84** 27)

Very sl sol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, **20** 830)

Sol in alcohol and ether (Berthemot, J Pharm **14** 610)

Sol in methyl acetate (Naumann, B 1909, **42** 3790)

Insol in ethyl acetate (Naumann, B 1910, **43** 314)

More sol in anhydrous ether than in abs alcohol Insol in  $\text{CS}_2$  (Hampe, Ch Z 1887, **11** 846)

Sol in quinoline (Beckmann and Gabel Z anorg 1906, **51** 236)

Mol weight determined in pyridine (Werner, Z anorg 1897, **15** 22)

+ $\text{H}_2\text{O}$  (Lescoeur, A ch 1894, (7) **2** 78)

+ $2\text{H}_2\text{O}$  Very hygroscopic

Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at

—8° 0° 13° 25° 30° 37° (mpt.)

79 06 79 55 80 76 82 46 84 08 86 20 g  $\text{ZnBr}_2$

(Dietz, Z anorg 1899, **20** 250)

+ $3\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at

—15° —10° —5° (mpt.)

77 13 78 45 80 64 g  $\text{ZnBr}_2$

(Dietz, Z anorg 1899, **20** 250)

**Zinc bromide ammonia,  $\text{ZnBr}_2 \cdot 2\text{NH}_3$**

Decomp by  $\text{H}_2\text{O}$  Sl sol in cold, more easily in warm  $\text{NH}_4\text{OH} + \text{Aq}$  (Rammelsberg, Pogg **55** 240)

+ $\frac{1}{2}\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  with separation of  $\text{ZnO}$  (André C R **96** 703)

+ $\text{H}_2\text{O}$  Above salt of Rammelsberg's has this composition (André)

$3\text{ZnBr}_2 \cdot 8\text{NH}_3 + 2\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (André)

$3\text{ZnBr}_2 \cdot 10\text{NH}_3 + \text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (André)

$2\text{ZnBr}_2 \cdot 10\text{NH}_3$  Efflorescent Decomp by  $\text{H}_2\text{O}$  (André)

**Zinc bromide cupric oxide,  $\text{ZnBr}_2 \cdot 3\text{CuO} + 2\text{H}_2\text{O}$**

+ $4\text{H}_2\text{O}$  (Mailhe, C R 1901, **133** 227)

**Zinc bromide hydrazine,  $\text{ZnBr}_2 \cdot 2\text{N}_2\text{H}_4$**

Decomp by  $\text{H}_2\text{O}$

Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Franzen, Z anorg 1908, **60** 277)

**Zinc chloride,  $\text{ZnCl}_2$**

Very deliquescent, and sol in  $\text{H}_2\text{O}$

Sol in 0.333 pt  $\text{H}_2\text{O}$  at 18.7° (Abt)  
Sol in  $\text{Aq}$  sat at 12.5° contains 78%  $\text{ZnCl}_2$   
(Hassensfranz, A ch **28** 291)

Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at

15° 20° 41° 60° 100°

79 12 81 19 82 21 83 51 86 01 g  $\text{ZnCl}_2$

(Dietz, Z anorg 1899, **20** 245)

$\text{ZnCl}_2 + \text{Aq}$  containing 1 pt  $\text{ZnCl}_2$  in 1.20, pts  $\text{H}_2\text{O}$  at 18° has sp gr = 1.3666 (Hit torf, Z phys Ch 1902, **39** 628)

Solubility in  $\text{H}_2\text{O}$  at t°  
100 g  $\text{H}_2\text{O}$  dissolve g  $\text{ZnCl}_2$

t°	Solid phase	g $\text{ZnCl}_2$	
—5	ice	14	
—10		25	
—40		83	
—62	ice 4aq	104	crvohydrate point
—50	$\text{ZnCl}_2 + 4\text{H}_2\text{O}$	113	
—40		127	
—30	4aq 3aq	160	transition point
—10	$\text{ZnCl}_2 + 3\text{H}_2\text{O}$	189	
0		208	
+5		230	
6 5		252	mpt
5		282	
0	3aq 1½aq	309	eutectic point
0	$\text{ZnCl}_2 + 2½\text{H}_2\text{O}$	235	
6 5	2½aq 3aq	252	transition point
10	$\text{ZnCl}_2 + 2½\text{H}_2\text{O}$	272	
12 5		303	mpt
11 5	2½aq 1½aq	335	eutectic point
9	2½aq 1aq	360	eutectic point
6	$\text{ZnCl}_2 + 2½\text{H}_2\text{O}$	385	
—6	$\text{ZnCl}_2 + 1½\text{H}_2\text{O}$	298	
+10		330	
20		368	
26	1½aq 1aq	423	transition point
26 3	1½aq $\text{ZnCl}_2$	433	transition point
0	$\text{ZnCl}_2 + \text{H}_2\text{O}$	342	
10		364	
20		396	
28	1aq 7n $\text{Cl}_2$	436	transition point
31	7n $\text{Cl}_2 + \text{H}_2\text{O}$	477	
25	$\text{ZnCl}_2$	432	
40		452	
60		488	
80		543	
100		610	
26.2			mpt

(Mylius and Dietz, Z anorg 1905, **44** 217)

See also below under hydrated salts

Sp gr of  $\text{ZnCl} + \text{Aq}$  at 19.5°

% $\text{ZnCl}$	Sp gr	% $\text{ZnCl}$	Sp gr
13.5	1.1275	37.5	1.3599
25.8	1.2466	49.2	1.5551

(Kramers Pogg **105** 360)

Sp gr of  $\text{ZnCl} + \text{Aq}$  at 19°

% $\text{ZnCl}$	Sp gr	% $\text{ZnCl}$	Sp gr	% $\text{ZnCl}$	Sp gr
1	1.010	20	1.238	40	1.488
5	1.045	30	1.291	50	1.666
10	1.091	40	1.352	60	1.860
15	1.137	40	1.420	60	1.710
20	1.186				

(Garduch, Z anorg **8** 25° calculated from Kramers)

Sp gr of  $\text{ZnCl} + \text{Aq}$  at t°

t°	15°	15°	15°	15°
% $\text{ZnCl}$	2.5	4.89	10.0	20.0
Sp gr	1.024	1.046	1.094	1.190

t°	15°	15°	15°
% $\text{ZnCl}$	29.86	40.0	58.88
Sp gr	1.297	1.423	1.728

(Long, W Ann 1880, **11** 38)

Sp gr of  $\text{ZnCl}_2 + \text{Aq}$  at room temp containing

15 334	23 487	33 752% $\text{ZnCl}_2$
1 1459	1 2288	1 3431

(Wagner, W Ann 1883, 18 267)

Sp gr of  $\text{ZnCl}_2 + \text{Aq}$  at 25°

Concentration of $\text{ZnCl}_2$ +Aq	Sp gr
1—normal	1 0590
$\frac{1}{2}$ —	1 0302
$\frac{1}{4}$ —	1 0152
$\frac{1}{8}$ —	1 0077

(Wagner, Z phys Ch 1890, 5 40)

Sp gr of  $\text{ZnCl}_2 + \text{Aq}$

% $\text{ZnCl}_2$ g in 1000 g of solution	Sp gr 16°/16
0	1 000000
0 5994	1 000560
2 3163	1 002163
5 0406	1 004708
9 8988	1 009243
19 4914	1 018228

(Dijken, Z phys Ch 1897, 24 108)

Insol in  $\text{SbCl}_3$  (Klemensiewicz, C C 308, II 1850)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch 1898, 20 830)

Easily sol in hot absolute alcohol, and her Sol in 1 pt strong alcohol at 12.5° Wenzel)

Sol in 0.35 pt absolute alcohol (Graham)  
Sol in butyl (Wurtz), and hexyl (Bouss) alcohol at ord temp, but decomp on heating

Very sol in acetic ether with evolution of gas (Cann, C R 102 363)

Easily sol in acetone (Krug and M'Elroy, J Anal Ch 6 181)

1 g  $\text{ZnCl}_2$  is sol in 2.3 g acetone at 18°  
p gr of sat solution 18/1° = 1.14 (Naumann, B 1901, 37 1338)

Sol in acetone and in methylal (Lidinann, C 1899, II 1011)

Sol in methyl acetate (Naumann, B 909, 42 3790)

Sol in hot benzonitrile also in other aromatic nitrile

Sol in methyl sulphide and in ethyl sulphide Very sol in piperidine (Werner, Z anorg 1897, 15 7)

Sol in benzyl alcohol, furfural, methylpropylketone, acetophenone, ethyl monochloracetate, ethyl cyanacetate, ethyl acetate, ethyl benzoate, ethyl oxalate, amylnitrate,  $\gamma$ -butyrolactone, and quinoline

Insol in aldehyde, ethyl nitrate, and nitrobenzene (Lincoln, J phys Chem 899, 3 460)

Sol in quinoline (Beckmann and Gabel, anorg 1906, 51 236)

Sol in 2 pts glycerine at ord temp (Clever, Bull Soc 1872, (2) 18 372)

100 g glycerol dissolve 50 g  $\text{ZnCl}_2$  at 15.5° (Ossendowski, Pharm J 1907, 79 575)

Insol in  $\text{CS}_2$  (Arctowski, Z anorg 1894, 6 257)

Sol in urethane (Castoro, Z anorg 1899, 20 61)

Mol weight determined in piperidine, pyridine and methyl sulphide (Werner, Z anorg 1897, 15 18)

+ $\text{H}_2\text{O}$  Very deliquescent Contains  $1\frac{1}{2}$   $\text{H}_2\text{O}$  (Engel, C R 102 1111)

Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at

0° 11° 27° (mpt)

74 33 78 25 84 61 g  $\text{ZnCl}_2$

(Dietz, Z anorg 1899, 20 245)

+ $1\frac{1}{2}$   $\text{H}_2\text{O}$

Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at

0° 10° 20° 26° (mpt)

67 45 73 65 80 08 83 43 g  $\text{ZnCl}_2$

(Dietz, Z anorg 1899, 20 245)

+2 $\text{H}_2\text{O}$  Sat aq solution contains at

—20° —14° —10° —4° —1°  
54 7 55 4 56 5 57 4 57 9% salt,

+5° 9° 15° 33° 42°  
59 1 60 2 62 0 66 0 66 0

(Étard, A ch 16)

Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at

0° 10° 19° (mpt)

67 56 73 70 79 07 g  $\text{ZnCl}_2$

(Dietz, Z anorg 1899, 20 245)

+2 $\frac{1}{2}$   $\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at

0° 8° 13° (mpt)

67 42 71 96 75 14 g  $\text{ZnCl}_2$

(Dietz, Z anorg 1899, 20 245)

+3 $\text{H}_2\text{O}$  Sol in 12.5 pts  $\text{H}_2\text{O}$  at 0° (Engel)

Solubility in  $\text{H}_2\text{O}$

100 g of the sat solution contain at

—5° 0° +7° (mpt)

64 5 67 58 71 57 g  $\text{ZnCl}_2$

(Dietz, Z anorg 1899, 20 245)

Zinc hydrogen chloride,  $2\text{ZnCl}_2, \text{HCl} + 2\text{H}_2\text{O}$

Deliquescent (Engel, C R 102 1068)

$\text{ZnCl}_2, \text{HCl} + 2\text{H}_2\text{O}$  (Engel)

Zinc hydrazine chloride,  $\text{ZnCl}_2, \text{N}_2\text{H}_4, \text{HCl}$

Very hygroscopic

Sol in  $\text{H}_2\text{O}$  (Curtius, J pr 1894, (2) 50 338)



**ZnCl<sub>2</sub>, 2(N<sub>2</sub>H<sub>4</sub>, HCl)** Hygroscopic, very sol in H<sub>2</sub>O

Sol in hot alcohol and NH<sub>4</sub>OH + Aq (Cur-  
tius, J pr 1894, (2) 50 338)

**Zinc chloride ammonia, ZnCl<sub>2</sub>, 5NH<sub>3</sub> + H<sub>2</sub>O**

Easily sol in little but decomp by much  
H<sub>2</sub>O Still more sol in ZnCl<sub>2</sub> + Aq with de-  
comp (Divers, C N 18 13)

**ZnCl<sub>2</sub>, 4NH<sub>3</sub> + H<sub>2</sub>O** (Kane)  
**ZnCl<sub>2</sub>, 2NH<sub>3</sub>** Not completely sol in H<sub>2</sub>O,  
can be recryst from hot NH<sub>4</sub>Cl + Aq (Ritt-  
hausen, J pr 60 473)

Insol in H<sub>2</sub>O Sol in NH<sub>4</sub>Cl or NH<sub>4</sub>OH +  
Aq (Thomas, B 20 743)

+1/4 H<sub>2</sub>O  
+1/2 H<sub>2</sub>O  
+1/2 H<sub>2</sub>O } Decomp by H<sub>2</sub>O  
+H<sub>2</sub>O

(André, C R 1882, 94 964)

**ZnCl<sub>2</sub>, NH<sub>3</sub>** Decomp by H<sub>2</sub>O (Kaut, A  
ch 72 290)

**Zinc chloride cupric oxide, ZnCl<sub>2</sub>, 3CuO +  
4H<sub>2</sub>O**

(Mailhe, C R 1901 134 226)

**Zinc chloride hydrazine, ZnCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>**

Franken, Z anorg 1908 60 275

Insol in H<sub>2</sub>O  
Easily sol in NH<sub>4</sub>OH + Aq (Cur-  
tius, J pr 1894, (2) 50 315)

**Zinc chloride hydroxylamine, ZnCl<sub>2</sub>, 2NH<sub>2</sub>OH**

Sl sol in cold water, more in warm  
H<sub>2</sub>O Very sol in NH<sub>4</sub>OH + Aq Very sol  
sol in alcohol and other organic solvents  
(Crimmet, Bull Soc C 3 116)

1 pt is dissolved in 100 pts aq solution  
sat at 20° (Antonoff, C C 1905, II 810)

**Zinc fluoride, ZnF<sub>2</sub>**

Sl sol in cold water, more in warm  
Insol in 95% alcohol Sol in boiling HNO<sub>3</sub>  
HCl, or H<sub>2</sub>SO<sub>4</sub> (Poulsen, C R 116 81)

Contrary to older statements ZnF<sub>2</sub> is quite  
sol in H<sub>2</sub>O (Kohlensch, Z phys Ch 1901,  
44 213)

Insol in liquid NH<sub>3</sub> (Com. Am. Ch. I  
1898, 20 830)

Insol in methyl acetate (Nannum, I  
1909, 42 3790)

+H<sub>2</sub>O Difficultly sol in H<sub>2</sub>O, some-  
what more sol in H<sub>2</sub>O containing HCl  
or HNO<sub>3</sub> Easily sol in NH<sub>4</sub>OH + Aq  
(Berzelius, Pogg. 1 26)

1 l H<sub>2</sub>O dissolves 16 g at 18° (Dobz)

**Zinc hydrogen fluoride**

Known only in solution

**Zinc zirconium fluoride**

See Fluozirconate, zinc

**Zinc hydrophosphide, Zn<sub>2</sub>H<sub>2</sub>P<sub>2</sub>**

Decomp by cold H<sub>2</sub>O and by dil HCl + Aq  
(Drechsel and Linkelstein, B 1871, 4 353)

**Zinc hydroxide, ZnO<sub>2</sub>H<sub>2</sub>**

Insol in H<sub>2</sub>O Sol in acids Sol in KOH,  
NaOH, NH<sub>4</sub>OH, or (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq

1 l H<sub>2</sub>O dissolve 0.01 g ZnO<sub>2</sub>H<sub>2</sub> at 25°  
(Bodlander, Z phys Ch 1898, 27 66)

Solubility in H<sub>2</sub>O is calculated to be 2.6 ×  
10<sup>-5</sup> g mols per l (Herz, Z anorg 1900, 23  
227)

1 l H<sub>2</sub>O dissolves 0.0042 g ZnO<sub>2</sub>H<sub>2</sub> at 18°  
(Dupre and Bialas, Z angew Ch 1903, 16  
55)

See also Zinc oxide

Solubility in NH<sub>4</sub>OH + Aq at 25°

ZnO <sub>2</sub> H <sub>2</sub> used	NH <sub>3</sub> norm	G ZnO per l
prepared from ZnSO <sub>4</sub>	1 287	7 28
	0 825	3 84
	0 311	0 85
prepared from Zn(NO <sub>3</sub> ) <sub>2</sub>	0 321	0 34
	0 613	0 845
	1 215	2 70
	1 928	5 07
	2 570	7 01
	2 215	10 16

(Bonsdorff, Z anorg 1901, 41 189)

Solubility of ZnO<sub>2</sub>H<sub>2</sub> in NH<sub>4</sub>OH and am-  
monium bases + Aq at 17-19°

g ZnO <sub>2</sub> H <sub>2</sub> in 100 g of the solution	g ZnO <sub>2</sub> H <sub>2</sub> in 100 g of the solution
0.0042 NH	0.0018
0.26 NH	0.0179
0.007 NH	0.0959
0.044 NH CH	0.0008
0.42 NH CH	0.0152
0.944 NH CH	0.0481
0.068 NH CH	0.0005
0.4 NH CH	0.0071
0.68 NH CH	0.0160
NH CH	insol
NH CH	

Herz, Z anorg 1902 30 280)

Solubility in NH<sub>4</sub>OH + Aq increases with  
increasing concentration of NH<sub>4</sub>OH (Fuler,  
P 1900 36 101)  
2 pts ZnO<sub>2</sub>H<sub>2</sub> dissolve in 5 pts KOH + Aq  
(sp gr 1.07, Bonnet)

Solubility of  $\text{ZnO}_2\text{H}_2$  in  $\text{NaOH}+\text{Aq}$ 

G Na in 20 ccm	G Zn in 20 ccm
0 1012	0 0040
0 1978	0 0150
0 4278	0 0442
0 6670	0 1771
0 9660	0 9630
1 4951	0 2481
2 9901	0 3700

When zinc hydroxide is treated with alkali, more dissolves at first than corresponds with the true equilibrium under the prevailing conditions, for such solutions spontaneously deposit more or less zinc hydroxide according to the concentration (Rubenbauer, *Z anorg* 1902, **30** 333)

Solubility of  $\text{ZnO}_2\text{H}_2$  in  $\text{NaOH}+\text{Aq}$  at  $25^\circ$ 

G mol per l	
Na	Zn
0 2636	0 00311
0 3871	0 0057
0 5414	0 0129
0 9280	0 0425

(Wood, *Chem Soc* 1910, **97** 884)

Freshly pptd  $\text{ZnO}_2\text{H}_2$  is easily sol in  $\text{KOH}+\text{Aq}$ , but it gradually goes over into a stable form which is difficultly sol in  $\text{KOH}+\text{Aq}$  (Herz, *Z anorg* 1901, **28** 474)

Freshly pptd  $\text{ZnO}_2\text{H}_2$  is sol in dil salt solutions (1 %) as follows. The given amts in mg (calculated as Zn) were dissolved per l at  $t^\circ$

Salt	Mg Zn	t
$\text{NaCl}$	51	18
$\text{KCl}$	43	20
$\text{CaCl}_2$	57 5	16
$\text{MgCl}$	65	16
$\text{BaCl}_2$	38	18
$\text{K}_2\text{SO}_4$	37 5	20
$\text{MgSO}_4$	27	21
$\text{KNO}_3$	17 5	15
$\text{NaNO}_3$	22	15
$\text{Ba(NO}_3)_2$	25	21
$\text{K CO}_3$	0	15
$\text{NH}_4\text{Cl}$	95	20
$\text{NH}_4\text{NO}_3$	77	20
$(\text{NH}_4)_2\text{SO}_4$	58	20

(Snyders, *B* **11** 936)

+HCl

See also Zinc oxide

Zinc hydrosulphide,  $\text{Zn}(\text{SH})_2$ 

Very unstable. Decomp by  $\text{H}_2\text{O}$  (Zotta, *M* **10** 807)

Sol in  $\text{NaSH}+\text{Aq}$  (Thomsen, *B* **11** 2044)

$\text{Zn}_3\text{H}_2\text{S}_4$  (Zotta)

Zinc iodide,  $\text{ZnI}_2$ 

Deliquescent Easily sol in  $\text{H}_2\text{O}$

Sat  $\text{ZnI}_2+\text{Aq}$  contains at

$-18^\circ$   $-5^\circ$   $+17^\circ$   $47^\circ$   $62^\circ$   $73^\circ$   
 70 9 74 0 80 4 80 3 81 3 81 2%  $\text{ZnI}_2$ ,  
 $97^\circ$  100° 107° 138° 140°  
 82 1 83 0 82 6 83 8%  $\text{ZnI}_2$   
 (Étard, *A ch* 1894, (7) **2** 544)

Solubility in  $\text{H}_2\text{O}$ 

100 g of the sat solution contain at

$0^\circ$   $18^\circ$   $40^\circ$   $60^\circ$   $80^\circ$   $100^\circ$   
 81 11 81 20 81 66 82 37 83 05 83 62 g  $\text{ZnI}_2$   
 (Dietz, *Z anorg* 1899, **20** 251)

See also under  $+\text{H}_2\text{O}$

Sp gr of  $\text{ZnI}_2+\text{Aq}$  at  $19.5^\circ$  containing

23 1 42 6 56 3 63 5 76 0%  $\text{ZnI}_2$   
 1 2340 1 5121 1 7871 1 9746 2 3976  
 (Kremers, *Pogg* **111** 61)

Sp gr of  $\text{ZnI}_2+\text{Aq}$  at  $19.5^\circ$  containing

5 10 15 20 25 %  $\text{ZnI}_2$ ,  
 1 045 1 091 1 140 1 196 1 255  
 30 35 40 45 50 %  $\text{ZnI}_2$ ,  
 1 368 1 390 1 420 1 560 1 650  
 55 60 65 70 75 %  $\text{ZnI}_2$   
 1 754 1 875 2 020 2 180 2 360

(Kremers, calculated by Gerlach, *Z anal* **8** 285)

Sol in  $(\text{NH}_4)_2\text{CO}_3+\text{Aq}$

Moderately sol in liquid  $\text{NH}_3$

*Am Ch J* 1898, **20** 830)

Sol in alcohol

100 pts glycerine dissolve 40 pts at ord temp (Klever, *Bull Soc* 1872, (2) **18** 372)

100 g glycerol dissolve 40 g  $\text{ZnI}_2$  at  $15.5^\circ$  (Ossendowski, *Pharm J* 1907, **79** 575)

More sol in anhydrous ether than in abs alcohol Insol in  $\text{CS}_2$  (Hampe, *Ch Z* 1887, **11** 846)

Sol in methyl acetate (Naumann, *B* 1909, **42** 3790), acetone (Eidmann, *C C* 1899, **II** 1014, Naumann, *B* 1904, **37** 4328)

Sol in quinoline (Beckmann and Gabel, *Z anorg* 1906, **51** 236)

Mol weight determined in methyl sulphate (Werner, *Z anorg* 1897, **15** 25)

$+\text{H}_2\text{O}$  Solubility in  $\text{H}_2\text{O}$   
 100 g of the sat solution contain at  
 $-10^\circ$   $-5^\circ$   $0^\circ$   $+10^\circ$   $22^\circ$   $27^\circ$  (mpt)  
 80 50 80 77 81 16 82 06 83 12 89 52 g  $\text{ZnI}_2$   
 (Dietz, *Z anorg* 1899, **20** 251)

$+4\text{H}_2\text{O}$  (Lubarski, *Z anorg* 1898, **18** 387)

Zinc tetraiodide,  $\text{ZnI}_4$ 

Known only in aqueous solution (Baup, *Report* **14** 412)

Sol in fenchone (Rimini and Olivari, *C C* 1907, **II** 241)

**Zinc iodide ammonia,  $\text{ZnI}_2 \cdot 4\text{NH}_3$** 

Decomp by cold  $\text{H}_2\text{O}$  Easily sol in acids and  $\text{NH}_4\text{OH} + \text{Aq}$  (Rammelsberg, Pogg 48 152)

$\text{ZnI}_2 \cdot 5\text{NH}_3$  Decomp by cold  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Rammelsberg)

$3\text{ZnI}_2 \cdot 5\text{NH}_3 + 3\text{H}_2\text{O}$  (Tassily, C R 1896, 122 324)

**Zinc iodide hydrazine,  $\text{ZnI}_2 \cdot 2\text{N}_2\text{H}_4$** 

Decomp by  $\text{H}_2\text{O}$   
Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Franzen, Z anorg 1908, 60 277)

**Zinc nitride,  $\text{Zn}_3\text{N}_2$** 

Decomp by  $\text{H}_2\text{O}$  with the greatest violence (Frankland, Phil Mag (4) 15 149)

Easily decomp by  $\text{H}_2\text{O}$  when finely powdered (Rossel, C R 1895, 121 942)

Sol in  $\text{HCl}$  (Fischer, B 1910, 43 1468)

**Zinc oxide,  $\text{ZnO}$** 

Insol in  $\text{H}_2\text{O}$  Some preparations of  $\text{ZnO}$  are sl sol in  $\text{H}_2\text{O}$ , never, however, in less than 1 million pts  $\text{H}_2\text{O}$  (Bineau, C R 41 510)

Calculated from electrical conductivity of  $\text{ZnO} + \text{Aq}$  1 pt  $\text{ZnO}$  is sol in 236,000 pts  $\text{H}_2\text{O}$  at  $18^\circ$  (Dupre and Bialas, Zeit angew Ch 1903, 16 55)

**Zinc hydroxide**

sol in acids, even after ignition  
in acids, even  $\text{H}_2\text{SO}_4$ , or  $\text{H}_2\text{CO}_3 +$

Solubility of  $\text{ZnO}$  in  $\text{CrO}_3 + \text{Aq}$  at  $25^\circ$   
1 l of the solution contains

G $\text{CrO}_3$	G $\text{ZnO}$	G $\text{CrO}_3$	G $\text{ZnO}$
0 010	0 013	101	44 9
0 010	0 013	151	66 1
0 010	0 013	192	83 8
0 604	0 409	192	83 6
2 14	1 16	285	123
4 19	2 24	392	168
11 4	5 84	450	193
11 5	5 89	461	196
22 2	10 7	463	197
31 4	14 9	475	202
43 1	20 1	574	240
57 5	26 7	660	274
66 5	30 3	769	318
66 7	30 4	879	354
70 6	32 2	970	389
93 3	41 5		

(Grogger Z anorg 1911, 70 136)

When moist is easily sol in  $\text{KOH}$ ,  $\text{NaOH}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$ , but only sl sol therein after ignition Partially reprecipitated from solution in  $\text{NH}_4\text{OH} + \text{Aq}$  by dilution with  $\text{H}_2\text{O}$

Anhydrous  $\text{ZnO}$  is insol in dil, but sol in conc alkali hydrates +  $\text{Aq}$ , but the hydroxide is easily sol even in dil alkalis +  $\text{Aq}$  (Fremy, A ch (3) 23 390)

Very sl sol in  $\text{NH}_4\text{OH} + \text{Aq}$  After igni-

tion its solubility is greatly increased by traces of  $\text{K}$  and  $\text{NH}_4$  salts Phosphates have the strongest action, then, in the following order arsenates, chlorides, sulphites, nitrates, acetates, carbonates, tartrates, citrates, and sulphates Succinates and benzoates increase the solubility in  $\text{NH}_4\text{OH} + \text{Aq}$ , only when it is very dil, borates, iodides, chlorates, arsenites, gallates, and oxalates do not increase the solubility (Schindler)

$\text{ZnO}$  is sol in  $\text{NH}_4\text{OH} + \text{Aq}$  only in presence of  $\text{NH}_4$  salts (Brandhorst, Zeit angew Ch 1904, 17 513)

Solubility in  $\text{KOH}$ ,  $\text{NaOH}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$

An excess over 4 mols  $\text{KOH}$  to 1 mol  $\text{ZnO}$  is necessary for solution, but that excess may be neutralised after solution, until only 4 mols are left, without pptn of  $\text{ZnO}$  Solution is pptd by addition of 12 vols  $\text{H}_2\text{O}$   $\text{KOH} + \text{Aq}$  containing 16 5 g  $\text{KOH}$  to a litre  $\text{H}_2\text{O}$  is the weakest solution which will dissolve  $\text{ZnO}$  Three times as much alkali are necessary for solution at  $50^\circ$  as at  $16-17^\circ$  Less excess of  $\text{NaOH}$  than of  $\text{KOH}$  is necessary 3 mols  $\text{NH}_4\text{OH}$  will dissolve 1 mol  $\text{ZnO}$ , and the temp and dilution are in this case of little influence (Prescott)

100 cc of 20%  $\text{NaOH} + \text{Aq}$  dissolve in many hours at most 2 97 g ignited  $\text{ZnO}$  Pptd  $\text{ZnO}$  is more quickly dissolved but the action becomes very slow after 100 cc of the solution contain 3 87 g of  $\text{Zn}$  (Forster and Gunther, Z Elektrochem 1900, 6 301)

Solubility of ignited  $\text{ZnO}$  in  $\text{NaOH} + \text{Aq}$  gradually decreases (Kunschert, Z anorg 1904, 41 343)

Sol in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ , either when moist or dry

Somewhat less sol in  $\text{NH}_4\text{NO}_3 + \text{Aq}$

Somewhat sol in water glass +  $\text{Aq}$  (Ordway)

Slowly sol in cold, easily in hot  $\text{NaCl} + \text{Aq}$  (Siersch, J B 1867 255)

Solubility of  $\text{ZnO}$  in  $\text{ZnCl}_2 + \text{Aq}$  at room temp

G $\text{ZnCl}_2$ per 100 g $\text{H}_2\text{O}$	G $\text{ZnO}$ per 100 g $\text{H}_2\text{O}$
8 22	0 0137
23 24	0 138
45 95	0 497
51 50	0 604
56 90	0 723
62 85	0 854
96 00	1 792
124 70	3 213
144 80	2 640
203 00	1 590

The solubility curve has a maximum at a point corresponding to about 125 g  $\text{ZnCl}_2$  per 100 g  $\text{H}_2\text{O}$  On the first branch of the curve the solid phase in equilibrium with the solution is  $\text{ZnCl}_2 \cdot 4\text{ZnO} \cdot 6\text{H}_2\text{O}$ , on the second branch it is  $\text{ZnCl}_2 \cdot \text{ZnO} \cdot 1 5\text{H}_2\text{O}$

(Driot, C R 1910, 150 1427)

Sol in boiling  $\text{Fe}(\text{NO}_3)_3$ , and  $\text{Pb}(\text{NO}_3)_2$  + Aq with pptn of oxides Not attacked by  $\text{Co}(\text{NO}_3)_2$ ,  $\text{Ni}(\text{NO}_3)_2$ , and  $\text{Ce}(\text{NO}_3)_3$  + Aq (Persoz)

Sol in boiling  $\text{KCN}$  + Aq

Insol in boiling K tartrate + Aq (Kahlenberg and Hillyer, Am Ch J 1894, 16 101)  
Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 830)

Tartaric acid somewhat hinders the pptn of  $\text{ZnO}_2\text{H}_2$

Insol in methyl acetate (Naumann, B 1909, 42 3790)

Insol in acetone (Naumann, B 1904, 37 4329, Erdmann, C C 1899, II 1014)

Sol in methyl amine, but insol in amyl amine + Aq (Wurtz)

1 l solution containing 174.4 g sugar and 14.1 g  $\text{CaO}$  dissolves 0.24 g  $\text{ZnO}$  (Bodenbender, J B 1865, 600)

Min *Zincate* Sol in acids

### Zinc peroxide

1 pt sol in 45,000 pts  $\text{H}_2\text{O}$

Very sol in acids (Foregger and Philipp, J Soc Chem Ind 1906, 25 300)

$\text{ZnO}_2$  (?) Ppt Decomp by acids with evolution of  $\text{H}_2\text{O}_2$  (Haass, B 17 2249)

$\text{ZnO}$ ,  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{O}_2$  (de Forcrand, A ch 1902, (7) 27 58)

$3\text{ZnO}$ ,  $2\text{H}_2\text{O}_2$  (de Forcrand)

$3\text{ZnO}$ ,  $\text{H}_2\text{O}$ ,  $2\text{H}_2\text{O}_2$  (de Forcrand)

$4\text{ZnO}$ ,  $\text{H}_2\text{O}$ ,  $3\text{H}_2\text{O}_2$  (de Forcrand)

$\text{ZnO}_2$ ,  $\text{ZnO}_2\text{H}_2$  Insol in  $\text{NH}_4\text{OH}$  + Aq (Kouriloff, A ch (6) 23 431)

$3\text{ZnO}_2$ ,  $\text{Zn}(\text{OH})_2$  Sol in  $\text{NaOH}$  + Aq with evolution of  $\text{O}$  (Eijkman, C C 1905, I 1628)

$\text{Zn}_2\text{O}_7$ ,  $3\text{ZnO}$  +  $4\text{H}_2\text{O}$  Completely sol in dil  $\text{H}_2\text{SO}_4$  (de Forcrand)

$10\text{ZnO}$ ,  $4\text{ZnO}$  +  $5\text{H}_2\text{O}$  Ppt (Teletow, C C 1911, I 1799)

### Zinc oxybromide, $\text{ZnBr}_2$ , $\text{ZnO}$ + $13\text{H}_2\text{O}$

$\text{ZnBr}_2$ ,  $4\text{ZnO}$  + 10, 13, and 19  $\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  into—

$\text{ZnBr}_2$ ,  $6\text{ZnO}$  +  $35\text{H}_2\text{O}$  (André)

$\text{ZnBr}_2$ ,  $5\text{ZnO}$  +  $6\text{H}_2\text{O}$  (André)

All oxybromides are sol in  $\text{KOH}$  and  $\text{NH}_4\text{OH}$  + Aq (André, C R 96 703)

### Zinc oxybromide ammonia, $\text{ZnBr}$ , $3\text{ZnO}$ , $2\text{NH}_3$ + $5\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (André, C R 96 703)

### Zinc oxychloride, $\text{ZnO}$ , $3\text{ZnCl}_2$ + $\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$

Very sol in dil acids (Ephraim, Z anorg 1908, 59 67)

+  $4\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$ , more sol in  $\text{ZnCl}_2$  + Aq

Easily sol in acids, or  $\text{NH}_4\text{OH}$ , or  $\text{KOH}$  + Aq (Schindler, Mag Pharm 36 45)

+  $5\text{H}_2\text{O}$  and  $8\text{H}_2\text{O}$  (André, A ch (6) 3 94)

$\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $1\frac{1}{2}\text{H}_2\text{O}$  (Driot, C R 1910, 150 1427)

$3\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $2\text{H}_2\text{O}$  Sl sol in  $\text{H}_2\text{O}$ , more easily sol in  $\text{ZnCl}_2$  + Aq Easily sol in acids and in  $\text{NH}_4\text{OH}$  or  $\text{KOH}$  + Aq (Schindler, Mag Pharm 36 45)

+  $3\text{H}_2\text{O}$  (Werner, B 1907, 40 4443)

+  $5\text{H}_2\text{O}$  (Mailhe, A ch 1902, (7) 27 367)

$3\text{ZnO}$ ,  $2\text{ZnCl}_2$  +  $11\text{H}_2\text{O}$  (André, C R 1888, 106 854)

$4\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $6\text{H}_2\text{O}$  (André, C R 1888, 106 854)

+  $11\text{H}_2\text{O}$  (André, A ch (6) 3 94)

$5\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $6\text{H}_2\text{O}$  (Perrot Bull Soc 1895, (3) 13 976)

+  $8\text{H}_2\text{O}$  (André, C R 1882 94. 1524)

$5\text{ZnO}$ ,  $2\text{ZnCl}_2$  +  $26\text{H}_2\text{O}$  Sol in  $\text{KOH}$  or  $\text{NH}_4\text{OH}$  + Aq Decomp by  $\text{H}_2\text{O}$  into—

$5\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $26\text{H}_2\text{O}$  Sol in  $\text{KOH}$  or  $\text{NH}_4\text{OH}$  + Aq Decomp by  $\text{H}_2\text{O}$  into—

$6\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $6\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Kane, A ch 72 296)

$8\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $10\text{H}_2\text{O}$  (Mailhe, A ch 1902, (7) 27 367)

$9\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $3\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$

Less sol in  $\text{NH}_4\text{OH}$  + Aq than  $\text{ZnCl}_2$ ,  $3\text{ZnO}$  +  $2\text{H}_2\text{O}$ , but easily sol in +  $14\text{H}_2\text{O}$

$9\text{ZnO}$ ,  $2\text{ZnCl}_2$  +  $12\text{H}_2\text{O}$  Insol in hot or cold  $\text{H}_2\text{O}$  (Habermann, M 5 432)

**Zinc oxychloride ammonia,  $6\text{ZnCl}$ ,  $\text{ZnO}$ ,  $12\text{NH}_3$  +  $4\text{H}_2\text{O}$**

Decomp by  $\text{H}_2\text{O}$  and boiling alcohol (André, A ch (6) 3 90)

$\text{ZnCl}$ ,  $3\text{ZnO}$ ,  $2\text{NH}_3$  +  $5\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (André)

$\text{ZnCl}$ ,  $2\text{ZnO}$ ,  $2\text{NH}_3$  +  $3\text{H}_2\text{O}$  André

$6\text{ZnCl}$ ,  $3\text{ZnO}$ ,  $10\text{NH}_3$  +  $15\text{H}_2\text{O}$  André

$4\text{ZnCl}$ ,  $\text{ZnO}$ ,  $8\text{NH}_3$  +  $2\text{H}_2\text{O}$  André

**Zinc oxydide,  $\text{ZnI}$ ,  $3\text{ZnO}$  +  $2\text{H}_2\text{O}$**

Insol in cold sl sol in boiling  $\text{H}_2\text{O}$  (Muller, J pr 26 441)

$\text{ZnI}$ ,  $9\text{ZnO}$  +  $24\text{H}_2\text{O}$  Insol in cold  $\text{H}_2\text{O}$

$\text{ZnI}$ ,  $5\text{ZnO}$  +  $11\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  (Tassilly, C R 1896 122 524)

**Zinc oxyphosphide,  $\text{ZnP}$  O**

(Renault, A ch 4, 9 162)

Probably is a mixture of zinc oxide and phosphorus (Vigier Bull Soc 1861 5)

**Zinc oxysulphide,  $\text{ZnO}$ ,  $\text{ZnS}$**

Sol in  $\text{HCl}$  + Aq (Arvedson, Pogg 1 59)

$4\text{ZnS}$ ,  $\text{ZnO}$  Not decomp by  $\text{H}_2\text{O}$   $\text{HCl}$ ,  $\text{H}_2\text{O}$  + Aq (Kersten, Schw J 57 180)

Min *olomite* Sol in  $\text{HCl}$  + Aq

**Zinc phosphide,  $\text{ZnP}$**

Less easily attacked by  $\text{HCl}$  + Aq than  $\text{Zn}_3\text{P}_2$

$\text{ZnP}$  Not attacked by hot  $\text{HCl}$  + Aq (Hvoslef, A 100 99)

$\text{ZnP}_4$  Insol in dil  $\text{HCl}$  + Aq Renault

$\text{Zn}_3\text{P}_2$  Insol in  $\text{H}_2\text{O}$  Sol in dil  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3 + \text{Aq}$ , with evolution of  $\text{PH}_3$  (Renault, A ch (4) 9 162)

$\text{Zn}_3\text{P}_4$  Insol in  $\text{HCl} + \text{Aq}$  (Renault)

### Zinc selenide, $\text{ZnSe}$

Cold dil  $\text{HNO}_3 + \text{Aq}$  dissolves out  $\text{Zn}$ , and  $\text{Se}$  separates out, which dissolves on warming as  $\text{H}_2\text{SeO}_3$  (Berzelius)

$+x\text{H}_2\text{O}$  Insol in  $\text{H}_2\text{O}$  (Berzelius)

### Zinc sulphide, $\text{ZnS}$

*Anhydrous* Insol in  $\text{H}_2\text{O}$  Sol in  $\text{HCl} + \text{Aq}$ , insol in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  (Ebelmen, A ch (3) 25 97)

Sol in  $\text{H}_2\text{S} + \text{Aq}$  under pressure in a sealed tube (Senarmont, A ch (3) 32 168)

Min *Blende, Sphalerite* Sl attacked by acids, expecting aqua regia

1 l  $\text{H}_2\text{O}$  dissolves  $6.65 \times 10^{-6}$  mols zinc blende at  $18^\circ$

1 l  $\text{H}_2\text{O}$  dissolves  $6.63 \times 10^{-6}$  mols artificial cryst  $\text{ZnS}$  at  $18^\circ$  (Wiegel, Z phys Ch 1907, 58 294)

Sol in an alkaline solution of  $\text{NaClO}$  (Sadtler, Trans Am Electrochem Soc 1902, 1 142)

Insol in liquid  $\text{NH}_3$  (Franklin, Am Ch J 1898, 20 830)

$+1/2, 2/3, \text{ or } 1\text{H}_2\text{O}$

*Pptd*  $\text{ZnS}$

1 l  $\text{H}_2\text{O}$  dissolves  $70.60 \times 10^{-6}$  mols pptd  $\text{ZnS}$  at  $18^\circ$  (Wiegel, Z phys Ch 1907, 58 294)

Insol in alkali hydrates, carbonates, and sulphides +  $\text{Aq}$  Insol in  $\text{NH}_4\text{OH}$ ,  $\text{HCl}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  Easily sol in very dil  $\text{HCl}$  and  $\text{HNO}_3 + \text{Aq}$ , but  $\text{H}_2\text{S}$  ppts  $\text{ZnS}$  in presence of very dil  $\text{HCl} + \text{Aq}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  (Ehott and Storer)

More easily sol in  $\text{HNO}_3 + \text{Aq}$  than in  $\text{HCl} + \text{Aq}$  (Fresenius)

Only sl sol in acetic acid (Wackenroder)

When still moist is sol in  $\text{H}_2\text{SO}_4 + \text{Aq}$

Insol in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$

$\text{K}_2\text{S} + \text{Aq}$  when added to  $\text{ZnSO}_4 + \text{Aq}$  produces a ppt in presence of 10,000 pts  $\text{H}_2\text{O}$ , and a slight opalescence with 20,000 pts (Lassaigne)

Slowly sol in conc  $\text{KCN} + \text{Aq}$  (Halm, J B 1870 1008)

Sl sol in  $\text{Na}_2\text{S} + \text{Aq}$ , sol in  $\text{NaSH} + \text{Aq}$  (Becker, Sil Am J (3) 33 199)

### Zinc pentasulphide, $\text{ZnS}_5$

Sol in acids, with separation of  $\text{S}$  (Schiff, A 115 74)

### Zinc sulphosilicide, $\text{ZnSiS}$

Decomp by acids and by alkalis (Fraenkel, Metall, 1909, 6 653)

### Zinc telluride, $\text{ZnTe}$

Decomp by acids Sol in  $\text{Br}_2 + \text{Aq}$  (Fabre C R 105 277)

### Zincic acid

Zinc hydroxide shows weak acid properties, and forms the following salts

**Ammonium zincate**,  $3\text{ZnO}, 4\text{NH}_3 + 12\text{H}_2\text{O} = 3\text{ZnO}, 2(\text{NH}_4)_2\text{O} + 10\text{H}_2\text{O}$

Decomp by much  $\text{H}_2\text{O}$

**Barium zincate**,  $\text{BaH}_2\text{Zn}_2\text{O}_4 + 7\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Bertrand, C R 115 939)

**Calcium zincate**,  $\text{CaH}_2\text{Zn}_2\text{O}_4 + 4\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  Sol in  $\text{NH}_4\text{OH} + \text{Aq}$  (Bertrand, C R 115 939)

**Cobaltous zincate**,  $x\text{CoO}, y\text{ZnO}$

*Runman's green* Sol in acids  $\text{H}_2\text{CO}_3 + \text{Aq}$  dissolves out  $\text{ZnO}$  (Corney)

**Potassium zincate**,  $\text{ZnO}, \text{K}_2\text{O}$

Easily sol in  $\text{H}_2\text{O}$ , but decomp by boiling (Laux, A 9 183)

$2\text{ZnO}, \text{K}_2\text{O}$  Decomp immediately by cold  $\text{H}_2\text{O}$  (Fremy, C R 15 1106)

**Sodic zincate**,  $\text{Na}_2\text{O}, 2\text{ZnO} + 8\text{H}_2\text{O}$ , or  $2\text{NaHZnO}_2 + 7\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  or alcohol (Corney and Jackson, Am Ch J 11 145)

$+7\text{H}_2\text{O}$  (Forster and Gunther, Z Elektrochem, 1899, 6 301)

$2\text{Na}_2\text{O}, 3\text{ZnO} + 18\text{H}_2\text{O}$  or  $\text{Zn}_3\text{O}_6\text{Na}_4\text{H}_2 + 17\text{H}_2\text{O}$  Decomp by  $\text{H}_2\text{O}$  or alcohol Insol in ether (Corney and Jackson)

**Strontium zincate**,  $\text{SrH}_2\text{Zn}_2\text{O}_4 + 7\text{H}_2\text{O}$

Decomp by  $\text{H}_2\text{O}$  (Bertrand)

### Zirconic acid

See Zirconium hydroxide

**Barium zirconate**,  $\text{BaZrO}_3$

Insol in acids (Ouvrard, C R 113 80)

**Calcium zirconate**,  $\text{CaZrO}_3$

Insol in acids (Ouvrard, C R 113 80)

**Calcium zirconate, acid**

Insol in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$  (Hjorth, A 137 237)

**Calcium potassium zirconate**,  $(\text{Ca}, \text{K})\text{LaO}_3$  (small quantity of  $\text{CaO}$  substituted by  $\text{K}_2\text{O}$ )

Sol in  $\text{HCl}$  (Venable, J Am Chem Soc 1896, 18 444)

**Cupric zirconate**

(Berthier, A ch 59 195)

**Lithium zirconate,  $\text{Li}_2\text{ZrO}_3$** 

Easily attacked by acids (Ouvrard, C R 112 1444)

**Magnesium zirconate**

Insol in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$  (Hiordthal, C R 61 215)

**Potassium zirconate**

Decomp by  $\text{HCl} + \text{Aq}$  (Knop, A 159 44)

**Sodium zirconate,  $\text{Na}_2\text{ZrO}_3$** 

Decomp by  $\text{H}_2\text{O}$   
 $\text{Na}_4\text{ZrO}_4$ . Decomp by  $\text{HCl} + \text{Aq}$ , and is dissolved by subsequent addition of  $\text{H}_2\text{O}$   
 $\text{Na}_2\text{O}$ ,  $8\text{ZrO}_2 + 12\text{H}_2\text{O}$  (Hiordthal)

**Strontium zirconate,  $\text{SrZrO}_3$** 

As  $\text{CaZrO}_3$  (Ouvrard)

**Zirconium, Zr**

*Crystallized* Attacked by conc  $\text{HCl} + \text{Aq}$  above  $50^\circ$ , but very slowly even at  $100^\circ$ , rapidly by hot aqua regia. Sol in cold conc  $\text{HF} + \text{Aq}$  (Troost, C R 61 109)

Very violently attacked by a mixture of  $\text{HNO}_3$  and  $\text{HF}$  (Berzelius, Pogg 4 117)

*Amorphous* Slowly attacked by boiling aqua regia,  $\text{H}_2\text{SO}_4$ , or conc  $\text{HCl} + \text{Aq}$  (Berzelius)

Easily sol in  $\text{HF}$  or  $\text{HNO}_3 + \text{HF}$

**Zirconium bromide,  $\text{ZrBr}_4$** 

Very hygroscopic. Violently decomp by  $\text{H}_2\text{O}$  to form oxybromide (Melliss, Zeit Ch (2) 6 296)

Sl sol in organic solvents (Matthews, J Am Chem Soc 1898, 20 840)

**Zirconium bromide ammonia,  $\text{ZrBr}_4 \cdot 4\text{NH}_3$** 

Ppt. Insol in organic solvents (Matthews, J Am Chem Soc 1898, 20 840)

$\text{ZrBr}_4 \cdot 10\text{NH}_3$ . Very hygroscopic. Decomp by  $\text{H}_2\text{O}$  (Stahler, B 1905, 38 2612)

**Zirconium carbide,  $\text{ZrC}$** 

Insol in  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$  and  $\text{HCl}$  Aq even when heated. Sol in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and fused alkali nitrates, chlorates, or hydroxides (Moissan, C R 1896, 122 653)

**Zirconium chloride,  $\text{ZrCl}_4$** 

Sol in  $\text{H}_2\text{O}$  with evolution of much heat to form  $\text{ZrOCl}_2$ . Sol in alcohol (Hinsberg, A 239 253)

Very unstable

Probably substances so described in the literature by Nylander and others were oxychlorides (Venable, J Am Chem Soc 1894, 16 471)

Sol in ether (Matthews, J Am Chem Soc 1898, 20 821)

**Zirconium chloride ammonia,  $\text{ZrCl}_4 \cdot 2\text{NH}_3$** 

Fumes in the air. Decomp by  $\text{H}_2\text{O}$  (Matthews, J Am Chem Soc 1898, 20 821)  
 $\text{ZrCl}_4 \cdot 3\text{NH}_3$  (Stahler, B 1905, 38 2611)  
 $\text{ZrCl}_4 \cdot 4\text{NH}_3$ . Decomp by  $\text{H}_2\text{O}$  (Paykull)

Unstable. Decomp by  $\text{H}_2\text{O}$  (Matthews, J Am Chem Soc 1898, 20 821)

$\text{ZrCl}_4 \cdot 8\text{NH}_3$ . Stable in the air. Decomp by  $\text{H}_2\text{O}$ . Insol in ether (Matthews, J Am Chem Soc 1898, 20 821)

Very hygroscopic. Decomp by  $\text{H}_2\text{O}$ . (Stahler, B 1905, 38 2611)

**Zirconium fluoride,  $\text{ZrF}_4$** 

*Anhydrous* Insol in  $\text{H}_2\text{O}$  and acids (Deville, A ch (3) 49 84)

Only sl sol in  $\text{H}_2\text{O}$

1388 g dissolve in 100 cc  $\text{H}_2\text{O}$  without hydrolysis. On warming the solution, zirconium hydrate begins to ppt out at about  $50^\circ$  (Wolter, Ch Z 1908, 32 606)

+3H<sub>2</sub>O. Sol in  $\text{H}_2\text{O}$ , but solution decomposes on diluting, with pptn of an insol basic salt. Sol in dil  $\text{HF} + \text{Aq}$  (Berzelius)

**Zirconium fluoride ammonia,  $5\text{ZrF}_4 \cdot 2\text{NH}_3$** 

(Wolter, Ch Z 1908, 32 607)

**Zirconium hydride,  $\text{ZrH}_2$** 

Not attacked by acids (Winkler B 24 873)

**Zirconium hydroxide,  $\text{Zr(OH)}_4$** 

Insol in  $\text{H}_2\text{O}$  or alcohol. Sol in 5000 pts  $\text{H}_2\text{O}$  (Melliss)

Sol in acids, even oxalic or tartaric acid, when precipitated cold. If precipitated hot it is slowly dissolved upon heating with conc acids

Sol in dil or conc min acids except  $\text{HI}$ . Readily sol in oxalic only sl sol in acetic acid

Much less sol when pptd from  $\text{Li}$  solution than when pptd from cold solution (Venable, J Am Chem Soc 1894, 20 274)

Sl sol in  $(\text{NH}_4)\text{CO}_3 + \text{Aq}$ . Insol in  $\text{K}_2\text{CO}_3$  and  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . Insol in  $\text{NaOH}$ ,  $\text{KOH}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$

Sol in  $(\text{NH}_4)_2\text{C}_2\text{H}_3\text{O}_6 + \text{NH}_4\text{OH} + \text{Ac}$ . Insol in  $\text{NH}_4$  salts + Aq

**Zirconium iodide,  $\text{ZrI}_4$** 

Fumes in the air

Sol in  $\text{H}_2\text{O}$  and acids with violent reaction

Decomp by alcohol. Sol in ether. Sl sol in benzene and  $\text{CS}_2$  (B 1904, 37 1157)

Insol in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ , aqua regia, and  $\text{CS}_2$

Sol in  $\text{H}_2\text{SO}_4$  with decomp unchanged by boiling  $\text{H}_2\text{O}$  (Dennis, J Am Chem Soc 1896, 18 678)

**Zirconium iodide ammonia**,  $\text{ZrI}_4 \cdot 6\text{NH}_3$ ,  
 $\text{ZrI}_4 \cdot 7\text{NH}_3$ ,  $\text{ZrI}_4 \cdot 8\text{NH}_3$ ,  $\text{ZrI}_4 \cdot 10\text{NH}_3$

All above comps are hygroscopic and lose  $\text{NH}_3$  in the air (Stahler, B 1905, **38** 2615)

### Zirconium nitride

Scarcely attacked by acids, aqua regia, and caustic alkalis. Slowly decomp by long contact with  $\text{H}_2\text{O}$  (Mallet, Sil Am J (2) **28** 346)

$\text{Zr}_2\text{N}_3$  Decomp when heated in the air, sol in HF, insol in other min acids (Mathews, J Am Chem Soc 1898, **20** 844)

$\text{Zr}_3\text{N}_8$  Decomp when heated in the air. Sol in HF, insol in other min acids (Mathews, J Am Chem Soc 1898, **20** 844)

### Zirconium oxide, $\text{ZrO}_2$

When ignited, is insol in all acids except HF and  $\text{H}_2\text{SO}_4$ . Sl sol in HF, sol in  $\text{H}_2\text{SO}_4$  only when very finely powdered and heated with a mixture of 2 pts  $\text{H}_2\text{SO}_4$  and 1 pt  $\text{H}_2\text{O}$  until the  $\text{H}_2\text{SO}_4$  volatilises (Berzelius)

### Zirconium peroxide, $\text{ZrO}_3$

(Cleve, Bull Soc (2) **43** 53), or  $\text{Zr}_2\text{O}_5$  according to Bailey (Chem Soc **49** 150)

Not attacked by cold dil  $\text{H}_2\text{SO}_4 + \text{Aq}$

### n silicon oxide

*Zircon* See Silicate, zirconium

### Zirconium oxy-compounds

See Zirconyl compounds

### Zirconium phosphide, $\text{ZrP}_2$

Insol in dil or conc acids and alkalis. Sl sol in aqua regia (Gewecke, A 1908, **361** 85)

### Zirconium silicide, $\text{ZrSi}_2$

Sol in HF, insol in other min acids. Not acted upon by 10%  $\text{KOH} + \text{Aq}$  or  $\text{NaOH} + \text{Aq}$

Decomp by fusion with  $\text{KOH}$  (Houngschmid, C R 1906, **143** 225)

### Zirconium sulphide

Insol in  $\text{H}_2\text{O}$ . Sol in HF, slowly sol in aqua regia. Insol in  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{KOH} + \text{Aq}$  (Berzelius)

Insol in dil acids. Sol in conc  $\text{HNO}_3 + \text{Aq}$  (perhaps an oxysulphide) (Fremy)

### Zirconomolybdic acid

#### Ammonium zirconomolybdate,

$2(\text{NH}_4)_2\text{O} \cdot \text{ZrO}_2 \cdot 12\text{MoO}_3 + 10\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Pechard, C R 1893, **117** 790)

**Potassium zirconomolybdate**,  
 $2\text{K}_2\text{O} \cdot \text{ZrO}_2 \cdot 12\text{MoO}_3 + 18\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$  (Pechard)

### Zirconotungstic acid

#### Ammonium zirconodecatungstate,

$3(\text{NH}_4)_2\text{O} \cdot \text{ZrO}_2 \cdot 10\text{WO}_3 + 13\text{H}_2\text{O}$

Very sol in  $\text{H}_2\text{O}$

Efflorescent (Hallopeau, Bull Soc 1896, (3) **15** 921)

$3(\text{NH}_4)_2\text{O} \cdot \text{H}_2\text{O} \cdot \text{ZrO}_2 \cdot 10\text{WO}_3 + 13\text{H}_2\text{O}$

Sol in  $\text{H}_2\text{O}$ , unstable, effloresces in the air (Hallopeau)

**Potassium zirconotungstate**,  $4\text{K}_2\text{O} \cdot \text{ZrO}_2 \cdot \text{WO}_3 + 20\text{H}_2\text{O}$

Sol in hot  $\text{H}_2\text{O}$  (Hallopeau)

$4\text{K}_2\text{O} \cdot \text{ZrO}_2 \cdot 10\text{WO}_3 + 15\text{H}_2\text{O}$  More sol in hot than in cold  $\text{H}_2\text{O}$

Sol in fused alkali carbonates (Hallopeau)

#### Potassium dezirconodecatungstate,

$4\text{K}_2\text{O} \cdot 2\text{ZrO}_2 \cdot 10\text{WO}_3 + 20\text{H}_2\text{O}$

More sol in hot than in cold  $\text{H}_2\text{O}$

Sol in fused alkali carbonates (Hallopeau)

### Zirconyl bromide, $\text{ZrOBr}_2 + 3\text{H}_2\text{O}$

Deliquescent. Decomp in moist air. Very sol in  $\text{H}_2\text{O}$  (Venible, J Am Chem Soc 1898, **20** 324)

+  $7\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Melliss)

+  $8\text{H}_2\text{O}$  Deliquescent. Decomp in moist air. Very sol in  $\text{H}_2\text{O}$  (Venible, J Am Chem Soc 1898, **20** 324)

+  $13\text{H}_2\text{O}$  Deliquescent. Decomp in moist air

Very sol in  $\text{H}_2\text{O}$  (Venible)

+  $14\text{H}_2\text{O}$  Deliquescent. Decomp in moist air (Venible)

Very sol in  $\text{H}_2\text{O}$  (Venible)

$\text{ZrBr}(\text{OH})_3 + \text{H}_2\text{O}$ , and +  $2\text{H}_2\text{O}$  Deliquescent, and decomp in moist air (Venible)

### Zirconyl chloride, $\text{ZrOCl}_2$

Sol in  $\text{H}_2\text{O}$ , insol in  $\text{HCl}$  (Venible, J Am Chem Soc 1894, **16** 47)

+  $2\text{H}_2\text{O}$  (Chauvenet, C R 1912 **154** 822)

+  $3\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Venible)

+  $3\frac{1}{2}\text{H}_2\text{O}$  (Chauvenet, C R 1912, **154** 522)

+  $6\text{H}_2\text{O}$  (Chauvenet)

Sol in  $\text{H}_2\text{O}$

Insol in  $\text{HCl}$  (Venible)

+  $4\frac{1}{2}\text{H}_2\text{O}$ ,  $6\frac{1}{2}\text{H}_2\text{O}$ , and  $8\text{H}_2\text{O}$

Efflorescent. Easily sol in  $\text{H}_2\text{O}$  and alcohol. Very sl sol in conc  $\text{HCl} + \text{Aq}$  (Berzelius)

+  $8\text{H}_2\text{O}$  Sol in  $\text{H}_2\text{O}$  (Venible, J Am Chem Soc 1898, **20** 321)

Effloresces in the air

Sol in  $H_2O$  Less sol in  $HCl + Aq$  and nearly insol in conc  $HCl$  (Chauvenet, C R 1912, **154**, 822)

$Zr_2OCl_2$  Sol in  $H_2O$  and alcohol (Endemann, J pr (2) **11** 219)

Not decomp by  $H_2O$

Sol in dil  $HCl$  (Chauvenet, C R 1912, **154** 1236)

+  $H_2O$  (Chauvenet, C R 1912, **154** 1236)

+  $3H_2O$  Decomp by  $H_2O$  Sol in dil  $HCl$  (Chauvenet)

$8ZrO_2, 7HCl$  Sol in  $H_2O$  (E)

$Zr_2OCl_6$  (Troost and Hautefeuille, C R **73** 563)

$Zr_2OCl_4 = ZrCl_4, 2ZrO_2$  Insol in  $H_2O$  (Hermann)

**Zirconyl iodide,  $ZrOI_2 + 8H_2O$**

Very sol in  $H_2O$  and alcohol

Very hygroscopic ((Stahler, B 1904, **37** 1138)

$ZrI(OH)_3 + 3H_2O$  Easily sol in  $H_2O$  (Hinsberg, A **239** 253)

Ppt Sl sol in  $HI + Aq$  (Venable, J Am Chem Soc 1898, **20** 328)

**Zirconyl sulphide (?)**

Decomp by  $HNO_3$  with separation of S (Freymy, A ch (3) **38** 326)





## APPENDIX

### FORMULÆ FOR CONVERTING AREOMETER DEGREES INTO SPECIFIC GRAVITY

$n$  = no of degrees on the areometer scale, sp gr = specific gravity

Areometer	Temp	Liquids heavier than H <sub>2</sub> O	Liquids lighter than H <sub>2</sub> O
<b>1 Baumé</b> <i>(a) According to Baumé's original directions</i> For liquids heavier than H <sub>2</sub> O Sp gr of a solution of 15 pts NaCl dissolved in 85 pts H <sub>2</sub> O at 12 5° $\left(d_{12\ 5^\circ}^{12\ 5^\circ} = 1.118988\right)$ = 15°, H <sub>2</sub> O = 0° For liquids lighter than H <sub>2</sub> O Sp gr of 10% NaCl + Aq. at 12 5° $\left(d_{12\ 5^\circ}^{12\ 5^\circ} = 1.0737665\right) = 0^\circ$ , H <sub>2</sub> O = 10° <i>(b) Old Form</i> Liquids heavier than H <sub>2</sub> O, 10% NaCl + Aq at 15° $\left(d_{15^\circ}^{15^\circ} = 1.073350\right)$ = 10°, H <sub>2</sub> O = 0° Liquids lighter than H <sub>2</sub> O, 10% NaCl + Aq = 0°, H <sub>2</sub> O = 10° <i>(c) New Form</i> So-called "Rational Scale" Liquids heavier than H <sub>2</sub> O, H <sub>2</sub> SO <sub>4</sub> + Aq $\frac{15^\circ}{15^\circ} = 1.842 = 66^\circ$ , H <sub>2</sub> O = 0°	15°	Sp gr = $\frac{149.05}{149.05 - n}$	Sp gr = $\frac{145.56}{135.56 - n}$
	12 5°	Sp gr = $\frac{145.88}{145.88 - n}$	Sp gr = $\frac{145.88}{135.88 - n}$
	15°	Sp gr = $\frac{146.3}{146.3 - n}$	Sp gr = $\frac{146.3}{136.3 - n}$
	17 5°	Sp gr = $\frac{146.78}{146.78 - n}$	Sp gr = $\frac{146.78}{136.78 - n}$
	15°	Sp gr = $\frac{144.3}{144.3 - n}$	
<b>2 Beck</b> H <sub>2</sub> O = 0°, liquid of 0.850 sp gr $\left(\frac{12\ 5^\circ}{12\ 5^\circ}\right) = 30^\circ$ Scale continued above and below	12 5°	Sp gr = $\frac{170}{170 - n}$	Sp gr = $\frac{170}{170 - n}$
<b>3 Twaddle</b> H <sub>2</sub> O = 0° Each degree corresponds to an increase of 0.005 in the sp gr	Given on the instrument	Sp gr = $1.000 + 0.005n$	

# TABLES FOR THE CONVERSION OF BAUMÉ DEGREES INTO SP GR

Since the original directions of Baumé there have been many slight modifications suggested, so that there are several varieties of Baumé hydrometers with somewhat varying readings, tables for the two principal ones of which are here-given

## 1 According to Baumé's original directions

For liquids heavier than  $H_2O$  Sp gr of 15 % NaCl+

$$Aq \left( \frac{12.5^\circ}{12.5^\circ} \right) = 1.1118988 = 15^\circ, H_2O = 0^\circ$$

$$\text{Calculated according to the formula, sp gr} = \frac{149.05}{149.05 - n}$$

Deg Baumé	Sp gr	Deg Baumé	Sp gr	Deg Baumé	Sp gr	Deg Baumé	Sp gr
0	1.00000	20	1.15497	39	1.35438	58	1.63701
1	1.00675	21	1.16399	40	1.36680	59	1.65519
2	1.01360	22	1.17316	41	1.37945	60	1.67378
3	1.02054	23	1.18246	42	1.39234	61	1.69279
4	1.02757	24	1.19192	43	1.40547	62	1.71223
5	1.03471	25	1.20153	44	1.41885	63	1.73213
6	1.04194	26	1.21129	45	1.43248	64	1.75250
7	1.04927	27	1.22122	46	1.44638	65	1.77335
8	1.05671	28	1.23131	47	1.46056	66	1.79470
9	1.06426	29	1.24156	48	1.47501	67	1.81657
10	1.07191	30	1.25199	49	1.48971	68	1.83899
11	1.07968	31	1.26260	50	1.50479	69	1.86196
12	1.08755	32	1.27338	51	1.52014	70	1.88551
13	1.09555	33	1.28436	52	1.53580	71	1.90967
14	1.10366	34	1.29522	53	1.55179	72	1.93446
15	1.11189	35	1.30688	54	1.56812	73	1.95989
16	1.12025	36	1.31844	55	1.58471	74	1.98601
17	1.12873	37	1.33621	56	1.60182	75	2.01283
18	1.13735	38	1.34218	57	1.61923	76	2.04038
19	1.14609						

For liquids lighter than  $H_2O$  Sp gr of 10 % NaCl

$$Aq \left( \frac{12.5^\circ}{12.5^\circ} \right) = 1.0737665 = 0^\circ, H_2O = 10^\circ$$

$$\text{Calculated according to the formula, sp gr} = \frac{145.56}{135.56 + n}$$

Deg Baumé	Sp gr	Deg Baumé	Sp gr	Deg Baumé	Sp gr	Deg Baumé	Sp gr
10	1.00000	30	0.87919	50	0.78443	65	0.72577
15	0.96679	35	0.85342	55	0.76385	70	0.70811
20	0.93571	40	0.82912	60	0.74432	75	0.69130
25	0.90657	45	0.80616				

2 According to the so-called Rational Scale

$$\text{Sp gr of } H_2SO_4 + Aq \left( \frac{15^\circ}{15^\circ} \right) = 1.842 = 66^\circ, H_2O = 0^\circ$$

$$\text{Calculated according to the formula, sp gr} = \frac{144.3}{144.3 - n}$$

Deg Baumé	Sp gr	Deg Baumé	Sp gr	Deg Baumé	Sp gr	Deg Baumé	Sp gr
1	1.007	18	1.142	35	1.320	51	1.547
2	1.014	19	1.152	36	1.332	52	1.563
3	1.021	20	1.161	37	1.345	53	1.580
4	1.029	21	1.170	38	1.357	54	1.598
5	1.036	22	1.180	39	1.370	55	1.616
6	1.043	23	1.190	40	1.384	56	1.634
7	1.051	24	1.200	41	1.397	57	1.653
8	1.059	25	1.210	42	1.411	58	1.672
9	1.066	26	1.220	43	1.424	59	1.692
10	1.074	27	1.230	44	1.439	60	1.712
11	1.082	28	1.241	45	1.453	61	1.732
12	1.091	29	1.251	46	1.468	62	1.753
13	1.099	30	1.262	47	1.483	63	1.775
14	1.107	31	1.274	48	1.498	64	1.797
15	1.116	32	1.285	49	1.514	65	1.820
16	1.125	33	1.296	50	1.530	66	1.842
17	1.133	34	1.308				

## SYNCHRONISTIC TABLE OF CHEMICAL

Year	A	A ch	Am J Sci	Ann Min	Ann Phil	Arch Pharm	Ch Gaz	C R	Dungl
1800		(1) 32-34							
1801		35-39							
1802		40-43							
1803		44-47							
1804		48-51							
1805		52-55							
1806		56-60							
1807		61-64							
1808		65-68							
1809		69-72							
1810		73-76							
1811		77-80							
1812		81-84							
1813		85-88			(1) 1, 2				
1814		89-92			3, 4				
1815		93-96			5, 6				
1816		(2) 1-3			7, 8				
1817		4-6		1, 2	9, 10				
1818		7-9		3	11, 12				
1819		10-12	(1) 1	4	13, 14				
1820		13-15	2	5	15, 16			1-3	
		16-18	3	6	(2) 1, 2			4-6	
		19-21	4, 5	7	3, 4	1, 2		7-9	
		22-24	6	8	5, 6	3-6		10-12	
		25-27	7, 8	9	7, 8	7-10		13-15	
		28-30	9	10, 11	9, 10	11-14		16-18	
		31-33	10, 11	12, 13	11, 12	16-19		19-22	
		34-36	12	(2) 1, 2		20-23		23-26	
		37-39	13, 14	3, 4		24-26		27-30	
		40-42	15, 16	5, 6		27-30		31-34	
		43-45	17, 18	7, 8		31-34		35-38	
1831		46-48	19, 20			35-39		39-42	
1832	1-4	49-51	21, 22	(3) 1, 2		40-43		43-47	
1833	5-8	52-55	23, 24	3, 4		44-47		48-50	
1834	9-12	56-57	25-27	5, 6		48-50		51-54	
1835	13-16	58-60	28, 29	7, 8		(2) 1-4	1	55-58	
1836	17-20	61-63	30, 31	9, 10		5-8	2, 3	59-62	
1837	21-24	64-66	32, 33	11, 12		9-12	4, 5	63-66	
1838	25-28	67-69	35, 35	13, 14		13-16	6, 7	67-70	
1839	29-32	70-72	36, 37	15, 16		17-20	8, 9	71-74	
1840	33-36	73-75	38, 39	17, 18		21-24	10, 11	75-78	
1841	37-40	(3) 1-5	40, 41	19, 20		25-28	12, 13	79-82	
1842	41-44	4-6	42, 43	(4) 1, 2		29-32	14, 15	83-86	
1843	45-48	7-9	44, 45	3, 4		33-36	1	87-90	
1844	49-52	10-12	46, 47	5, 6		37-40	2	91-94	
1845	53-56	13-15	48-50	7, 8		41-44	20, 21	95-98	
1846	57-60	(2) 1, 2	9, 10			45-48	3	99-102	
1847	61-64	19-21	3, 4	11, 12		49-52	4	24, 25	103-106

## AND OTHER SCIENTIFIC PERIODICALS—Part I

Gilb Ann	J Chm med	J Pharm	J pr	Phil Mag	Pogg	Proc Am Acad	Proc Roy Soc	Q J Sci	Scher J	Schw J
4-6				6-8					3, 4	
7-9				9-11					5, 6	
10-12				12-14					7, 8	
13-15				15-17					9, 10	
16-18				18-20					12, 12	
19-21				21-23					13, 14	
22-24				24-26					15, 16	
25-27				27-29					17, 18	
28-30				30-32					19, 20	
31-33		(1) 1		33, 34					21, 22	
34-36		2		35, 36					23, 24	
37-39		3		37, 38					Cont as	(1) 1-3
40-42		4		39, 40					Schw J	4-6
43-45		5		41, 42						7-9
46-48		6		43, 44						10-12
49-51		(2) 1		45, 46						13-15
52-54		2		47, 48				1		16-18
55-57		3		49, 50				2, 3		19-21
58-60		4		51, 52				4, 5		22-24
61-63		5		53, 54				6, 7		25-27
64-66		6		55, 56				8, 9		28-30
67-69		7		57, 58				10, 11		(2) 1-3
70-72		8		59, 60				12, 13		4-6
73-75		9		61, 62				14, 15		7-9
76		10		63, 64	1, 2			16, 17		10-12
Cont as	(1) 1	11		65, 66	3-5			18, 19		13-15
Pogg	2	12		67, 68	6-8			20, 21		16-18
	3	13		(2) 1, 2	9-11					19-21
	4	14		3, 4	12-14					22-24
	5	15		5, 6	15-17					25-27
	6	16		7, 8	18-20					28-30
	7	17		9, 10	21-23					(3) 1-3
	8	18		11, (3) 1	24-26					4-6
	9	19		2, 3	27-30	1	1			7-9
	10	20	1-3	4, 5	31-33		2			Cont as
(2) 1	21	4-6	6, 7	34-36	37-39					J pr
2	22	7-9	8, 9	40-42	43-45					
3	23	10-12	10, 11	46-48	49-51		3			
4	24	13-15	12, 13	52-54	55-57					
5	25	16-18	14, 15	58-60	61-63					
6	26	19-21	16, 17	64-66	67-69					
7	27	22-24	18, 19	70-72						
8	(3) 1, 2	25-27	20, 21				4			
9	3, 4	28-30	22, 23							
10	5, 6	31-33	24, 25							
(3) 1	7, 8	34-36	26, 27							
2	9, 10	37-39	28, 29			2				
3	11, 12	40-42	30, 31							

## SYNCHRONISTIC TABLE OF CHEMICAL

Year	A	A ch	Am J Sci	Ann Min	Ann Phil	Arch Pharm	Ch Gaz	C R	Dingl
1800		(1) 32-34							
1801		35-39							
1802		40-43							
1803		44-47							
1804		48-51							
1805		52-55							
1806		56-60							
1807		61-64							
1808		65-68							
1809		69-72							
1810		73-76							
1811		77-80							
1812		81-84							
1813		85-88			(1) 1, 2				
1814		89-92			3, 4				
1815		93-96			5, 6				
1816		(2) 1-3			7, 8				
1817		4-6		1, 2	9, 10				
1818		7-9		3	11, 12				
1819		10-12	(1) 1	4	13, 14				
1820		13-15	2	5	15, 16			1-3	
1821		16-18	3	6	(2) 1, 2			4-6	
1822		19-21	4, 5	7	3, 4	1, 2		7-9	
1823		22-24	6	8	5, 6	3-6		10-12	
		25-27	7, 8	9	7, 8	7-10		13-15	
		28-30	9	10, 11	9, 10	11-14		16-18	
		31-33	10, 11	12, 13	11, 12	16-19		19-22	
		34-36	12	(2) 1, 2		20-23		23-26	
		37-39	13, 14	3, 4		24-26		27-30	
		40-42	15, 16	5, 6		27-30		31-34	
		43-45	17, 18	7, 8		31-34		35-38	
1831		46-48	19, 20			35-39		39-42	
1832	1-4	49-51	(3) 1, 2			40-43		43-47	
1833	5-8	52-55	3, 4			44-47		48-50	
1834	9-12	56-57	5, 6			48-50		51-54	
1835	13-16	58-60	7, 8		(2) 1-4	55-58		55-58	
1836	17-20	61-63	9, 10			5-8	1	59-62	
1837	21-24	64-66	11, 12			9-12	2, 3	63-66	
1838	25-28	67-69	13, 14			13-16	4, 5	67-70	
1839	29-32	70-72	15, 16			17-20	6, 7	71-74	
1840	33-36	73-75	17, 18			21-24	8, 9	75-78	
1841	37-40	(3) 1-3	19, 20			25-28	10, 11	79-82	
1842	41-44	4-6	40, 41			29-32	12, 13	83-86	
1843	45-48	7-9	(4) 1, 2			33-36	14, 15	87-90	
1844	49-52	10-12	3, 4			37-40	16, 17	91-94	
1845	53-56	13-15	5, 6			41-44	18, 19	95-98	
1846	57-60	16-18	(2) 1, 2			45-48	20, 21	99-102	
1847	61-64	19-21	3, 4	11, 12		49-52	22, 23	103-106	

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Gilb Ann	J Chim med	J Pharm	J pr	Phil Mag	Pogg	Proc Am Acad	Proc Roy Soc	Q J Sci	Scher J	Schw J
4-6				6-8					3, 4	
7-9				9-11					5, 6	
10-12				12-14					7, 8	
13-15				15-17					9, 10	
16-18				18-20					12, 12	
19-21				21-23					13, 14	
22-24				24-26					15, 16	
25-27				27-29					17, 18	
28-30				30-32					19, 20	
31-33		(1) 1		33, 34					21, 22	
34-36		2		35, 36					23, 24	
37-39		3		37, 38					Cont as	(1) 1-3
40-42		4		39, 40					Schw J	4-6
43-45		5		41, 42						7-9
46-48		6		43, 44						10-12
49-51		(2) 1		45, 46						13-15
52-54		2		47, 48				1		16-18
55-57		3		49, 50				2, 3		19-21
58-60		4		51, 52				4, 5		22-24
61-63		5		53, 54				6, 7		25-27
64-66		6		55, 56				8, 9		28-30
67-69		7		57, 58				10, 11		(2) 1-3
70-72		8		59, 60				12, 13		4-6
73-75		9		61, 62				14, 15		7-9
76		10		63, 64	1, 2			16, 17		10-12
Cont as	(1) 1	11		65, 66	3-5			18, 19		13-15
Pogg	2	12		67, 68	6-8			20, 21		16-18
	3	13		(2) 1, 2	9-11					19-21
	4	14		3, 4	12-14					22-24
	5	15		5, 6	15-17					25-27
	6	16		7, 8	18-20					28-30
	7	17		9, 10	21-23					(3) 1-3
	8	18		11, (3) 1	24-26					4-6
	9	19		2, 3	27-30	1	1			7-9
	10	20	1-3	4, 5	31-33		2			Cont as
(2) 1	21	21	4-6	6, 7	34-36					J pr
2	22	22	7-9	8, 9	37-39					
3	23	23	10-12	10, 11	40-42			3		
4	24	24	13-15	12, 13	43-45					
5	25	25	16-18	14, 15	46-48					
6	26	26	19-21	16, 17	49-51					
7	27	27	22-24	18, 19	52-54					
8	(3) 1, 2	25-27	20, 21	20, 21	55-57					
9	3, 4	28-30	22, 23	22, 23	58-60			4		
10	5, 6	31-33	24, 25	24, 25	61-63					
(3) 1	7, 8	34-36	26, 27	26, 27	64-66					
2	9, 10	37-39	28, 29	28, 29	67-69	2				
3	11, 12	40-42	30, 31	30, 31	70-72					

## SYNCHRONISTIC TABLE OF CHEMICAL AND

Year	A	A ch	Am Ch J	Am J Sci	Analyst	Ann Min	Arch Pharm	A suppl	B	Bull Soc
1848	65-68	22-24		5, 6		13, 14	53-56			
1849	69-72	25-27		7, 8		15, 16	57-60			
1850	73-76	28-30		9, 10		17, 18	61-64			
1851	77-80	31-33		11, 12		19, 20	65-68			
1852	81-84	34-36		13, 14		(5) 1, 2	69-72			
1853	85-88	37-39		15, 16		3, 4	73-76			
1854	89-92	40-42		17, 18		5, 6	77-80			
1855	93-96	43-45		19, 20		7, 8	81-84			
1856	97-100	46-48		21, 22		9, 10	85-88			
1857	101-104	49-51		23, 24		11, 12	89-92			
1858	105-108	52-54		25, 26		13, 14	93-96			
1859	109-112	55-57		27, 28		15, 16	97-100			1
1860	113-116	58-60		29, 30		17, 18	101-104			2
1861	117-120	61-63		31, 32		19, 20	105-108	1		3
1862	121-124	64-66		33, 34		(6) 1, 2	109-112	2		4
1863	125-128	67-69		35, 36		3, 4	113-116			5
1864	129-132	(4) 1-3		37, 38		5, 6	117-120		(2) 1, 2	6
1865	133-136	4-6		39, 40		7, 8	121-124	4		7
1866	137-140	7-9		41, 42		9, 10	125-128			8
1867	141-144	10-12		43, 44		11, 12	129-132	5		9
1868	145-148	13-16		45, 56		13, 14	133-136	6	1	10
1869	149-152	16-18		47, 48		15, 16	137-140		2	11
1870	153-156	19-21		49, 50		17, 18	141-144	7	3	12
1871	157-160	22-24		(3) 1, 2*		19, 20	145-148	4	4	13
	161	25-27		3, 4		(7) 1, 2	149, 150	8	5	14
						(3) 1†				15
	-170	28-30		5, 6		3, 4	2, 3		6	16
	171-174	(5) 1-3		7, 8		5, 6	4, 5		7	17
1875	175-179	4-6		9, 10		7, 8	6, 7		8	18
1876	180-183	7-9		11, 12	0	9, 10	8, 9		9	19
1877	184-189	10-12		13, 14	2	11, 12	10, 11		10	20
1878	190-194	13-15		15, 16	3	13, 14	12, 13		11	21
1879	195-199	16-18	1	17, 18	4	15, 16	14, 15		12	22
1880	200-205	19-21	2	19, 20	5	17, 18	16, 17		13	23
1881	206-210	22-24	3	21, 22	6	19, 20	18, 19		14	24
1882	211-215	25-27	4	23, 24	7	(8) 1, 2	20		15	25
1883	216-221	28-30	5	25, 26	8	3, 4	21		16	26
1884	222-226	(6) 1-3	6	27, 28	9	5, 6	22		17	27
1885	227-231	4-6	7	29, 30	10	7, 8	23		18	28
1886	232-236	7-9	8	31, 32	-11	9, 10	24		19	29
1887	237-242	10-12	9	33, 34	12	11, 12	25		20	30
1888	243-249	13-15	10	35, 36	13, 14	13, 14	26		21	31
1889	250-255	16-18	11	37, 38	15, 16	15, 16	27		22	32
1890	256-260	19-21	12	39, 40	17, 18	17, 18	228		23	33
1891	261-266	22-24	13	41, 42	19, 20	19, 20	229		24	34
1892	267-271	25-27	14	43, 44	21, 22	(9) 1, 2	230		25	35
1893	272-277	28-30	15	45, 46	23, 24	3, 4	231		26	36
1894	278-283	(7) 1-3	16	47, 48	25, 26	5, 6	232		27	37
1895	284-289	4-6	17	49, 50	27, 28	7, 8	233		28	38

\* Also cited as whole series, 101, 102, 103, etc

† Also cited as 201, 202, etc

## OTHER SCIENTIFIC PERIODICALS—Part II

C C	Chem Ind	Chem Soc	Ch Gaz	Ch Ztg	Cim	C N	C R	Dingl	Gazz ch it	J Am Chem Soc	J Anal Ch
			5				26, 27	107-110			
		1	6				28, 29	111-114			
		2	7				30, 31	115-118			
		3	8				32, 33	119-122			
		4	9		1, 2		34, 35	123-126			
		5	10		3, 4		36, 37	127-130			
		6	11		5, 6		38, 39	131-134			
		7	12		Cont as N		40, 41	135-138			
1		8	13		Cim		42, 43	139-142			
2		9	14				44, 45	143-146			
3		10	15				46, 47	147-150			
4		11	16				48, 49	151-154			
5		12	17			1, 2	50, 51	155-158			
6		13	Cont as N			3, 4	52, 53	159-162			
7		14, 15	16*			5, 6	54, 55	163-166			
8		16*	C N			7, 8	56, 57	167-170			
9		17				9, 10	58, 59	171-174			
10		18				11, 12	60, 61	175-178			
11		19				13, 14	62, 63	179-182			
12		20				15, 16	64, 65	183-186			
13		21				17, 18	66, 67	187-190			
14		22				9, 20	68, 69	191-194			
15		23				21, 22	70, 71	195-198			
16		24				23, 24	72, 73	199-202	1		
17		25				25, 26	74, 75	203-206	2		
18		26				27, 28	76, 77	207-210	3		
19		27				29, 30	78, 79	211-214	4		
20		28				31, 32	80, 81	215-218	5		
21		29, 30				33, 34	82, 83	219-222	6		
22		31, 32				35, 36	84, 85	223-226	7		
23	1	33, 34		1		37, 38	86, 87	227-230	8		
24	2	35, 36		3		39, 40	88, 89	231-234	9	1	
25	3	37, 38		4		41, 42	90, 91	235-238	10	2	
26	4	39, 40		5		43, 44	92, 93	239-242	11	3	
27	5	41, 42		6		45, 46	94, 95	243-246	12	4	
28	6	43, 44		7		47, 48	96, 97	247-250	13	5	
29	7	45, 46		8		49, 50	98, 99	251-254	14	6	
30	8	47, 48		9		51, 52	100, 101	255-258	15	7	
31	9	49, 50		10		53, 54	102, 103	259-262	16	8	
32	10	51, 52		11		55, 56	104, 105	263-266	17	9	
33	11	53, 54		12		57, 58	106, 107	267-270	18	10	
34	12	55, 56		13		59, 60	108, 109	271-274	19	11	
35	13	57, 58		14		61, 62	110, 111	275-278	20	12	
36	14	59, 60		15		63, 64	112, 113	279-282	21	13	
37	15	61, 62		16		65, 66	114, 115	283-286	22	14	
38	16	63, 64		17		67, 68	116, 117	287-290	23	15	
39	17	65, 66		18		69, 70	118, 119	291-294	24	16	
40	18	67, 68		19		71, 72	120, 121	295-298	25	17	

\* Also cited as (2) 1, 2, 3, etc

## SYNCHRONISTIC TABLE OF CHEMICAL AND

Year	A	A ch	Am Ch J	Am J Sci	Analyst	Ann Min	Arch Pharm	A suppl	B	Bull Soc
1848	65-68	22-24		5, 6		13, 14	53-56			
1849	69-72	25-27		7, 8		15, 16	57-60			
1850	73-76	28-30		9, 10		17, 18	61-64			
1851	77-80	31-33		11, 12		19, 20	65-68			
1852	81-84	34-36		13, 14		(5) 1, 2	69-72			
1853	85-88	37-39		15, 16		3, 4	73-76			
1854	89-92	40-42		17, 18		5, 6	77-80			
1855	93-96	43-45		19, 20		7, 8	81-84			
1856	97-100	46-48		21, 22		9, 10	85-88			
1857	101-104	49-51		23, 24		11, 12	89-92			
1858	105-108	52-54		25, 26		13, 14	93-96			
1859	109-112	55-57		27, 28		15, 16	97-100			1
1860	113-116	58-60		29, 30		17, 18	101-104			2
1861	117-120	61-63		31, 32		19, 20	105-108	1		3
1862	121-124	64-66		33, 34		(6) 1, 2	109-112	2		4
1863	125-128	67-69		35, 36		3, 4	113-116			5
1864	129-132	(4) 1-3		37, 38		5, 6	117-120		(2) 1, 2	6
1865	133-136	4-6		39, 40		7, 8	121-124	4	3, 4	7
1866	137-140	7-9		41, 42		9, 10	125-128		5, 6	8
1867	141-144	10-12		43, 44		11, 12	129-132	5	7, 8	9
1868	145-148	13-16		45, 56		13, 14	133-136	6	9, 10	10
1869	149-152	16-18		47, 48		15, 16	137-140		11, 12	11
1870	153-156	19-21		49, 50		17, 18	141-144	7	13, 14	12
1871	157-160	22-24	(3) 1, 2*			19, 20	145-148		15, 16	13
1872	161-164	25-27	3, 4			(7) 1, 2	149, 150	8	17, 18	14
						(3) 1†				
1873	165-170	28-30		5, 6		3, 4	2, 3		19, 20	
1874	171-174	(5) 1-3		7, 8		5, 6	4, 5		21, 22	
1875	175-179	4-6		9, 10		7, 8	6, 7		23, 24	
1876	180-183	7-9		11, 12	0	9, 10	8, 9		25, 26	
1877	184-189	10-12		13, 14	2	11, 12	10, 11	10	27, 28	
1878	190-194	13-15		15, 16	3	13, 14	12, 13	11	29, 30	
1879	195-199	16-18	1	17, 18	4	15, 16	14, 15	12	31, 32	
1880	200-205	19-21	2	19, 20	5	17, 18	16, 17	13	33, 34	
1881	206-210	22-24	3	21, 22	6	19, 20	18, 19	14	35, 36	
1882	211-215	25-27	4	23, 24	7	(8) 1, 2	20	15	37, 38	
1883	216-221	28-30	5	25, 26	8	3, 4	21	16	39, 40	
1884	222-226	(6) 1-3	6	27, 28	9	5, 6	22	17	41, 42	
1885	227-231	4-6	7	29, 30	10	7, 8	23	18	43, 44	
1886	232-236	7-9	8	31, 32	-11	9, 10	24	19	45, 46	
1887	237-242	10-12	9	33, 34	12	11, 12	25	20	47, 48	
1888	243-249	13-15	10	35, 36	13, 14	13, 14	26	21	49, 50	
1889	250-255	16-18	11	37, 38	15, 16	15, 16	27	22	(3) 1, 2	
1890	256-260	19-21	12	39, 40	17, 18	17, 18	228	23	3, 4	
1891	261-266	22-24	13	41, 42	19, 20	19, 20	229	24	5, 6	
1892	267-271	25-27	14	43, 44	21, 22	(9) 1, 2	230	25	7, 8	
1893	272-277	28-30	15	45, 46	23, 24	3, 4	231	26	9, 10	
1894	278-283	(7) 1-3	16	47, 48	25, 26	5, 6	232	27	11, 12	
1895	284-289	4-6	17	49, 50	27, 28	7, 8	233	28	13, 14	

\* Also cited as whole series, 101, 102, 103, etc

† Also cited as 201, 202, etc

## OTHER SCIENTIFIC PERIODICALS—Part II

C C	Chem Ind	Chem Soc	Ch Gaz	Ch Ztg	Chm	C N	C R	Dingl	Gazz ch it	J Am Chem Soc	J Anal Ch
			5				26, 27	107-110			
		1	6				28, 29	111-114			
		2	7				30, 31	115-118			
		3	8				32, 33	119-122			
		4	9		1, 2		34, 35	123-126			
		5	10		3, 4		36, 37	127-130			
		6	11		5, 6		38, 39	131-134			
		7	12		Cont as N		40, 41	135-138			
		8	13		Cm		42, 43	139-142			
		9	14				44, 45	143-146			
1		10	15				46, 47	147-150			
2		11	16				48, 49	151-154			
3		12	17			1, 2	50, 51	155-158			
4		13	18			3, 4	52, 53	159-162			
5		14, 15	16*			5, 6	54, 55	163-166			
6		16	Cont as C N			7, 8	56, 57	167-170			
7		17				9, 10	58, 59	171-174			
8		18				11, 12	60, 61	175-178			
9		19				13, 14	62, 63	179-182			
10		20				15, 16	64, 65	183-186			
11		21				17, 18	66, 67	187-190			
12		22				9, 20	68, 69	191-194			
13		23				21, 22	70, 71	195-198			
14		24				23, 24	72, 73	199-202	1		
15		25				25, 26	74, 75	203-206	2		
16		26					76, 77	207-210	3		
17		27					78, 79	211-214	4		
18		28					80, 81	215-218	5		
19		29, 30					82, 83	219-222	6		
20		31, 32					84, 85	223-226	7		
21		33, 34					86, 87	227-230	8		
22		35, 36					88, 89	231-234	9		
23	1	37, 38					90, 91	235-238	10	1	
24	2	39, 40					92, 93	239-242	11	2	
25	3	41, 42					94, 95	243-246	12	3	
26	4	43, 44					96, 97	247-250	13	4	
27	5	45, 46					98, 99	251-254	14	5	
28	6	47, 48					100, 101	255-258	15	6	
29	7	49, 50					102, 103	259-262	16	7	
30	8	51, 52					104, 105	263-266	17		1
31	9	53, 54					106, 107	267-270	18		2
32	10	55, 56					108, 109	271-274	19		3
33	11	57, 58					110, 111	275-278	20		4
34	12	59, 60					112, 113	279-282	21		5
35	13	61, 62					114, 115	283-286	22		6
36	14	63, 64					116, 117	287-290	23		7
37	15	65, 66					118, 119	291-294	24		
38	16	67, 68					120, 121	295-298	25		
39	17										
40	18										

\* Also cited as (2) 1, 2, 3, etc



## SYNCHRONISTIC TABLE OF CHEMICAL AND

Year	J Chim méd	Jena Zeit	J Pharm	J pr	J Russ Soc	J Soc Chem Ind	M Ch	Monit Scient	N Cim	N Rep Pharm	Pharm J Trans	Phil Mag
1848	4		13, 14	43-45								32, 33
1849	5		15, 16	46-48								34, 35
1850	6		17, 18	49-51								36, 37
1851	7		19, 20	52-54								(4) 1, 2
1852	8		21, 22	55-57						1		3, 4
1853	9		23, 24	58-60						2		5, 6
1854	10		25, 26	61-63						3		7, 8
1855	(4) 1		27, 28	64-66					1, 2	4		9, 10
1856	2		29, 30	67-69					3, 4	5		11, 12
1857	3		31, 32	70-72			(1) 1		5, 6	6		13, 14
1858	4		33, 34	73-75			2		7, 8	7		15, 16
1859	5		35, 36	76-78			3		9, 10	8		17, 18
1860	6		37, 38	79-81			4		11, 12	9		19, 20
1861	7		39, 40	82-84					13, 14	10		21, 22
1862	8		41, 42	85-87						11		23, 24
1863	9		43, 44	88-90						12		25, 26
1864	10	1	45, 46	91-93			(2) 6			13		27, 28
1865	(5) 1		(4) 1, 2	94-96			7			14		29, 30
1866	2	2	3, 4	97-99			8			15		31, 32
1867	3	3	5, 6	100-102			9			16		33, 34
1868	4	4	7, 8	103-105			10			17		35, 36
1869	5		9, 10	106-108	1		11			18		37, 38
1870	6	5	11, 12	(2) 1, 2	2		12			19		39, 40
1871	7	6	13, 14	3, 4	3		(5) 13			20		41, 42
1872	8		15, 16	5, 6	4		14			21		43, 44
1873	9	7	17, 18	7, 8	5		15			22		45, 46
1874	10	8	19, 20	9, 10	6		16			23		47, 48
1875	11	9	21, 22	11, 12	7		17			24		49, 50
1876	12	10	23, 24	13, 14	8		18			6	(5) 1, 2	51, 52
1877		110	25, 26	15, 16	9		19			7		53, 54
1878		12	27, 28	17, 18	10		20			8		55, 56
1879		13	29, 30	19, 20	11		21			9		57, 58
1880		14	31, 32	21, 22	12		22			10		59, 60
1881		15	33, 34	23, 24	13	1	23			11		61, 62
1882			35, 36	25, 26	14		24			12		63, 64
1883		16	37, 38	27, 28	15	2	25			13		65, 66
1884		17	39, 40	29, 30	16		26			14		67, 68
1885		18	41, 42	31, 32	17	4	27			15		69, 70
1886		19	43, 44	33, 34	18		28			16		71, 72
1887		20	45, 46	35, 36	19	5	29			17		73, 74
1888		21	47, 48	37, 38	20		30			18		75, 76
1889		22	49, 50	39, 40	21	8	31			19		77, 78
1890		23	51, 52	41, 42	22		32			20		79, 80
1891		24	53, 54	43, 44	23	10	33			21		81, 82
1892		25	55, 56	45, 46	24		34			22		83, 84
1893		26	57, 58	47, 48	25	11	35			23		85, 86
1894		27	59, 60	49, 50	26		36			24		87, 88
1895		28	61, 62	51, 52	27	14	37			25		89, 90

## OTHER SCIENTIFIC PERIODICALS—Part II—Continued

Pogg	Proc Am Acad	Proc Roy Soc	Rep Anal Ch	R t c	Tech J B	W A B	W Ann	Z anal	Z angew Ch	Z anorg	Zett Ch	Z phys Ch
73-75	3											
76-78	4					1						
79-81						2, 3						
82-84		5				4, 5						
85-87						6, 7						
88-90						8, 9						
91-93		6				10, 11						
94-96	5					12-14						
97-99		7			(1) 1	15-18						
100-102		8			2	19-21						
103-105	6				3	22-27						
106-108		9			4	28-33						
109-111	7	10			5	34-38				(1) 1		
112-114	8				6	39-42				2		
115-117		11			7	43				3		
118-120		12			8	44, 45				4		
121-123		13			9	46-48				5		
124-126		14			10	49						
127-129					11	50-52						
130-132	9	15			12	53, 54				(2) 1		
133-135	10	16			13	55, 56				2		
136-138		17			14	57, 58				3		
139-141		18			15	59, 60				4		
142-144		19			(2) 1	61, 62				5		
145-147		20			2	63, 64				6		
148-150		21			3	65, 66						
151-153		22			4	67, 68						
154-156		23			5	69, 70						
157-159	11	24			6	71, 72						
160	12	25			7	73, 74						
Compt Rend	13	26			8	75, 76	1, 2					
W Ann	14	27			9	77, 78	3, 4					
	15	28			10	79, 80	5, 6					
	16	29			11	81, 82	7, 8					
	17	30			12	83, 84	9, 11					
	18	31			13	85, 86	12, 14					
	19	32			14	87, 88	15, 17					
	20	33			15	89, 90	18, 20					
	21	34			16	91, 92	21, 26					
	22	35			17	93, 94	27, 29					
	23	36			18	95, 96	30, 32					
	24	37			19	97, 98	33, 35					
	25	38			20	99, 100	36, 38					
	26	39			21	101, 102	39, 41					
	27	40			22	103, 104	42, 44					
	28	41			23	105, 106	45, 47					
	29	42			24	107, 108	48, 50					
	30	43			25	109, 110	51, 53					
		44			26	111	54, 56					

## SYNCHRONISTIC TABLE OF CHEMICAL AND

Year	J Chm méd	Jena Zeit	J Pharm	J pr	J Russ Soc	J Soc Chem Ind	M Ch	Monit Scienc	N Cum	N Rep Pharm	Pharm J Trans	Phil Mag
1848	4		13, 14	43-45								32, 33
1849	5		15, 16	46-48								34, 35
1850	6		17, 18	49-51								36, 37
1851	7		19, 20	52-54								(4) 1, 2
1852	8		21, 22	55-57						1		3, 4
1853	9		23, 24	58-60						2		5, 6
1854	10		25, 26	61-63					1, 2	3		7, 8
1855	(4) 1		27, 28	64-66					3, 4	4		9, 10
1856	2		29, 30	67-69				(1) 1	5, 6	5		11, 12
1857	3		31, 32	70-72				2	7, 8	6		13, 14
1858	4		33, 34	73-75				3	9, 10	7		15, 16
1859	5		35, 36	76-78				4	11, 12	8		17, 18
1860	6		37, 38	79-81					13, 14	9		19, 20
1861	7		39, 40	82-84						10		21, 22
1862	8		41, 42	85-87				5		11		23, 24
1863	9		43, 44	88-90				(2) 6		12		25, 26
1864	10	1	45, 46	91-93				7		13		27, 28
1865	(5) 1		(4) 1, 2	94-96				8		14		29, 30
1866	2	2	3, 4	97-99				9		15		31, 32
1867	3	3	5, 6	100-102				10		16		33, 34
1868	4	4	7, 8	103-105	1			11		17		35, 36
1869	5	5	9, 10	106-108	2			12		18		37, 38
1870	6	6	11, 12	(2) 1, 2				(a) 13		19		39, 40
1871	7	7	13, 14	3, 4				14		20		41, 42
1872	8	8	15, 16	5, 6	4					21		43, 44
1873	9	9	17, 18	7, 8				15		22		45, 46
1874	10	10	19, 20	9, 10	6			16		23		47, 48
1875	11	11	21, 22	11, 12	7			17		24		49, 50
1876	12	12	23, 24	13, 14	8			18				51, 52
1877		13	25, 26	15, 16	9			19				53, 54
1878		14	27, 28	17, 18	10			20				55, 56
1879		15	29, 30	19, 20	11			21				57, 58
1880		16	(a) 1, 2	21, 22	12		1	22				59, 60
1881		17	3, 4	23, 24	13		2	23				61, 62
1882		18	5, 6	25, 26	14		3	24				63, 64
1883		19	7, 8	27, 28	15		4	25				65, 66
1884		20	9, 10	29, 30	16		5	26				67, 68
1885		21	11, 12	31, 32	17		6	27				69, 70
1886		22	13, 14	33, 34	18		7	28				71, 72
1887		23	15, 16	35, 36	19		8	29				73, 74
1888		24	17, 18	37, 38	20		9	30				75, 76
1889		25	19, 20	39, 40	21		10	31				77, 78
1890		26	21, 22	41, 42	22		11	32				79, 80
1891		27	23, 24	43, 44	23		12	33				81, 82
1892		28	25, 26	45, 46	24		13	34				83, 84
1893		29	27, 28	47, 48	25		14	35				85, 86
1894		30	29, 30	49, 50	26		15	36				87, 88
1895		31	31, 32	51, 52	27		16	37				89, 90
1896		32	33, 34	53, 54	28		17	38				91, 92
1897		33	35, 36	55, 56	29		18	39				93, 94
1898		34	37, 38	57, 58	30		19	40				95, 96
1899		35	39, 40	59, 60	31		20	41				97, 98
1900		36	41, 42	61, 62	32		21	42				99, 100
1901		37	43, 44	63, 64	33		22	43				101, 102
1902		38	45, 46	65, 66	34		23	44				103, 104
1903		39	47, 48	67, 68	35		24	45				105, 106
1904		40	49, 50	69, 70	36		25	46				107, 108
1905		41	51, 52	71, 72	37		26	47				109, 110
1906		42	53, 54	73, 74	38		27	48				111, 112
1907		43	55, 56	75, 76	39		28	49				113, 114
1908		44	57, 58	77, 78	40		29	50				115, 116
1909		45	59, 60	79, 80	41		30	51				117, 118
1910		46	61, 62	81, 82	42		31	52				119, 120
1911		47	63, 64	83, 84	43		32	53				121, 122
1912		48	65, 66	85, 86	44		33	54				123, 124
1913		49	67, 68	87, 88	45		34	55				125, 126
1914		50	69, 70	89, 90	46		35	56				127, 128
1915		51	71, 72	91, 92	47		36	57				129, 130
1916		52	73, 74	93, 94	48		37	58				131, 132
1917		53	75, 76	95, 96	49		38	59				133, 134
1918		54	77, 78	97, 98	50		39	60				135, 136
1919		55	79, 80	99, 100	51		40	61				137, 138
1920		56	81, 82	101, 102	52		41	62				139, 140
1921		57	83, 84	103, 104	53		42	63				141, 142
1922		58	85, 86	105, 106	54		43	64				143, 144
1923		59	87, 88	107, 108	55		44	65				145, 146
1924		60	89, 90	109, 110	56		45	66				147, 148
1925		61	91, 92	111, 112	57		46	67				149, 150
1926		62	93, 94	113, 114	58		47	68				151, 152
1927		63	95, 96	115, 116	59		48	69				153, 154
1928		64	97, 98	117, 118	60		49	70				155, 156
1929		65	99, 100	119, 120	61		50	71				157, 158
1930		66	101, 102	121, 122	62		51	72				159, 160
1931		67	103, 104	123, 124	63		52	73				161, 162
1932		68	105, 106	125, 126	64		53	74				163, 164
1933		69	107, 108	127, 128	65		54	75				165, 166
1934		70	109, 110	129, 130	66		55	76				167, 168
1935		71	111, 112	131, 132	67		56	77				169, 170
1936		72	113, 114	133, 134	68		57	78				171, 172
1937		73	115, 116	135, 136	69		58	79				173, 174
1938		74	117, 118	137, 138	70		59	80				175, 176
1939		75	119, 120	139, 140	71		60	81				177, 178
1940		76	121, 122	141, 142	72		61	82				179, 180
1941		77	123, 124	143, 144	73		62	83				181, 182
1942		78	125, 126	145, 146	74		63	84				183, 184
1943		79	127, 128	147, 148	75		64	85				185, 186
1944		80	129, 130	149, 150	76		65	86				187, 188
1945		81	131, 132	151, 152	77		66	87				189, 190
1946		82	133, 134	153, 154	78		67	88				191, 192
1947		83	135, 136	155, 156	79		68	89				193, 194
1948		84	137, 138	157, 158	80		69	90				195, 196
1949		85	139, 140	159, 160	81		70	91				197, 198
1950		86	141, 142	161, 162	82		71	92				199, 200
1951		87	143, 144	163, 164	83		72	93				201, 202
1952		88	145, 146	165, 166	84		73	94				203, 204
1953		89	147, 148	167, 168	85		74	95				205, 206
1954		90	149, 150	169, 170	86		75	96				207, 208
1955		91	151, 152	171, 172	87		76	97				209, 210
1956		92	153, 154	173, 174	88		77	98				211, 212
1957		93	155, 156	175, 176	89		78	99				213, 214
1958		94	157, 158	177, 178	90		79	100				215, 216
1959		95	159, 160	179, 180	91		80	101				217, 218
1960		96	161, 162	181, 182	92		81	102				219, 220
1961		97	163, 164	183, 184	93		82	103				221, 222
1962		98	165, 166	185, 186	94		83	104				223, 224
1963		99	167, 168	187, 188	95		84	105				225, 226
1964		100	169, 170	189, 190	96		85	106				227, 228
1965		101	171, 172	191, 192	97		86	107				229, 230
1966		102	173, 174	193, 194	98		87	108				231, 232
1967		103	175, 176	195, 196	99		88	109				233, 234
1968		104	177, 178	197, 198	100		89	110				235, 236
1969		105	179, 180	199, 200	101		90	111				237, 238
1970		106	181, 182	201, 202	102		91	112				239, 240
1971		107	183, 184	203, 204	103		92	113				241, 242

## SYNCHRONISTIC TABLE OF CHEMICAL AND

Year	A	A ch	Am Ch J	Am J Sci	Arch Pharm	B	Bull Soc	C A	Chem Soc	Chem Weekbl	C R	Gazz ch it	J Am Chem Soc
1896	289-293	(7)7-9	18	(4)1, 2	234	29	(2)15, 16		69, 70		122, 123	26	18
1897	294-298	10-12	19	3, 4	235	30	17, 18		71, 72		124, 125	27	19
1898	299-303	13-15	20	5, 6	236	31	19, 20		73, 74		126, 127	28	20
1899	304-309	16-18	21, 22	7, 8	237	32	21, 22		75, 76		128, 129	29	21
1900	310-314	19-21	23, 24	9, 10	238	33	23, 24		77, 78		130, 131	30	22
1901	314-319	22-24	25, 26	11, 12	239	34	25, 26		79, 80		132, 133	31	23
1902	320-326	25-27	27, 28	13, 14	240	35	27, 28		81, 82		134, 135	32	24
1903	326-330	28-30	29, 30	15, 16	241	36	29, 30		83, 84		136, 137	33	25
1904	330-338	(8)1-3	31, 32	17, 18	242	37	31, 32		85, 86	1	138, 139	34	26
1905	338-343	4-6	33, 34	19, 20	243	38	33, 34		87, 88	2	140, 141	35	27
1906	344-351	7-9	35, 36	21, 22	244	39	35, 36		89, 90	3	142, 143	36	28
1907	351-358	10-12	37, 38	23, 24	245	40	(4) 1, 2	1	91, 92	4	144, 145	37	29
1908	358-364	13-15	39, 40	25, 26	246	41	3, 4	2	93, 94	5	146, 147	38	30
1909	364-371	16-18	41, 42	27, 28	247	42	5, 6	3	95, 96	6	148, 149	39	31
1910	371-378	19-21	43, 44	29, 30	248	43	7, 8	4	97, 98	7	150, 151	40	32
1911	378-386	22-24	45, 46	31, 32	249	44	9, 10	5	99, 100	8	152, 153	41	33
1912	386-394	25-27	47, 48	33, 34	250	45	11, 12	6	101, 102	9	154, 155	42	34
1913	395-402	27-30	49, 50	35, 36	251	46	13, 14	7	103, 105	10	156, 157	43	35
1914	402-406	(9)1-2		37, 38	252	47	15, 16	8	105, 106	11	158, 159	44	36
1915	407-410	3-4		39, 40	253	48	17, 18	9	107, 108	12	160, 161	45	37

## OTHER SCIENTIFIC PERIODICALS—Part III

J Pharm	J phys Ch	J pr	J Soc Chem Ind	M	Proc Roy Soc	R t c	W Ann	Z anal	Z angew Ch	Z anorg	Z Liek trochem	Z Krvst Min	Z phys Ch
(6)3, 4		53, 54	15	17	59, 60	15	57-59	35	10	11, 12	3	25, 26	19-21
5, 6	1	55, 56	16	18	60, 61	16	60-62	36	11	13-15	4	27, 28	22-24
7, 8	2	57, 58	17	19	62, 63	17	63-65	37	12	16-18	5	29	25-27
9, 10	3	59, 60	18	20	64, 65	18	66-68	38	13	19-21	6	30, 31	28-31
11, 12	4	61, 62	19	21	66, 67	19	(4)1-3	39	14	22-25	7	32, 33	32-35
13, 14	5	63, 64	20	22	68, 69	20	4-6	40	15	26-29		34	36-39
15, 16	6	65, 66	21	23	70, 71	21	7-9	41	16	29-33	8	35, 36	39-42
17, 18	7	67, 68	22	24	71, 72	22	10-12	42	17	33-37	9	37	42-46
21, 22	9	71, 72	24	26	76A	24	16-18	44	19	43-44	11	40	50-54
23, 24	10	73, 74	25	27	77, 78A	25	09-21	45	20	48-51	12	41, 42	54-57
25, 26	11	75, 76	26	28	79A	26	22-24	46	21	52-56	13	42-44	57-61
27, 28	12	77, 78	27	29	80, 81A	27	25-27	47	22	56-60	14	44, 45	61-65
29, 30	13	79, 80	28	30	82, 83A	28	28-30	48	23	61-65	15	46	65-68
(7)1, 2	14	81, 82	29	31	83, 84A	29	33-31	49	24	65-69	16	47	68-75
3, 4	15	83, 84	30	32	84-86A	30	34-36	50	25	69-73	17	48, 49	75-78
5, 6	16	85, 86	31	33	86, 87A	31	37-39	51	26	73-79	18	50	78-81
7, 8	17	87, 88	32	34	88, 89A	32	40-42	52	27	79-84	19	51, 52	81-86
9, 10	18	89, 90	33	35	89, 91A	33	43-45	53	28	84-89	20	53	86-89
11, 12	19	91, 92	34	36	91, 92A	34	46-48	54	29	90-93	21	54	89, 90

## SYNCHRONISTIC TABLE OF CHEMICAL AND

Year	A	A ch	Am Ch J	Am J Sci	Arch Pharm	B	Bull Soc	C A	Chem Soc	Chem Weekbl	C R	Gazz ch it	J Am Soc Chem
1896	289-293	(7)7-9	18	(4)1, 2	234	29	(2)15, 16		69, 70		122, 123	26	18
1897	294-298	10-12	19	3, 4	235	30	17, 18		71, 72		124, 125	27	19
1898	299-303	13-15	20	5, 6	236	31	19, 20		73, 74		126, 127	28	20
1899	304-309	16-18	21, 22	7, 8	237	32	21, 22		75, 76		128, 129	29	21
1900	310-314	19-21	23, 24	9, 10	238	33	23, 24		77, 78		130, 131	30	22
1901	314-319	22-24	25, 26	11, 12	239	34	25, 26		79, 80		132, 133	31	23
1902	320-326	25-27	27, 28	13, 14	240	35	27, 28		81, 82		134, 135	32	24
1903	326-330	28-30	29, 30	15, 16	241	36	29, 30		83, 84		136, 137	33	25
1904	330-338	(8)1-3	31, 32	17, 18	242	37	31, 32		85, 86	1	138, 139	34	26
1905	338-343	4-6	33, 34	19, 20	243	38	33, 34		87, 88	2	140, 141	35	27
1906	344-351	7-9	35, 36	21, 22	244	39	35, 36		89, 90	3	142, 143	36	28
1907	351-358	10-12	37, 38	23, 24	245	40	(4) 1, 2	1	91, 92	4	144, 145	37	29
1908	358-364	13-15	39, 40	25, 26	246	41	3, 4	2	93, 94	5	146, 147	38	30
1909	364-371	16-18	41, 42	27, 28	247	42	5, 6	3	95, 96	6	148, 149	39	31
1910	371-378	19-21	43, 44	29, 30	248	43	7, 8	4	97, 98	7	150, 151	40	32
1911	378-386	22-24	45, 46	31, 32	249	44	9, 10	5	99, 100	8	152, 153	41	33
1912	386-394	25-27	47, 48	33, 34	250	45	11, 12	6	101, 102	9	154, 155	42	34
1913	395-402	27-30	49, 50	35, 36	251	46	13, 14	7	103, 105	10	156, 157	43	35
1914	402-406	(9)1-2		37, 38	252	47	15, 16	8	105, 106	11	158, 159	44	36
1915	407-410	3-4		39, 40	253	48	17, 18	9	107, 108	12	160, 161	45	37

## OTHER SCIENTIFIC PERIODICALS—Part III

J Pharm	J phys Ch	J pr	J Soc Chem Ind	M	Proc Roy Soc	R t c	W Ann	Z anal	Z angew Ch	Z anorg	Z Dlek trochem	Z Krvst Min	Z phys Ch
(6)3, 4		53, 54	15	17	59, 60	15	57-59	35	10	11, 12	3	25, 26	19-21
5, 6	1	55, 56	16	18	60, 61	16	60-62	36	11	13-15	4	27, 28	22-24
7, 8	2	57, 58	17	19	62, 63	17	63-65	37	12	16-18	5	29	25-27
9, 10	3	59, 60	18	20	64, 65	18	66-68	38	13	19-21	6	30, 31	28-31
11, 12	4	61, 62	19	21	66, 67	19	(4)1-3	39	14	22-25	7	32, 33	32-35
13, 14	5	63, 64	20	22	68, 69	20	4-6	40	15	26-29		34	36-39
15, 16	6	65, 66	21	23	70, 71	21	7-9	41	16	29-33	8	35, 36	39-42
17, 18	7	67, 68	22	24	71, 72	22	10-12	42	17	33-37	9	37	42-46
21, 22	9	71, 72	24	26	76A	24	16-18	44	19	43-44	11	40	50-54
23, 24	10	73, 74	25	27	77, 78A	25	09-21	45	20	48-51	12	41, 42	54-57
25, 26	11	75, 76	26	28	79A	26	22-24	46	21	52-56	13	42-44	57-61
27, 28	12	77, 78	27	29	80, 81A	27	25-27	47	22	56-60	14	44, 45	61-65
29, 30	13	79, 80	28	30	82, 83A	28	28-30	48	23	61-65	15	46	65-68
(7)1, 2	14	81, 82	29	31	83, 84A	29	33-31	49	24	65-69	16	47	68-75
3, 4	15	83, 84	30	32	84-86A	30	34-36	50	25	69-73	17	48, 49	75-78
5, 6	16	85, 86	31	33	86, 87A	31	37-39	51	26	73-79	18	50	78-81
7, 8	17	87, 88	32	34	88, 89A	32	40-42	52	27	79-84	19	51, 52	81-86
9, 10	18	89, 90	33	35	89, 91A	33	43-45	53	28	84-89	20	53	86-89
11, 12	19	91, 92	34	36	91, 92A	34	46-48	54	29	90-93	21	54	89, 90